**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **09EI219/ 10EI205/ EI203/14EI2005/18EI2002** | **Duration** | **3hrs** |
| **Course Name** | **CONTROL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Identify the equivalent parameter for Spring (K) in force-voltage analogy. | | CO1 | U | | 1 |
| 2. | State the basic components in mechanical translational system. | | CO1 | R | | 1 |
| 3. | List any two time domain specifications. | | CO2 | R | | 1 |
| 4. | Sketch the diagram of unit step input signal. | | CO2 | A | | 1 |
| 5. | Define state variable. | | CO3 | R | | 1 |
| 6. | Show the general form of state equation in state model. | | CO3 | R | | 1 |
| 7. | Tell the stability of the system Whose transfer function is =. | | CO4 | R | | 1 |
| 8. | Calculate the number of branches of the root locus plot of a system which has 3 open loop poles and 2 open loop zeros. | | CO4 | A | | 1 |
| 9. | Name the controller whose transfer function is  . | | CO5 | R | | 1 |
| 10. | Identify the type of non-linearity shown in the figure. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Explain mason’s gain formula in detail. | | CO1 | | An | 3 |
| 12. | Show the structure of the polar plot for the following system whose open loop transfer function is . Also write the order number and type number of the given function. | | CO2 | | U | 3 |
| 13. | Illustrate the advantages of state model. | | CO3 | | An | 3 |
| 14. | Apply RH criteria and check stability for the following system whose characteristic equation is  . | | CO4 | | A | 3 |
| 15. | Sketch the diagram of Lead –lag compensator and write the transfer function. | | CO5 | | A | 3 |
| 16. | Distinguish linear and non-linear systems. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | Calculate the transfer function for the given mechanical system. | CO1 | | A | 6 |
|  | b. | Develop the transfer function using Mason’s gain formula. | CO1 | | A | 6 |
|  |  |  |  | |  |  |
| 18. | a. | Evaluate static error constants Kp, Kv, Ka for the unity feedback system whose open loop transfer function is  . | CO2 | | An | 6 |
|  | b. | Develop the time response of first order system for a unit step input. | CO2 | | A | 6 |
|  |  |  |  | |  |  |
| 19. | a. | Calculate the eigenvalues and eigenvectors of the matrix  A=. | CO3 | | A | 8 |
|  | b. | Illustrate the state model from the given state equation  . | CO3 | | U | 4 |
|  |  |  |  | |  |  |
| 20. |  | A unity feedback control system has open loop transfer function.  Draw the bode plot. Determine gain margin and phase margin. | CO4 | | A | 12 |
|  |  |  |  | |  |  |
| 21. |  | Sketch the polar plot for the system whose open loop transfer function  G(S) =  Determine phase margin and gain margin. | CO5 | | A | 12 |
|  |  |  |  | |  |  |
| 22. |  | The open loop transfer function of a unity feedback control system is given by  By applying Routh criterion, determine marginal value of K and frequency of sustained oscillations. | CO4 | | A | 12 |
|  |  |  |  | |  |  |
| 23. | a. | Describe the following controllers with block diagram and derive its transfer function  i) PD  ii) PID | CO5 | | U | 8 |
|  | b. | Evaluate the following for a system whose damping ratio ϛ is 0.2 and natural frequency ωn is 6 rad/sec.  i) Resonant Peak  ii)Resonant frequency | CO2 | | An | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Explain the non-linearity in physical system. | CO6 | | U | 8 |
|  | b. | Write the advantages of optimal control system. | CO6 | | A | 4 |

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|  | **COURSE OUTCOMES** | | | | | | | |
| CO1 | Develop mathematical model of physical systems. | | | | | | | |
| CO2 | Analyze the various linear models in time domain and frequency domain. | | | | | | | |
| CO3 | Outline the basics of state space representation of systems. | | | | | | | |
| CO4 | Examine the stability of systems. | | | | | | | |
| CO5 | Design appropriate controller for the given specifications. | | | | | | | |
| CO6 | Acquire knowledge on Optimal and Non-linear control. | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | | |
| CO / P | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** | |
| CO1 | | 1 | 1 | 12 | 3 |  |  | 17 | |
| CO2 | | 1 | 3 | 7 | 10 |  |  | 21 | |
| CO3 | | 2 | 4 | 8 | 3 |  |  | 17 | |
| CO4 | | 1 |  | 28 |  |  |  | 29 | |
| CO5 | | 1 | 8 | 15 |  |  |  | 24 | |
| CO6 | |  | 12 | 4 |  |  |  | 16 | |
|  | | | | | | | | **124** | |

**Graphical user interface, application

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| **Course Code** | **18BM2004** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL DIAGNOSTICS AND THERAPEUTIC EQUIPMENT I** | **Max. Marks** | **100** |

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| **Q. No.** | | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | | Differentiate ECG and EEG electrodes. | | CO1 | U | | 1 |
| 2. | | Outline about standard 12 lead configurations. | | CO1 | R | | 1 |
| 3. | | Indicate the normal blood pH value. | | CO2 | R | | 1 |
| 4. | | Potential generated and pH for a glass electrode is related. How? | | CO2 | R | | 1 |
| 5. | | Define the term “Ventilation”. | | CO3 | U | | 1 |
| 6. | | Highlight the term Diffusion. | | CO3 | R | | 1 |
| 7. | | Express the term Defibrillator. | | CO4 | U | | 1 |
| 8. | | Define the term truncated defibrillator. | | CO4 | R | | 1 |
| 9. | | Infer the term negative pressure. | | CO5 | U | | 1 |
| 10. | | What is electro diagnosis? | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | | Paraphrase about the origin of heart sounds. | | CO1 | | An | 3 |
| 12. | | Explain the technique for measuring the blood pO2. | | CO2 | | U | 3 |
| 13. | | Conclude the method of thermo dilution. | | CO3 | | An | 3 |
| 14. | | Differentiate AC & DC defibrillator. | | CO4 | | U | 3 |
| 15. | | Relate the time cycled ventilators with volume cycled ventilators. | | CO5 | | An | 3 |
| 16. | | Define Faradic current. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | | |
| 17. | | a. | Explain in detail various types of leads used for recording ECG signal. | CO1 | | U | 5 |
|  | | b. | Describe with the help of a diagram the major building blocks of an EEG machine. | CO1 | | U | 7 |
| 18. | | a. | Define the method for measurement of blood pH with diagram. What is the effect of blood on the working of the glass electrode and the measures taken to minimize the effect? | CO2 | | A | 6 |
|  | | b. | Illustrate in detail on Apnea detectors. | CO2 | | An | 6 |
| 19. | | a. | Explain in detail the Ultrasonic Spirometer. | CO3 | | U | 6 |
|  | | b. | Illustrate in detail the ‘Impedance change’ method for measuring cardiac output. | CO3 | | An | 6 |
| 20. | | a. | Sketch the different types of defibrillators. | CO4 | | A | 6 |
|  | | b. | Recognize the modes of operation of pacemakers. | CO4 | | U | 6 |
| 21. | | a. | Explain pressure cycled & volume cycled ventilators. | CO5 | | R | 7 |
|  | | b. | Illustrate in detail the patient monitoring systems. | CO5 | | An | 5 |
| 22. | | a. | Describe the electromagnetic flow meters used for blood flow measurement. | CO3 | | U | 7 |
|  | | b. | Explain Pulse oximetry. | CO3 | | R | 5 |
| 23. | | a. | Explain the displacement method and thermistor method for respiration rate method. | CO2 | | R | 6 |
|  | | b. | Describe any method for blood pressure measurement. | CO2 | | U | 6 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | | a. | Explain the Interferential current therapy. | CO6 | | R | 6 |
|  | | b. | Summarize the Spinal cord stimulator. | CO6 | | U | 6 |
|  | | **COURSE OUTCOMES** | | | | | | |
| CO1 | | Identify the procedures for acquisition of physiological signals. | | | | | | |
| CO2 | | Demonstrate the methods for vital and biochemical parameters measurement. | | | | | | |
| CO3 | | Describe the functions of various non-invasive equipment. | | | | | | |
| CO4 | | Illustrate the techniques for cardiac equipment. | | | | | | |
| CO5 | | Assess the merits of the respiratory equipment based on its applications. | | | | | | |
| CO6 | | Analyse the behaviour of electrotherapy equipment. | | | | | | |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 13 | - | 3 | - | - | 17 |
| CO2 | 8 | 9 | 6 | 6 | - | - | 29 |
| CO3 | 6 | 14 | - | 9 | - | - | 29 |
| CO4 | 1 | 10 | 6 | - | - | - | 17 |
| CO5 | 7 | 1 | - | 8 | - | - | 16 |
| CO6 | 6 | 10 | - | - | - | - | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

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| **Course Code** | **18BM2010** | **Duration** | **3hrs** |
| **Course Name** | **BIOSIGNAL PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | The conversion of continuous signal to discrete signal is known as \_\_\_\_\_\_\_\_. | | CO1 | U | | 1 |
| 2. | Name the bioelectric signal related to the heart activity. | | CO1 | R | | 1 |
| 3. | List the two methods of filtering used for FIR Filter design. | | CO2 | R | | 1 |
| 4. | Comment on the stability of poles of a Butterworth filter in the s plane. | | CO2 | R | | 1 |
| 5. | State an advantage of Chebyshev filter. | | CO3 | U | | 1 |
| 6. | List the two common filters used for IIR Filter design. | | CO3 | R | | 1 |
| 7. | For an FIR filter of order 15, map the different values of h(n). | | CO4 | U | | 1 |
| 8. | In a FIR filters only \_\_\_\_\_\_ are present. | | CO4 | R | | 1 |
| 9. | When a person is asleep, what are the two types of EEG waves produced? | | CO5 | U | | 1 |
| 10. | State an abnormal condition in an EEG wave. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Describe aliasing effect. | | CO1 | | An | 3 |
| 12. | Substantiate with proper formula for bi-linearly transforming an S domain function to a Z domain function. | | CO2 | | U | 3 |
| 13. | Given an analogue time domain signal  x(t)=Cos(2π1000t)  Express in digital form for sampling frequency of 2000 Hz. | | CO3 | | An | 3 |
| 14. | Find w(n) for N=7 in Hamming Window. | | CO4 | | U | 3 |
| 15. | Tabulate the various states and waves in an EEG wave. | | CO5 | | An | 3 |
| 16. | Mention an abnormal condition in an ECG wave and state the detection procedure. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | For x(n)={1,1,1,1,3,3,3,3}  Find X(k) using Decimation in Frequency FFT Algorithm | CO1 | | E | 12 |
|  |  |  |  | |  |  |
| 18. |  | For the given digital filter specifications   1. Find the Analogue specifications of the filter and illustrate them. 2. Find the cut off frequency and the order of the digital filter. 3. Find the poles of the analogue filter. | CO2 | | A | 12 |
|  |  |  |  | |  |  |
| 19. | a. | Find the digital transfer function of the following analogue transfer function | CO3 | | E | 7 |
|  | b. | Differentiate IIR and FIR Filters. | CO3 | | An | 5 |
|  |  |  |  | |  |  |
| 20. |  | Plot the magnitude frequency response for N=11 in an ideal low pass FIR filter using Fourier Series method with | CO4 | | E | 12 |
|  |  |  |  | |  |  |
| 21. | a. | Describe the electro-physiological origin of Heart waves. | CO5 | | An | 6 |
|  | b. | Discuss the basic ECG Analysis blocks with proper formulae. | CO5 | | An | 6 |
|  |  |  |  | |  |  |
| 22. |  | Determine the transfer function H(z) for N=7 in an ideal bandpass filter using Blackmann Window with | CO4 | | E | 12 |
|  |  |  |  | |  |  |
| 23. |  | For the given digital filter specifications   1. Find the analogue specifications for the Chebyshev filter design and illustrate the filter. 2. Find the analogue poles of Chebyshev filter with diagrammatic representation using bilinear transformation method. | CO3 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | For an ECG of a **Supra ventricular Tachycardia** condition, describe the various blocks of signal processing units used to detect the patient’s condition. | CO6 | | An | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the fundamentals of signal processing. |
| CO2 | Identify the effect of IIR Digital filter design. |
| CO3 | Illustrate the various applications of IIR filter. |
| CO4 | Discuss the FIR Filter design and applications. |
| CO5 | Show the various methods to analyze biosignals. |
| CO6 | Explain the biosignal processing concepts for real time applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 | - | 3 | 12 | - | 17 |
| CO2 | 2 | 3 | 12 | - | - | - | 17 |
| CO3 | 1 | 1 | 12 | 8 | 7 | - | 29 |
| CO4 | 1 | 4 | - | - | 24 | - | 29 |
| CO5 | - | 1 | - | 15 | - | - | 16 |
| CO6 | - | 4 | - | 12 | - | - | 16 |
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**Graphical user interface, application

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| **Course Code** | **18BM2014** | **Duration** | **3hrs** |
| **Course Name** | **REAL TIME EMBEDDED SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Name any three components of the embedded system. | CO1 | R | 1 |
| 2. | List different types of memory used in embedded system. | CO1 | R | 1 |
| 3. | Identify the register in the 8051 used to load address of the next instruction to be fetched. | CO3 | U | 1 |
| 4. | List any two software tools used in the embedded system. | CO3 | R | 1 |
| 5. | Give the importance of watchdog timer. | CO2 | U | 1 |
| 6. | Name the embedded system which supports 32-64 bit multiple chips and can perform distributed jobs. | CO2 | U | 1 |
| 7. | What is the significance of the ALE signal in 8051. | CO4 | R | 1 |
| 8. | Mention any one advantage of high-level language programming. | CO5 | U | 1 |
| 9. | Identify any two types of scheduling algorithms in RTOS. | CO5 | R | 1 |
| 10. | Mention different classifications of embedded systems. | CO4 | U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Distinguish the general-purpose computing system and embedded system. | CO1 | An | 3 |
| 12. | Define task in real time embedded system. | CO2 | U | 3 |
| 13. | List the design challenges in embedded system. | CO6 | U | 3 |
| 14. | Distinguish top- to- down and bottom-to-top design. | CO5 | An | 3 |
| 15. | Give the importance of queue in datastructure. | CO4 | U | 3 |
| 16. | Write an embedded c program to switch on and off the buzzer with equal delay. | CO3 | A | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. | a. | With a functional diagram, explain the hardware components of the embedded system. | CO1 | U | 6 |
| b. | Discuss the skill requirement for the embedded system designer. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Summarize the issues related to embedded software development. | CO2 | U | 6 |
| b. | Explain the various design metrics of embedded system. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Design an interfacing circuit for a 4x4 keypad with a microcontroller and write an algorithm to display the pressed key on LCD. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the advantages of object-oriented programming in embedded system. | CO4 | U | 6 |
| b. | Justify why do we use an infinite loop in embedded system software. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Justify the importance of hard and soft real-time system. | CO5 | An | 6 |
| b. | Discuss the kernel services in RTOS. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate, for example, the different types of semaphores in RTOS. | CO5 | A | 6 |
| b. | Describe different ways how the system responds to hardware source calls from the interrupts. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Summarize different types of memory used in embedded system. | CO2 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | With a block diagram, explain dc motor interfacing with microcontroller. Write an embedded C program to rotate the motor in a clockwise direction. | CO6 | A | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Discuss the basics of embedded systems and its hardware units. |
| CO2 | Identify the various tools and development process of embedded system. |
| CO3 | Demonstrate the various I/O interfacing with microcontroller. |
| CO4 | Create the programming for embedded system design. |
| CO5 | Summarize the real-time models, languages, and operating systems. |
| CO6 | Design a real-time embedded system for biomedical applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 12 | - | 3 | - | - | 17 |
| CO2 | 2 | 21 | - | 6 |  |  | 29 |
| CO3 | 1 | 1 | 15 | - | - | - | 17 |
| CO4 | 1 | 10 | - | 6 |  |  | 17 |
| CO5 | 1 | 13 | 9 | 6 | - | - | 29 |
| CO6 | - | 3 | 12 | - | - | - | 15 |
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**Graphical user interface, application

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| **Course Code** | **18EI2011** | **Duration** | **3hrs** |
| **Course Name** | **VIRTUAL INSTRUMENTATION THEORY AND APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | | **Questions** | | **Course Outcome** | | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | | What is the execution pattern followed in graphical programming? | | CO1 | | U | 1 |
| 2. | | DAQ Stands for \_\_\_\_\_\_\_\_\_\_\_. | | CO1 | | R | 1 |
| 3. | | What is the keyboard shortcut to remove all broken wires? | | CO2 | | R | 1 |
| 4. | | What are stacked shift register? | | CO3 | | R | 1 |
| 5. | | Write the functions of any sensor-based instrument. | | CO1 | | U | 1 |
| 6. | | How Auto indexing got enabled and disenabled is defaulted in ‘for loop’ and ‘while loop’? | | CO4 | | R | 1 |
| 7. | | What is the function of a cluster in LabVIEW ? | | CO4 | | U | 1 |
| 8. | | Each statement in LabVIEW program is terminated by using \_\_\_\_\_\_\_\_\_. | | CO5 | | R | 1 |
| 9. | | ASCI files are also called as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO6 | | U | 1 |
| 10. | | What purpose DAQ assistant is used for? | | CO6 | | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | | What is the role of software in Virtual Instrumentation? | | CO1 | | R | 3 |
| 12. | | Explicate the two different windows in LabVIEW programing. | | CO1 | | U | 3 |
| 13. | | What are the different types are of loops used in LabVIEW? | | CO2 | | R | 3 |
| 14. | | Create a VI with front panel and block diagram window | | CO3 | | U | 3 |
| 15. | | Point how to customize graph and charts appearance? | | CO5 | | R | 3 |
| 16. | | Explain the three main serial I/O types | | CO5 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | | |
| 17. | a. | | Explain while modelling a project; why graphical program is preferred than hardware modeling? | CO1 | C | | 8 |
|  | b. | | Make a detailed comparison between text based programming and graphical programming. | CO1 | C | | 4 |
| 18. | a. | | “Simulation tests plays a critical role in the design and manufacturing of today’s electronic devices” Justify the statement with necessary block diagrams. | CO2 | U | | 6 |
|  | b. | | Explain the salient features in LabVIEW software environment | CO2 | U | | 6 |
| 19. |  | | Compute the expression by drawing both front panel and block diagram windows and explain the main blocks which is used.  Where A=12, B=6, C=1, D=28, E=4 | CO4 | E | | 12 |
| 20. | a. | | How can a standalone application can be created by using LabVIEW? | CO5 | An | | 6 |
|  | b. | | Compute the total area of a circle and a square with the radius of 12cm and length 9cm respectively. | CO5 | An | | 6 |
| 21. |  | | Create a VI to check whether the cluster elements are in range or not. Specify the upper and lower limits. Display the coerced output and a cluster of LEDs to indicate whether a particular cluster element is in the range or not also explain the steps for creating a cluster. | CO5 | A | | 12 |
| 22. | a. | | Format specifier is a code that indicates how to format a string; point out all the function format strings with necessary blocks. | CO6 | U | | 6 |
|  | b. | | Explain the steps and create a VI with both front panel and block diagram window to add or subtract two numbers. Use Boolean true or false and text ring function. | CO6 | U | | 6 |
| 23. | a. | | Draw and explain virtual instrumentation software architecture (VISA) with necessary blocks. | CO5 | R | | 6 |
|  | b. | | Explain the blocks of instrument driver model and draw its structure | CO5 | R | | 6 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. |  | | Explain the advantages of using the DAQ assistant and lists its main inputs and outputs. | CO6 | | R | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand Virtual Instrument concepts. |
| CO2 | Create a Virtual Instrument using graphical programming |
| CO3 | Develop systems for real-time signal acquisition and analysis. |
| CO4 | Apply concepts of network interface for data communication. |
| CO5 | Implement and design data acquisition systems for practical applications. |
| CO6 | Suggest solutions for automation and control applications using virtual instrumentation. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 5 |  |  |  | 12 | 21 |
| CO2 | 4 | 12 |  |  |  |  | 16 |
| CO3 | 1 | 4 |  |  |  |  | 5 |
| CO4 | 1 | 1 |  |  | 12 |  | 14 |
| CO5 | 16 | 3 | 12 | 12 |  |  | 43 |
| CO6 | 13 | 13 |  |  |  |  | 26 |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **19BM2006** | **Duration** | **3hrs** |
| **Course Name** | **GRAPHICAL SYSTEM DESIGN FOR BIOMEDICAL ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Expand LabVIEW. | | | CO1 | R | | 1 |
| 2. | Interpret the working of Pause Button in VI. | | | CO1 | U | | 1 |
| 3. | Specify the working of property node. | | | CO2 | R | | 1 |
| 4. | Recall data constructs. | | | CO2 | R | | 1 |
| 5. | Identify the variable that is used to access front panel objects in several places in the block diagram of VI. | | | CO3 | R | | 1 |
| 6. | Give the powerful tool for application programming. | | | CO3 | R | | 1 |
| 7. | Mention the function that represents calling the VI. | | | CO4 | R | | 1 |
| 8. | Recall VI properties. | | | CO4 | R | | 1 |
| 9. | List any two performance issues involved in VI. | | | CO5 | R | | 1 |
| 10. | Mention the concept of polymorphism. | | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Give the steps in creating and saving a VI. | | | CO1 | | R | 3 |
| 12. | Discuss about Local Variable with an example. | | | CO2 | | U | 3 |
| 13. | Compare and contrast TCP and UDP communication protocols. | | | CO3 | | U | 3 |
| 14. | Discuss the handling of errors in VI. | | | CO4 | | U | 3 |
| 15. | Explain the loop operations involved in programming. | | | CO5 | | U | 3 |
| 16. | Discuss the role of LabVIEW in controlling assistive devices. | | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | | |
| 17. |  | Explain the Front Panel, Block Diagram and Connector Pane in LabVIEW environment. | | CO1 | | U | 12 |
|  |  |  | |  | |  |  |
| 18. |  | Discuss the concept of Flat and Stacked Sequence with relevant examples. | | CO2 | | U | 12 |
|  |  |  | |  | |  |  |
| 19. |  | Design a VI to create a queue for displaying a sequence of values and to destroy the values. | | CO3 | | A | 12 |
|  |  |  | |  | |  |  |
| 20. |  | Explain the steps involved in creating a sub-VI with an example. | | CO4 | | U | 12 |
|  |  |  | |  | |  |  |
| 21. |  | Explain the programming practices in dataflow and user interface controls. | | CO5 | | U | 12 |
|  |  |  | |  | |  |  |
| 22. |  | Describe the user interface event handler and queued message event handler. | | CO3 | | U | 12 |
|  |  |  | |  | |  |  |
| 23. |  | Implement the concept of VI server to dynamically run a sub-VI. | | CO2 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. |  | | Design a VI for displaying and monitoring the vital parameters of human body. | CO6 | | A | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the basics of LabVIEW programming. |
| CO2 | Interface with real time signals. |
| CO3 | Analyzing the application of VIs in medical instrumentation in developing medical instruments. |
| CO4 | Interpret the concepts of data communication and synchronization. |
| CO5 | Perform signal processing operations using virtual instrumentation. |
| CO6 | Apply virtual instrumentation for biomedical applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 13 |  |  |  |  | 17 |
| CO2 | 2 | 27 |  |  |  |  | 29 |
| CO3 | 2 | 15 | 12 |  |  |  | 29 |
| CO4 | 2 | 15 |  |  |  |  | 17 |
| CO5 | 1 | 15 |  |  |  |  | 16 |
| CO6 | 1 | 3 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **19BM2007** | **Duration** | **3hrs** |
| **Course Name** | **BIO-MEMS TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | What does Bio-MEMS stands for? | | CO1 | U | | 1 |
| 2. | Write down the various types of MEMS sensors. | | CO1 | R | | 1 |
| 3. | Define light modulators. | | CO2 | R | | 1 |
| 4. | Ribbon switching occurs in order of \_\_\_\_\_\_\_\_\_. | | CO2 | R | | 1 |
| 5. | What is meant by a micro fluidic system? | | CO3 | U | | 1 |
| 6. | Give suitable example which works on the principle of thermo capillary effect. | | CO3 | R | | 1 |
| 7. | What is the difference between photolithography and x-ray lithography? | | CO4 | U | | 1 |
| 8. | Give an example for 1D material. | | CO4 | R | | 1 |
| 9. | What is meant by lab-on-a-chip? | | CO5 | U | | 1 |
| 10. | Give short notes on nano particles. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Discuss the application of micro system in healthcare industries. | | CO1 | | An | 3 |
| 12. | Write down the advantages of MOEMS technology. | | CO2 | | U | 3 |
| 13. | Give short notes on micro needle. | | CO3 | | An | 3 |
| 14. | List the properties of materials used in micromachining. | | CO4 | | U | 3 |
| 15. | Write the process flow in a fabrication micro system design technology. | | CO5 | | An | 3 |
| 16. | List the types of nano material characterization. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | With neat sketch explain the MEMS pressure sensors in detail. | CO1 | | An | 12 |
|  |  |  |  | |  |  |
| 18. | a. | What is meant by DMD in MOEMS? | CO2 | | An | 2 |
|  | b. | Describe the working principles of DMD in detail. | CO2 | | A | 10 |
|  |  |  |  | |  |  |
| 19. | a. | Explain dielectrophorosis in fluid actuation method with neat sketch. | CO3 | | A | 6 |
|  | b. | Explain electro osmosis flow in fluid actuation method with neat sketch. | CO3 | | A | 6 |
|  |  |  |  | |  |  |
| 20. |  | Define etching. Explain the various types of etching in detail with neat diagram. | CO4 | | A | 12 |
|  |  |  |  | |  |  |
| 21. | a. | Explain in detail the various software tools used for designing a micro system. | CO5 | | An | 10 |
|  | b. | Justify why micro system products are designed in software tool prior to fabrication. | CO5 | | An | 2 |
|  |  |  |  | |  |  |
| 22. | a. | Describe the DNA sensors with its application in MEMS. | CO4 | | A | 4 |
|  | b. | Explain the various hybridization types of DNA Sensors with neat diagram in detail. | CO4 | | An | 8 |
|  |  |  |  | |  |  |
| 23. |  | With neat sketch explain in detail the thin film deposition in fabrication process. | CO6 | | An | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Explain the bio molecular sensing for cancer diagnostics using carbon nano tubes. | CO6 | | An | 4 |
|  | b. | Explain in detail the application of Nano-devices in biomedical applications. Give examples. | CO6 | | A | 8 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the principles of sensors and actuators. |
| CO2 | Summaries the optical devices and applications. |
| CO3 | Classify the performances of micro fluidic devices to the environment. |
| CO4 | Use the software tools for designing and analyzing the sensors. |
| CO5 | Recommend the suitable principles of testing for biomedical conditions. |
| CO6 | Create simple systems for medical applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 |  | 15 | - | - | 17 |
| CO2 | 2 | 3 | 10 | 2 | - | - | 17 |
| CO3 | 1 | 1 | 12 | 3 | - | - | 17 |
| CO4 | 1 | 4 | 16 | 8 | - | - | 29 |
| CO5 | - | 1 | - | 15 | - | - | 16 |
| CO6 | - | 4 | 8 | 16 | - | - | 28 |
|  | | | | | | | **124** |

**Graphical user interface, application

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| **Course Code** | **19BM2008** | **Duration** | **3hrs** |
| **Course Name** | **MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | | **Bloom’s Level** | | | **Marks** | |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | | |
| 1. | Expand ETP and its Features. | | CO1 | | R | | | 1 | |
| 2. | Write down the rule for Version spaces. | | CO1 | | Apply | | | 1 | |
| 3. | Define Bayes’ Theorem. | | CO2 | | R | | | 1 | |
| 4. | Write the formula for construction decision tree. | | CO2 | | Apply | | | 1 | |
| 5. | Human brain contains \_\_\_\_\_\_\_\_\_\_ number of neurons. | | CO3 | | U | | | 1 | |
| 6. | Expand ANN and its features. | | CO3 | | R | | | 1 | |
| 7. | Expand BPN and its features. | | CO4 | | R | | | 1 | |
| 8. | Define ART Network. | | CO4 | | R | | | 1 | |
| 9. | Write down the formula for Expected count value. | | CO5 | | U | | | 1 | |
| 10. | Difference between classical set and fuzzy set. | | CO6 | | U | | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | | |
| 11. | List out the issues arise in Machine learning. | | CO1 | | | R | | 3 | |
| 12. | Define classification and Regression. | | CO2 | | | R | | 3 | |
| 13. | List out the types of Taxonomy of Artificial Neural Network. | | CO3 | | | R | | 3 | |
| 14. | Difference between Auto assistive and Hetero associative network. | | CO4 | | | U | | 3 | |
| 15. | Draw the block diagram of Fuzzy logic control. | | CO5 | | | An | | 3 | |
| 16. | Draw the flow diagram of GA process. | | CO6 | | | An | | 3 | |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | | | | |
| 17. | a. | |  |  |  | | --- | --- | --- | | **F1** | **F2** | **Target** | | A | X1 | YES | | A | Y1 | YES |   Using candidate eliminate algorithm eliminate the inconsistent data for given attributes:  (A,X) (A,Y) (A,?) (B,X) (B,Y) (B,?) (?,X) (?,Y)(?,?) (,) | | CO1 | | | Apply | | 6 |
|  | b. | Explain in detail about the perspective in machine learning. | | CO1 | | | Un | | 6 |
|  |  |  | |  | | |  | |  |
| 18 | a. | |  |  |  | | --- | --- | --- | | **History** | **Economics** | **Target** | | 4 | 3 | F | | 6 | 7 | P | | 7 | 8 | P | | 5 | 5 | F | | 8 | 8 | P |   By Using Euclidean formula find the 4 Nearest value w.r.t History=6, Economics=8. | | CO2 | | | Apply | | 10 |
|  | b. | List out the types of clustering. | | CO2 | | | Rem | | 2 |
|  |  |  | |  | | |  | |  |
| 19. |  | Using Hebb rule find weights require to perform the following classification of C pattern which consider the target value of 1, H pattern which consider the target value of 1 and T pattern consider the target value of -1. | | CO3 | | | Apply | | 12 |
|  |  |  | |  | | |  | |  |
| 20. | a. | Explain in detail any two types of ANN. | | CO4 | | | An | | 5 |
|  | b. | Write a case study on application of ANN in healthcare industry. | | CO4 | | | Create | | 7 |
|  |  |  | |  | | |  | |  |
| 21. |  | By applying fuzzy relations method solve the given problem.  Pik = 0.3 0.5 0.8 0.9 0.5 0.7 0.7  0 0.7 1 Qkj= 0.3 0.2 0 0.9  0.4 0.6 0.5 1 0 0.5 0.5 | | CO5 | | | Apply | | 12 |
|  |  |  | |  | | |  | |  |
| 22. |  | Apply the concept of Genetic algorithm and maximize the function with Xin interval [0, 32]. | | CO6 | | | Apply | | 12 |
|  |  |  | |  | | |  | |  |
| 23. | a. | Justify the rule of McCulloch-Pitts neuron and solve any basic gates using the same. | | CO3 | | | Create | | 10 |
|  | b. | List out the properties of fuzzy gates. | | CO6 | | | R | | 2 |
| **COMPULSORY QUESTION** | | | | | | | | | |
| 24. |  | It is necessary to compare 2 sensors based upon their detection and gain setting the table of gain settings and sensor detection levels with a standard item being monitored providing typical membership values to represent the detection levels for each sensor is given in table.   |  |  |  | | --- | --- | --- | | **Gain setting** | **D1 Sensor** | **D2 Sensor** | | 0 | 0 | 0 | | 10 | 0.2 | 0.35 | | 20 | 0.35 | 0.25 | | 30 | 0.65 | 0.8 | | 40 | 0.85 | 0.95 | | 50 | 1 | 1 |   Find i) D1UD2  ii) D1 n D2  iii) Compliment of D1  iv) Compliment of D2  v) D1/D2  vi) D2/D1 | | CO6 | | | Apply | | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Describe features that can be used for a particular machine learning approach. |
| CO2 | Classify contrast pros and cons of various machine learning techniques. |
| CO3 | Infer various machine learning approaches and paradigms. |
| CO4 | Interpret various neural networks and fuzzy logic method. |
| CO5 | Illustrate the fuzzy logic concepts using examples. |
| CO6 | Interrelate genetic algorithm concepts for the given problem. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 6 | 7 | - | - | - | 17 |
| CO2 | 6 | - | 11 | - | - | - | 17 |
| CO3 | 4 | 1 | 12 | - | - | 10 | 27 |
| CO4 | 2 | 3 | - | 5 | - | 7 | 17 |
| CO5 | 2 | 1 | - | 3 | - | 10 | 16 |
| CO6 | 2 | 1 | 24 | 3 | - | - | 30 |
|  | | | | | | | **124** |

**Graphical user interface, application

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| **Course Code** | **19BM2009** | **Duration** | **3hrs** |
| **Course Name** | **TELEMEDICINE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Give an example for Full Duplex Communication. | | CO1 | R | | 1 |
| 2. | Interpret Telemonitoring. | | CO1 | U | | 1 |
| 3. | Mention the security points at which the data can be at risk. | | CO2 | R | | 1 |
| 4. | List the configuration of Firewall. | | CO2 | R | | 1 |
| 5. | Interpret the term Roaming. | | CO3 | R | | 1 |
| 6. | Give the type of waves that is not used for long distance. | | CO3 | R | | 1 |
| 7. | Name the type of camera that is used for examination of skin and review of x-ray. | | CO4 | R | | 1 |
| 8. | Expand LASER. | | CO4 | R | | 1 |
| 9. | Identify the layer in OSI Model that determines the best path and manages data congestion problems. | | CO5 | R | | 1 |
| 10. | Comment on health education received through telecommunication technology. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Discuss the benefits of telemedicine. | | CO1 | | U | 3 |
| 12. | Comment on the different types of consent. | | CO2 | | U | 3 |
| 13. | Give an outline on plain old telephone system and its components. | | CO3 | | U | 3 |
| 14. | Explain the types of display systems. | | CO4 | | U | 3 |
| 15. | Describe substitution cipher and transposition cipher in symmetric key cryptography. | | CO5 | | U | 3 |
| 16. | Discuss the process of telemedicine in pathology. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Explain the functional diagram of telemedicine and its types. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. |  | Give an outline on the ethical and legal aspects of telemedicine in terms of Patient Rights and Consent. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 19. |  | Discuss the types of antenna with its advantages, disadvantages and applications. | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 20. |  | Explain the layers of OSI Model and the protocols used. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 21. |  | Analyze the standards followed while using DICOM in Telemedicine. | CO5 | | AN | 12 |
|  |  |  |  | |  |  |
| 22. | a. | Show the problems faced in a videoconferencing system with suitable examples. | CO3 | | AN | 8 |
|  | b. | Describe the operation of MEO satellite in GPS system. | CO3 | | U | 4 |
|  |  |  |  | |  |  |
| 23. |  | Explain the different types of Storage devices. | CO5 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Describe the operation of teleradiology and its applications in the medical field. | CO6 | | U | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the concepts of Telemedicine. |
| CO2 | Interpret the legal aspects of Telemedicine. |
| CO3 | Illustrate multimedia technologies in telemedicine. |
| CO4 | Use protocols behind encryption techniques for secure transmission of data. |
| CO5 | Explain the data acquisition and the data storage devices. |
| CO6 | Apply telehealth in healthcare. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 16 |  |  |  |  | 17 |
| CO2 | 2 | 15 |  |  |  |  | 17 |
| CO3 | 2 | 19 |  | 8 |  |  | 29 |
| CO4 | 2 | 15 |  |  |  |  | 17 |
| CO5 | 1 | 27 |  |  |  |  | 28 |
| CO6 | 1 | 15 |  |  |  |  | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **19BM2011/17BM2029/15EI2029** | **Duration** | **3hrs** |
| **Course Name** | **PATIENT AND DEVICE SAFETY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome / Pattern** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | \_\_\_\_\_\_\_ is the beginning of the life of an electronic component or assembly.  (a) Mechanical reliability (b) Infant mortality (c) Software reliability (d) Wearout | CO1/ R | 1 |
| 2. | The term \_\_\_\_\_\_\_ refers to the degradation of the performance of a device outside a specified value.   1. Reliability (b) Failure (c) Unreliability (d) Safety testing | CO1/ U | 1 |
| 3. | The term \_\_\_\_\_\_\_ is defined as the probable rate of occurrence of a hazard causing harm and the degree of severity of the harm.   1. Human factor (b) Risk (c) Failure (d) Device user | CO2/ R | 1 |
| 4. | The \_\_\_\_\_\_\_ is based on that defined component or sub-assembly level where the basic failure criteria are available.   1. FMEA (b) RRR (c) Risk Management (d) Risk estimation | CO2/ U | 1 |
| 5. | The non-performance or inability of a component or system to perform its intended function for a specified time under specified environmental conditions.   1. True (b) False | CO3/ R | 1 |
| 6. | Medical devices should be designed to withstand the worst-case \_\_\_\_\_\_ conditions in the product specification, with a safety margin included.   1. Environmental (b) Ecological (c) Safety (d) Clinical | CO3/ U | 1 |
| 7. | The \_\_\_\_\_\_\_ shock test assures the device will withstand the stresses of alternate exposure to hot and cold temperatures.   1. Leakage current (b) Macro (c) Thermal (d) Micro | CO4 / R | 1 |
| 8. | The fundamental purpose of \_\_\_\_\_\_\_ is to ensure that research activities are conducted in an ethical and legal manner.   1. IRB (b) IDE (c) GLP (d) GMP | CO5/ R | 1 |
| 9. | The purpose of Medical Devices Directives is for Diagnosis, prevention, monitoring, treatment or alleviation of disease.   1. True (b) False | CO6/ R | 1 |
| 10. | Write the full form of AIMDD. | CO6 / U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | | Compare Reliability and Unreliability. | | CO1 / U | | 3 |
| 12. | | Outline the three major factors considered in medical device risk assessment. | | CO2 / U | | 3 |
| 13. | | Recall the importance of the medical device maintenance. | | CO3/ R | | 3 |
| 14. | | Illustrate about leakage currents in patient leads. | | CO4/ U | | 3 |
| 15. | | Explain any three deliberations of the Institutional Review Boards (IRBs). | | CO5/ U | | 3 |
| 16. | | Classify any three purposes of the medical device directives (MDD). | | CO6/ U | | 3 |
|  | |  | |  | |  |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23. Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | | Define reliability and mention its types. | | CO1/ R | 3 |
| b. | | Explain in detail about the electronic reliability with neat diagram. | | CO1/ U | 5 |
| c. | | Model the mechanical reliability curve and discuss about it. | | CO1/ A | 4 |
|  |  | |  | |  |  |
| 18. | a. | | Define the term risk and mention its elements. | | CO2/ R | 3 |
| b. | | Explain the factors important to medical device risk assessment. | | CO2/ U | 6 |
| c. | | Examine the tools for the risk estimation. | | CO2/ A | 3 |
|  |  | |  | |  |  |
| 19. | a. | | Prioritize few challenges to regulate the environmental impact of medical devices. | | CO3 / R | 4 |
| b. | | Recall any four environmental tests for the medical device. | | CO3/ R | 4 |
| c. | | Point out few potential pathways to improve the medical device sustainability for environmental and ecological safety. | | CO3/ U | 4 |
|  |  | |  | |  |  |
| 20. | a. | | Classify macroshock and microshock. | | CO4/ U | 2 |
| b. | | Illustrate leakage current and its classifications in detail. | | CO4/ U | 6 |
| c. | | Summarize the basic approaches to protect the patients against shock. | | CO4/ U | 4 |
|  |  | |  | |  |  |
| 21. | a. | | Summarize Good Laboratory Practices (GLPs) and Good Manufacturing Practices (GMPs) in detail. | | CO5/ U | 4 |
| b. | | Explain the human factors and its hardware/software elements in detail. | | CO5 / U | 4 |
| c. | | Discuss in detail Investigational Device Exemptions (IDE) format. | | CO5 / U | 4 |
|  |  | |  | |  |  |
| 22. | a. | | Explain the process of the medical device directives in detail. | | CO6/ R | 5 |
| b. | | Enumerate about the types of directives used in the field of medical devices. | | CO6/ U | 4 |
| c. | | Outline any three general essential requirement list for the medical devices. | | CO6/ U | 3 |
|  |  | |  | |  |  |
| 23. | a. | | Explain the hardware and software failures in detail. | | CO1/ U | 6 |
| b. | | Recall the types of failures in medical devices. | | CO1/ R | 4 |
| c. | | Define the term failure and failure rate. | | CO1/ R | 2 |
|  |  | | **Compulsory:** | | | |
| 24. | a. | | Explain the risk management process with the neat diagram in detail. | | CO2 / U | 4 |
| b. | | Recall the four elements of the negligence action in liability. | | CO2 / R | 3 |
| c. | | Explain about the manufacturers and physician’s responsibilities for medical devices. | | CO2 / U | 4 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the mechanical and electrical safety standards of medical equipment |
| CO2 | Understand device specific safety goals |
| CO3 | Interpret reasonable, acceptable and effective remedies. |
| CO4 | Access the clinical suitability to under the impact of the device on the environment |
| CO5 | Device more reliable medical equipment incorporating safety goals |
| CO6 | Suggest new techniques for device management |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 10 | 15 | 4 |  |  |  | 29 |
| CO2 | 7 | 18 |  |  |  |  | 25 |
| CO3 | 9 | 5 |  |  |  |  | 14 |
| CO4 | 1 | 14 |  |  |  |  | 16 |
| CO5 | 1 | 14 |  |  |  |  | 15 |
| CO6 | 6 | 8 |  |  |  |  | 13 |
|  | | | | | | | **112** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| --- | --- | --- | --- |
| **Course Code** | **19BM2013** | **Duration** | **3hrs** |
| **Course Name** | **RADIOLOGICAL IMAGING TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Define ‘electron volt’. | | CO1 | R | | 1 |
| 2. | Give the name of the equipment which is used for the generation of radioactive element. | | CO1 | U | | 1 |
| 3. | Mention the different types of magnets used in MRI system. | | CO2 | R | | 1 |
| 4. | Write the frequency of Ultrasound. | | CO2 | R | | 1 |
| 5. | Portray the applications of diagnostic Ultrasound. | | CO3 | U | | 1 |
| 6. | State the principle of TLC. | | CO3 | U | | 1 |
| 7. | List the advantages of thermography. | | CO4 | R | | 1 |
| 8. | Contrast thermography and radiography. | | CO4 | U | | 1 |
| 9. | Expand NEMA. | | CO5 | R | | 1 |
| 10. | Expand VNA. | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Sketch the electromagnetic spectrum. | | CO1 | | U | 3 |
| 12. | Distinguish PET and SPECT. | | CO2 | | U | 3 |
| 13. | Compare MRI and functional MRI. | | CO3 | | U | 3 |
| 14. | State the features of Liquid Crystals. | | CO4 | | R | 3 |
| 15. | Define Spectral Reflectivity. | | CO5 | | R | 3 |
| 16. | Differentiate pyroelectric and piezoelectric effect. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Explain the working principle of an X-ray Machine. | CO1 | | A | 12 |
|  |  |  |  | |  |  |
| 18. |  | Analyze the concept of SPECT. | CO2 | | AN | 12 |
|  |  |  |  | |  |  |
| 19. |  | Explain about MRI Instrumentation. | CO3 | | A | 12 |
|  |  |  |  | |  |  |
| 20. |  | Analyze the principles of various modes of Ultrasound display. | CO4 | | AN | 12 |
|  |  |  |  | |  |  |
| 21. |  | Highlight functions of hardware elements of Videocon camera. | CO5 | | U | 12 |
|  |  |  |  | |  |  |
| 22. |  | Summarize the applications of Optical Coherence Tomography. | CO2 | | AN | 12 |
|  |  |  |  | |  |  |
| 23. |  | Interpret the algorithm involved in image reconstruction of CT images. | CO3 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Elaborate on the concepts and applications of CT angiography. | CO6 | | A | 6 |
|  | b. | Discuss the concept of picture archiving. | CO3 | | U | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | List out the various medical imaging techniques. |
| CO2 | Explain the principle of specific medical imaging techniques. |
| CO3 | Interpret the imaging outputs. |
| CO4 | Identify the suitable medical imaging techniques for specific pathology. |
| CO5 | Devise new ideas to solve certain issues in medical imaging. |
| CO6 | Justify the impact of medical imaging system for diagnosis. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 4 | 12 |  |  |  | 17 |
| CO2 | 1 | 4 |  | 24 |  |  | 29 |
| CO3 |  | 11 | 24 |  |  |  | 35 |
| CO4 | 4 | 1 |  | 12 |  |  | 27 |
| CO5 | 4 | 12 |  |  |  |  | 16 |
| CO6 | 1 | 3 | 6 |  |  |  | 10 |
|  | | | | | | | **124** |

**Graphical user interface, application

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| **Course Code** | **19BM2014** | **Duration** | **3hrs** |
| **Course Name** | **BIOMECHANICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | \_\_\_\_\_\_\_\_\_\_ is the study of forces involved in the movement of an object or body. | | CO1 | R | | 1 |
| 2. | Give one example of sliding friction. | | CO1 | R | | 1 |
| 3. | When both the net muscle torque and the direction of angular motion at a joint are in the same direction, the work done by the muscles is said to be \_\_\_\_\_\_\_\_\_\_, opposite directions is \_\_\_\_\_\_\_\_\_\_. | | CO2 | R | | 1 |
| 4. | The process of producing new bone matrix is called \_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | | 1 |
| 5. | Epiphysis is connected to diaphysis at both ends with a narrow zone called as \_\_\_\_\_\_\_\_\_\_\_. | | CO3 | U | | 1 |
| 6. | The ratio of weight to volume is known as \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | | 1 |
| 7. | \_\_\_\_\_\_\_\_\_\_ is a fluid force that always acts vertically upward. | | CO4 | U | | 1 |
| 8. | The junction between nerve and muscle is called \_\_\_\_\_\_\_\_\_\_\_. | | CO5 | R | | 1 |
| 9. | When the resistance (force) is negligible, muscle \_\_\_\_\_\_\_\_\_\_\_\_ with maximal velocity. | | CO5 | U | | 1 |
| 10. | The longer the time \_\_\_\_\_\_\_ is exerted, the greater the endurance. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | A skater goes from a standstill to a speed of 6.7 m/s in 12 seconds.  What is the acceleration of the skater? | | CO1 | | An | 3 |
| 12. | List and explain with diagrams any 3 types of methods of measuring body angles. | | CO2 | | U | 3 |
| 13. | Differentiate between trabecular and cortical bone. | | CO3 | | U | 3 |
| 14. | Define Viscosity. State Newton’s law of viscosity and write the equation. | | CO4 | | U | 3 |
| 15. | List and define the roles assumed by muscles. | | CO5 | | An | 3 |
| 16. | Draw the anatomy of shoulder and name the parts. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | With a neat diagram, explain the coordinate planes and direction terminologies of a human body in standing position. | CO1 | | A | 8 |
|  | b. | During a race, a sprinter increases from 5.0 m/s to 7.5 m/s over a period of 1.25s.  What is the sprinter’s average acceleration during this period? | CO1 | | E | 4 |
|  |  |  |  | |  |  |
| 18. | a. | The coefficient of static friction between a sled and the snow is 0.18, with a coefficient of kinetic friction of 0.15. A 250 N boy sits on the 200 N sled. How much force directed parallel to the horizontal surface is required to start the sled in motion? How much force is required to keep the sled in motion? | CO2 | | E | 8 |
|  | b. | Define impulse and describe the relationship between impulse and momentum derived from Newton’s second law with equation. | CO2 | | U | 4 |
|  |  |  |  | |  |  |
| 19. | a. | Illustrate the bone structure with cross sectional diagram. | CO3 | | U | 8 |
|  | b. | Briefly discuss various functions of Osteocytes. | CO3 | | An | 4 |
|  |  |  |  | |  |  |
| 20. |  | Examine the following with neat diagrams: Flotation, Skin Friction/surface drag, Form drag, Wave Drag, Lift Force and Magnus Effect. | CO4 | | An | 12 |
|  |  |  |  | |  |  |
| 21. |  | Interpret the 3-Element Hill model of muscle contraction and the behavioral properties of the musculotendinous unit. | CO5 | | E | 12 |
|  |  |  |  | |  |  |
| 22. | a. | Discuss the factors affecting muscular force generation with relationships: Force Vs Velocity, Length vs Tension and Stretch Vs Shortening Cycle. | CO5 | | An | 9 |
|  | b. | Illustrate the skeletal muscle function with neat diagrams. | CO5 | | An | 3 |
|  |  |  |  | |  |  |
| 23. |  | Elaborate the regions of Spine with a neat diagram and the forces acting on the spine. | CO6 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | List and briefly discuss the movements that can be carried out at the hip joint and the various ligaments of the hip joint. | CO6 | | An | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Recognize the concepts of mechanics and kinematics for human movements. |
| CO2 | Interpret the human factors that affect the environmental conditions. |
| CO3 | Apply the engineering techniques in human physiological applications. |
| CO4 | Analyze the properties and functions for effective performance. |
| CO5 | Evaluate the methods, solutions to human problems for specific needs. |
| CO6 | Design the advanced system concepts implement solutions to human factors problem. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 |  | 8 | 3 | 4 |  | 17 |
| CO2 | 1 | 7 |  |  | 8 |  | 16 |
| CO3 | 1 | 12 |  | 4 |  |  | 17 |
| CO4 | 1 | 4 |  | 12 |  |  | 17 |
| CO5 | 1 | 1 |  | 15 | 12 |  | 29 |
| CO6 |  | 4 |  | 12 | 12 |  | 28 |
|  | | | | | | | **124** |

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| **Course Code** | **19BM2015** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL ETHICS AND STANDARDS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Interpret “Ethics”. | | CO1 | R | | 1 |
| 2. | Specify the need of medical ethics. | | CO1 | R | | 1 |
| 3. | Recall the principle of Autonomy. | | CO2 | R | | 1 |
| 4. | List the ethical issues in reproductive medicine. | | CO2 | R | | 1 |
| 5. | Mention the importance of IEEE 11073 Standard. | | CO3 | U | | 1 |
| 6. | Expand JCAHO. | | CO3 | R | | 1 |
| 7. | Name the two types of Accreditation provided by JCI. | | CO4 | R | | 1 |
| 8. | Express “Accreditation” in your own words. | | CO4 | R | | 1 |
| 9. | Mention few evacuation procedures to protect individuals from fire. | | CO5 | R | | 1 |
| 10. | Interpret “Safety” in terms of medical devices. | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Discuss the procedures followed in clinical research. | | CO1 | | U | 3 |
| 12. | Distinguish Non Maleficence and Beneficence. | | CO2 | | U | 3 |
| 13. | Comment on the benefits of Electronic Patient Record. | | CO3 | | U | 3 |
| 14. | Cite out few drawbacks of JCI accreditation. | | CO4 | | U | 3 |
| 15. | Indicate the procedure to use fire extinguisher. | | CO5 | | U | 3 |
| 16. | Describe the classes of medical devices with examples. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Explain the doctor-patient relationship and the duties of the doctor towards his profession given by American Medical Association. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. |  | Discuss the ethical principles in medical field with real life examples. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 19. | a. | Discuss on the Ethical norms to be followed in biomedical research and publication. | CO2 | | U | 8 |
|  | b. | Mention the procedures followed for Hospital Accreditation. | CO4 | | U | 4 |
|  |  |  |  | |  |  |
| 20. |  | Summarize from an Indian perspective about the various healthcare organization standards. | CO4 | | AN | 12 |
|  |  |  |  | |  |  |
| 21. |  | Describe the importance of HL7 and the regulations followed in transmission of medical data. | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 22. |  | Explain the types of fire safety equipment and its maintenance. | CO5 | | U | 12 |
|  |  |  |  | |  |  |
| 23. | a. | Analyze how the hazardous waste can be managed and minimized. | CO5 | | AN | 8 |
|  | b. | Identify any two Smoking prohibitions and exceptions. | CO5 | | U | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Summarize about IEC 60601 Collateral and Particular standards. | CO6 | | U | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the scope of medical ethics. |
| CO2 | Illustrate the concepts of ethical theories and moral principles for the health professions. |
| CO3 | Explain the purpose of medical standards. |
| CO4 | Acquire knowledge about hospital accreditation standards. |
| CO5 | Summarize the importance of hospital safety standards. |
| CO6 | Recommend the suitable principles of medical equipment safety standards in hospitals. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 15 |  |  |  |  | 17 |
| CO2 | 2 | 23 |  |  |  |  | 25 |
| CO3 | 1 | 16 |  |  |  |  | 17 |
| CO4 | 2 | 7 |  | 12 |  |  | 21 |
| CO5 | 1 | 19 |  | 8 |  |  | 28 |
| CO6 | 1 | 15 |  |  |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

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| **Course Code** | **19BM2016** | **Duration** | **3hrs** |
| **Course Name** | **SIGNALS AND SYSTEMS FOR BIOMEDICAL ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Expand Cos(nπ). | | CO1 | U | | 1 |
| 2. | State the condition for a causal signal. | | CO1 | R | | 1 |
| 3. | State the formula for trigonometric furrier series expansion. | | CO2 | R | | 1 |
| 4. | How is the frequency response of a filter represented as? | | CO2 | R | | 1 |
| 5. | What is the use of Gabor Transform? | | CO3 | U | | 1 |
| 6. | State the transform applied for non-stationary signals. | | CO3 | R | | 1 |
| 7. | State the way to find the number of zeros in Laplace Transform. | | CO4 | U | | 1 |
| 8. | Give substantiation for time shifting property in Laplace Transforms. | | CO4 | R | | 1 |
| 9. | How is Z transform related to Laplace Transform? | | CO5 | U | | 1 |
| 10. | State the Z transform of a unit step function. | | CO5 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Give expressions for unit impulse and unit step function with examples. | | CO1 | | R | 3 |
| 12. | List the conditions for the existence of Fourier Transform. | | CO2 | | U | 3 |
| 13. | List the various Joint Time Frequency Analysis algorithms. | | CO3 | | R | 3 |
| 14. | What is Region of Convergence in Laplace Transform? How is it calculated? | | CO4 | | U | 3 |
| 15. | State the z transform of unit impulse and unit step function. | | CO5 | | R | 3 |
| 16. | List the properties of Non Linear Systems. | | CO6 | | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | Explain briefly any three types of classifications of systems | CO1 | | R | 6 |
|  | b. | Explain any three basic operations on signals | CO1 | | R | 6 |
| 18. | a. | Find the Fourier Series for the periodic signal with the function | CO2 | | E | 10 |
|  | b. | Substantiate with proper formulae for expanding a periodic signal in cosine terms. | CO2 | | A | 2 |
| 19. | a. | Explain the Gabor and Adaptive Gabor transform with proper substantiation. | CO3 | | U | 6 |
|  | b. | Illustrate and explain how joint time-frequency analysis is applied to EEG signals to diagnose epilepsy. | CO3 | | An | 6 |
| 20. | a. | Find the Laplace Transform of the function | CO4 | | E | 6 |
|  | b. | Find inverse Laplace Transform of the function | CO4 | | E | 6 |
| 21. | a. | Using long division , determine the inverse Z transform of the function | CO5 | | E | 8 |
|  | b. | State the properties of region of convergence in Z Transform. | CO5 | | U | 4 |
| 22. | a. | Find the Fourier Transform of the following and sketch the magnitude and phase spectrum | CO2 | | E | 10 |
|  | b. | List the conditions for the existence of Fourier Transform. | CO2 | | R | 2 |
| 23. | a. | Compute the cosine Fourier series of the function  where the fundamental period is 2π. | CO2 | | E | 8 |
| b. | Compute the Laplace Transform of the function  x(t) = sin Ω0t. | CO4 | | E | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Discuss any one of the Physical Factors Determining the Dynamic Behavior of Physiological Signal. | CO6 | | An | 12 |

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|  | **COURSE OUTCOMES** | | | | | | | |
| CO1 | Identify the nature of biomedical signals. | | | | | | | |
| CO2 | Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis. | | | | | | | |
| CO3 | Classify systems based on their properties and determine the response of LTI system using Laplace transform. | | | | | | | |
| CO4 | Apply Laplace transform and Z- transform to analyze continuous-time and discrete-time signals and systems. | | | | | | | |
| CO5 | Analyze system properties based on impulse response by FIR, IIR filtering techniques. | | | | | | | |
| CO6 | Demonstrate mathematical tools in characterization of physiological system. | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | |
| CO / P | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | 16 | 1 | - | - | - | - | 17 |
| CO2 | | 4 | 3 | 2 | - | 28 | - | 37 |
| CO3 | | 4 | 7 | - | 6 | - | - | 17 |
| CO4 | | 1 | 4 | - | - | 16 | - | 21 |
| CO5 | | 4 | 5 | - | - | 8 | - | 17 |
| CO6 | | 3 | - | - | 12 | - | - | 15 |
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| **Course Code** | **19BM2018 / 18BM2001** | **Duration :** | **3hrs** |
| **Course Name** | **HUMAN ANATOMY AND PHYSIOLOGY** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome / Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | 1. Why are Mitochondria referred to as “power houses” of the cell? | CO1/U | 1 |
| 2. | What is Action Potential? | CO1/U | 1 |
| 3. | 1. Define Hypoxia and Asphyxia. | CO2/R | 1 |
| 4. | Write the role of Chemoreceptors in Respiration. | CO2/U | 1 |
| 5. | Define Cartilage. | CO3/R | 1 |
| 6. | 1. Name the Synovial Joints. | CO3/R | 1 |
| 7. | Mention the factors affecting Blood Pressure. | CO4/U | 1 |
| 8. | 1. Mention the events of the Cardiac Cycle. | CO4/U | 1 |
| 9. | 1. Define Micturition. | CO5/R | 1 |
| 10. | What is the Renal clearance test? Mention its types. | CO5/ U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Explain the structure and functions of the cell membrane. | CO1/An | 3 |
| 12. | Give the description, function and examples of each type of Cartilage. | CO2/An | 3 |
| 13. | 1. Explain the mechanism of Respiration. | CO3/U | 3 |
| 14. | 1. Write short note on heart valves and heart sounds. | CO4/R | 3 |
| 15. | Describe the structure of the Kidney and explain its functions. | CO5/A | 3 |
| 16. | 1. Describe the functions of the autonomic nervous system. | CO6/An | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23. Q.No 24 is Compulsory)** | | | | |
| 17. | a. | Write in detail the Action Potential. | CO1/A | 4 |
| b. | Explain in detail the Cell membrane transport. | CO1/U | 4 |
| c. | What are the types of Glands present in the body? | CO1/R | 4 |
|  |  |  |  |  |
| 18. | a. | 1. Name the bones of the cranium. | CO2/R | 4 |
| b. | Classify the axial skeletal system with examples. | CO2/R | 4 |
| c. | Write the composition and functions of bone. | CO2/U | 4 |
|  |  |  |  |  |
| 19. | a. | Name the muscles of respiration. | CO3/R | 4 |
| b. | Write a short note on artificial respiration. | CO3/U | 4 |
| c. | Explain the lung volumes and capacities. | CO3/U | 4 |
|  |  |  |  |  |
| 20. | a. | 1. Describe the internal anatomy of the heart with a neat labeled diagram. | CO4/U | 4 |
| b. | Explain systemic and pulmonary circulation. | CO4/U | 4 |
| c. | 1. Explain the normal ECG with a labeled diagram. | CO4/U | 4 |
|  |  |  |  |  |
| 21. | a. | 1. Draw a neat and labeled diagram of nephron. | CO5/R | 4 |
| b. | 1. Describe how urine is formed. | CO5/A | 4 |
| c. | 1. Describe the micturition reflex. | CO5/A | 4 |
|  |  |  |  |  |
| 22. | a. | 1. Enumerate the role of the kidney in maintaining acid-base balance. | CO5/U | 4 |
| b. | 1. Describe the structure of the kidney and explain its functions. | CO5/U | 4 |
| c. | 1. Write the significance of inulin clearance test. | CO5/A | 4 |
|  |  |  |  |  |
| 23. | a. | 1. What is the cardiac cycle? | CO4/R | 4 |
| b. | 1. Describe various events of the cardiac cycle. | CO4/U | 4 |
| c. | Define cardiac arrhythmia and cardiac arrhythmia. | CO4/U | 4 |
|  |  | **Compulsory:** | | |
| 24. | a. | 1. Name the divisions of the CNS. | CO6/An | 4 |
| b. | Explain the functions of the hypothalamus and cerebrum. | CO6/U | 4 |
| c. | 1. Draw and label diagram of a neuron. | CO6/R | 4 |

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic elements of human body. |
| CO2 | Compare the major bones and their processes as they relate to each region of the body. |
| CO3 | Interpret the major organs and components of the respiratory system. |
| CO4 | Recognize the major organs and vessels of the cardiovascular system. |
| CO5 | Describe the basic components and functions of urinary and special sensing systems. |
| CO6 | Demonstrate the structure and functions of nervous systems |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 6 | - | 7 | - | - | 17 |
| CO2 | 9 | 5 | - | 3 | - | - | 17 |
| CO3 | 6 | 11 | - | - | - | - | 17 |
| CO4 | 7 | 22 | - | - | - | - | 29 |
| CO5 | 5 | 9 | 15 | - | - | - | 29 |
| CO6 | 4 | 4 | - | 7 | - | - | 15 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **19BM2019** | **Duration** | **3hrs** |
| **Course Name** | **BIOMEDICAL SENSORS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define hysteresis. | | CO1 | R | 1 |
| 2. | List three different types of transducers. | | CO2 | R | 1 |
| 3. | High Precision equipment do not imply high accuracy. True/False. | | CO1 | U | 1 |
| 4. | Name the electrode used for measuring ECG. | | CO3 | R | 1 |
| 5. | The time difference between the systems response to 10% of its final value to 90% of its final value is called \_\_\_\_\_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 6. | Mention the range of Clinical thermometer. | | CO3 | R | 1 |
| 7. | Name the person behind the concept of sensors. | | CO6 | R | 1 |
| 8. | \_\_\_\_\_\_\_\_\_\_\_ provide transduction between ionic and electronic conduction. | | CO2 | U | 1 |
| 9. | Mention the material that is preferred in making the plated disk of disposable foam pad board type elcetrode. | | CO3 | U | 1 |
| 10. | List the significant features of thermocouple. | | CO2 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Why is blood pressure measured in Brachial Artery? | | CO2 | AN | 3 |
| 12. | Define mechanoreceptors. | | CO3 | U | 3 |
| 13. | Write about capacitive sensor with neat sketch. | | CO1 | U | 3 |
| 14. | The speed of light in an unknown medium is measured to be 2.76 x 108m/s.  Calculate the refractive index of the medium. | | CO4 | A | 3 |
| 15. | Compare the sensitivity and range of operation of RTD and thermistor. | | CO3 | AN | 3 |
| 16. | Comprehend on the use of enzymes in biocatalyst based sensors. | | CO5 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. |  | Discuss in detail on generalized Static characteristics of sensor. | CO1 | U | 12 |
| 18. | a. | Elaborate on how the receptors work and discuss about how a  stimuli is converted to nerve impulse. | CO2 | AN | 6 |
|  | b. | Discuss about Mechanoreceptors. | CO2 | U | 6 |
| 19. |  | Mention the different method of blood pressure measurement and discuss in detail about blood pressure measurement using  Sphygmomanometer. | CO3 | U | 12 |
| 20. |  | Illustrate the biomedical application of capacitive sensor and explain in detail about the types of capacitive sensors. | CO4 | A | 12 |
| 21. |  | Explain in detail about the fiber optics and optical measurement with a general block diagram. | CO5 | R | 12 |
| 22. |  | Analyze about the different temperature measurement types and discuss in detail about the measurement of temperature using thermistor & RTD. | CO3 | AN | 12 |
| 23. |  | Summarize the different types of bio recognition based biosensors. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the use of different measurement methods in blood flow and compare the electromagnetic type blood flow meter and ultrasonic based blood flow meter. | CO6 | AN | 12 |

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| **COURSE OUTCOMES** | |
| CO1 | Identify the calibration procedure for the basic instruments involved in physiological parameter measurement. |
| CO2 | Interpret the errors in measurement by analyzing the performance characteristics of the sensors. |
| CO3 | Demonstrate the appropriate sensor approach which is most likely to meet a specific biosensor application. |
| CO4 | Apply the suitable design criteria for developing a medical sensor for a particular application. |
| CO5 | Develop advanced medical sensors based on the basic transduction principles. |
| CO6 | Predict the qualitative performance of advanced medical sensors. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 12 | 3 |  |  |  |  |  |
| CO2 | 6 | 7 |  | 9 |  |  |  |
| CO3 | 2 | 14 |  | 12 |  |  |  |
| CO4 |  | 1 | 27 |  |  |  |  |
| CO5 | 14 |  | 3 |  |  |  |  |
| CO6 |  |  |  | 12 |  |  |  |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **19BM2020** | **Duration** | **3hrs** |
| **Course Name** | **SIGNAL CONDITIONING CIRCUITS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | State contact potential. | | CO1 | U | | 1 |
| 2. | Which device is used to increase the amplitude level of bio signals? | | CO1 | R | | 1 |
| 3. | Define input impedance. | | CO2 | R | | 1 |
| 4. | Identify the name of the terminal with a (-) sign in an operational amplifier. | | CO2 | R | | 1 |
| 5. | Name the filter which is made from one resistor and one capacitor. | | CO3 | U | | 1 |
| 6. | Which filter circuit offering easy passage to low-frequency signals and difficult passage to high-frequency signals? | | CO3 | R | | 1 |
| 7. | List the types of digital to analog converter. | | CO4 | U | | 1 |
| 8. | Mention the use of priority encoder. | | CO4 | R | | 1 |
| 9. | List the example of harmonic oscillators. | | CO5 | U | | 1 |
| 10. | Define Phase detector. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Write the expression for Nernst potential. | | CO1 | | R | 3 |
| 12. | List the ideal characteristics of an operational amplifier. | | CO2 | | U | 3 |
| 13. | Differentiate capacitive and inductive bandpass filter. | | CO3 | | U | 3 |
| 14. | Write the significance of comparator in biomedical applications. | | CO4 | | R | 3 |
| 15. | Define Phase Locked Loop. | | CO5 | | U | 3 |
| 16. | Write the necessity of safety standards in biopotential measurement. | | CO6 | | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | Describe the different stages of nerve action potential. | CO1 | | U | 8 |
| b. | State the role of recording electrodes and highlight its features. | CO1 | | R | 4 |
|  |  |  |  | |  |  |
| 18. |  | Describe the working principle of an integrator with neat sketch. | CO2 | | A | 12 |
|  |  |  |  | |  |  |
| 19. |  | Explain in detail the circuit configuration of first order active low pass filter. | CO3 | | C | 12 |
|  |  |  |  | |  |  |
| 20. | a. | Explain in detail the working of 555 timers with neat sketch. | CO4 | | A | 10 |
|  | b. | Draw the circuit diagram of a Non-inverting comparator. | CO4 | | U | 2 |
|  |  |  |  | |  |  |
| 21. | a. | Describe the functions of voltage-controlled oscillators. | CO5 | | U | 8 |
|  | b. | Differentiate analog and digital phase detectors. | CO5 | | R | 4 |
|  |  |  |  | |  |  |
| 22. | a. | Illustrate the operation of successive approximation type analog to digital converter. | CO6 | | U | 8 |
|  | b. | Draw the circuit configuration of weighted resistor DAC. | CO6 | | A | 4 |
|  |  |  |  | |  |  |
| 23. |  | Derive the closed loop gain of an inverting operational amplifier with neat sketch. | CO2 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Illustrate the functions of various components involved in advanced medical instrumentation systems. | CO6 | | U | 6 |
|  | b. | Write short notes on electrical interface problems and safety standards in bio potential measurement. | CO6 | | R | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the origin and characteristics of various biosignals and its acquisition. |
| CO2 | Apply the signal conditioning circuits for biomedical field. |
| CO3 | Analyze and deign bio filters and isolation circuits used in medical signal conditioning. |
| CO4 | Interface the bioelectric signals with analog and digital circuits for data acquisition. |
| CO5 | Create the various circuits for designing medical equipment’s using different ICs. |
| CO6 | Recommend the various safety standards in biomedical instrumentation. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 8 | 9 |  |  |  |  | 17 |
| CO2 | 2 | 15 | 12 |  |  |  | 29 |
| CO3 | 1 | 4 |  |  |  | 12 | 17 |
| CO4 | 4 | 3 | 10 |  |  |  | 17 |
| CO5 | 4 | 12 |  |  |  |  | 16 |
| CO6 | 9 | 15 | 4 |  |  |  | 28 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**(Ordinary graph sheet, Polar graph sheet, Semi log graph sheet to be provided)**

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| --- | --- | --- | --- |
| **Course Code** | **19BM2022** | **Duration** | **3hrs** |
| **Course Name** | **CONTROL SYSTEM FOR BIOMEDICAL ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Write the rule for eliminating feedback loop. | | CO1 | R | | 1 |
| 2. | Define non-touching loop. | | CO1 | R | | 1 |
| 3. | Define damping ratio. | | CO2 | R | | 1 |
| 4. | Find the type and order of the following system transfer function | | CO2 | U | | 1 |
| 5. | Define Bandwidth. | | CO3 | R | | 1 |
| 6. | Give an example for non-minimum phase transfer function. | | CO3 | U | | 1 |
| 7. | Define BIBO stability. | | CO4 | R | | 1 |
| 8. | Write the formula to determine centroid. | | CO4 | R | | 1 |
| 9. | Sketch the schematic illustration of muscle stretch reflex. | | CO5 | U | | 1 |
| 10. | Mention the unit for ventilator flow rate. | | CO5 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Differentiate between open loop and closed loop systems. | | CO1 | | U | 3 |
| 12. | A second order system has a damping ratio of 0.6 and natural frequency of oscillation is 10 rad/sec. Determine the damped frequency of oscillation. | | CO2 | | A | 3 |
| 13. | State the advantages of frequency response analysis. | | CO3 | | U | 3 |
| 14. | How the root locus is determined on real axis? | | CO4 | | A | 3 |
| 15. | Sketch the simplified model of cardiac output regulation. | | CO5 | | R | 3 |
| 16. | Draw the electrical analog of lung mechanics. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Reduce the block diagram and find C/R. | CO1 | | A | 12 |
| 18. |  | A Unity feedback control system has an open loop transfer function G(s)=10/(s(s+2)). Find the rise time, Percentage overshoot, peak time and settling time for a step input. | CO2 | | A | 12 |
| 19. |  | Sketch Bode plot for the following transfer function and obtain the gain cross over frequency. **.** | CO3 | | AN | 12 |
| 20. |  | Measurements conducted on a servomechanism show the system response to be c(t)=1+0.2e-60t -1.2e-10t when subject to a unit step input. Obtain an expression for closed loop transfer function. Determine the undamped natural frequency and damping ratio. | CO2 | | U | 12 |
| 21. |  | Construct Routh array and determine the stability of the system represented by the characteristic equation,s6+2s5+8s4+12s3+20s2 +16s+16=0.Comment on the location of the roots of characteristic equation. | CO4 | | AN | 12 |
| 22. |  | A unity feedback control system has an open loop transfer function, .Sketch the root locus. | CO4 | | A | 12 |
| 23 |  | Differentiate engineering and physiological control systems using suitable examples. | CO5 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Analyze physiological control system representation for muscle reflex. | CO6 | | AN | 12 |

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|  | **COURSE OUTCOMES** | | | | | | | |
| CO1 | Represent the system in various forms. | | | | | | | |
| CO2 | Interpret the response of the system in time domain. | | | | | | | |
| CO3 | Analyze the frequency response of any system. | | | | | | | |
| CO4 | Examine the stability of the system. | | | | | | | |
| CO5 | Compute the mathematical model of physiological systems. | | | | | | | |
| CO6 | Summarize the features of physiological system. | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | |
| CO / P | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | 2 | 3 | 12 |  | - | - | 17 |
| CO2 | | 1 | 13 | 15 |  |  |  | 29 |
| CO3 | | 1 | 4 |  | 12 | - | - | 17 |
| CO4 | | 2 |  | 15 | 12 |  |  | 29 |
| CO5 | | 4 | 13 |  |  | - | - | 17 |
| CO6 | |  | 3 |  | 12 | - | - | 15 |
|  | | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **19BM2025** | **Duration** | **3hrs** |
| **Course Name** | **EMBEDDED SYSTEMS FOR BIOMEDICAL APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Which type of embedded system is designed with a 32-bit microcontroller? | | CO1 | U | | 1 |
| 2. | \_\_\_\_\_\_\_\_\_\_ takes instruction codes to execution unit of the processor. | | CO1 | R | | 1 |
| 3. | Identify a device which is used to transfer data between hardware components of a computer. | | CO2 | R | | 1 |
| 4. | Which of the software tool is used for reallocating the physical memory addresses into system RAM memory? | | CO2 | R | | 1 |
| 5. | Identify the largest value that can be loaded in a 16-bit microcontroller register. | | CO3 | U | | 1 |
| 6. | State IDE. | | CO3 | R | | 1 |
| 7. | If X=0 and Y=1, then X|Y is \_\_\_\_\_\_\_\_\_\_. | | CO4 | U | | 1 |
| 8. | A \_\_\_\_\_\_\_\_\_\_ in a C program is used to get an address of a variable. | | CO4 | E | | 1 |
| 9. | Define Kernel. | | CO5 | U | | 1 |
| 10. | Mention the advantages of simulators. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Draw the architecture of an embedded system. | | CO1 | | R | 3 |
| 12. | Differentiate host and target machine in an embedded system. | | CO2 | | U | 3 |
| 13. | Estimate the target count value for generating 1ms delay by a microcontroller. | | CO3 | | E | 3 |
| 14. | Consider supply voltage, Vcc = 3V and LED forward voltage, Vdiode = 2V and Calculate the resistance value for the required diode current Idiode = 10 mA. | | CO4 | | U | 3 |
| 15. | Explain the significance of state machine design in an embedded system. | | CO5 | | R | 3 |
| 16. | Draw the schematic diagram of wireless patient monitoring system. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Describe the various components involved in embedded system application development. | CO1 | | U | 12 |
| 18. |  | Elaborate on various design process and metrics that is to be optimized in an embedded system design. | CO2 | | R | 12 |
| 19. | a. | Explain in detail the techniques for interfacing LED with microcontroller. | CO3 | | A | 8 |
| b. | Draw the schematic diagram of successive approximation type ADC. | CO3 | | U | 4 |
| 20. | a. | Summarize the features of Java based embedded system design. | CO4 | | R | 6 |
| b. | Write short notes on various C programming elements. | CO4 | | R | 6 |
| 21. |  | Illustrate the different methods of handling interrupt services in RTOS environment. | CO5 | | U | 12 |
| 22. |  | Draw the hardware connection between microcontroller and Seven segment display and write the embedded C code for activating it. | CO3 | | C | 12 |
| 23. | a. | Explain in detail the software development tools used in real time system. | CO2 | | U | 8 |
| b. | List the typical characteristics of an embedded system? | CO2 | | U | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | List the different drive methods of stepper motor interfacing. | CO6 | | U | 2 |
| b. | Design an embedded system to measure the heart rate of the patient. Select any known embedded processor of your interest. Support your hardware design with a block diagram and the software development with a flow diagram. | CO6 | | C | 10 |

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|  | **COURSE OUTCOMES** |
| CO1 | Discuss the basics of embedded systems and its hardware units. |
| CO2 | Identify the various tools and development process of embedded system. |
| CO3 | Demonstrate the various I/O interfacing with microcontroller. |
| CO4 | Create the programming for embedded system design. |
| CO5 | Summarize the real time models, languages and operating systems. |
| CO6 | Design a real time embedded system for biomedical applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 13 |  |  |  |  | 17 |
| CO2 | 14 | 15 |  |  |  |  | 29 |
| CO3 | 1 | 5 | 8 |  | 3 | 12 | 29 |
| CO4 | 12 | 4 |  |  | 1 |  | 17 |
| CO5 | 3 | 13 |  |  |  |  | 16 |
| CO6 | 5 | 1 |  |  |  | 10 | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **19BM2036** | **Duration** | **3hrs** |
| **Course Name** | **AUGMENTED / VIRTUAL REALITY APPLICATIONS IN BIOMEDICAL ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Relate Flight simulation methodology in two important areas. | | CO1 | U | | 1 |
| 2. | Define Augmented Reality. | | CO1 | R | | 1 |
| 3. | Recall the two types of surfaces used in 3D boundary representation. | | CO2 | R | | 1 |
| 4. | List the modern manufacturing processes in 2D to 3D conversion. | | CO2 | R | | 1 |
| 5. | Interpret the equation given in deforming 2D shapes. | | CO3 | U | | 1 |
| 6. | Name the translation and rotations in the animation of objects. | | CO3 | R | | 1 |
| 7. | Discover the sensor hardwares used in Virtual Reality. | | CO4 | U | | 1 |
| 8. | Tell the human factors that is involved in Virtual Reality. | | CO4 | R | | 1 |
| 9. | Classify the three modes of interaction. | | CO5 | U | | 1 |
| 10. | Illustrate the use of Augmented Reality in the field of Dental care. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Describe Real-time computer graphics. | | CO1 | | R | 3 |
| 12. | Convert the Virtual Reality objects from 2D to 3D formation in swept surfaces. | | CO2 | | U | 3 |
| 13. | Discuss the particle systems in animating the Virtual Environment. | | CO3 | | U | 3 |
| 14. | Rewrite the different types of physical simulation in Virtual Reality software system. | | CO4 | | U | 3 |
| 15. | Examine the working of simple pendulum as a physical simulator. | | CO5 | | R | 3 |
| 16. | Write the role of Augmented Reality interfaces. | | CO4 | | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Classify the Virtual environment systems based on user immersion and the degree of interaction. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. | a. | Predict 3D digitizer system by modelling aircraft in geometric modelling. | CO2 | | A | 6 |
|  | b. | Define 3D boundary representation and recall the classification in 3D boundary. | CO2 | | R | 4 |
|  | c. | List the four modelling transformations with sequence evaluation. | CO2 | | R | 2 |
|  |  |  |  | |  |  |
| 19. |  | Write a note on the schemes used to simulate the physical behavior of an object in Virtual environment. | CO3 | | A | 12 |
|  |  |  |  | |  |  |
| 20. | a. | Relate the methods used in designing the Augmented Reality interfaces. | CO4 | | A | 4 |
|  | b. | Paraphrase Augmented Reality and VRML toolkit. | CO4 | | U | 8 |
|  |  |  |  | |  |  |
| 21. |  | Correlate the four types on Augmented Reality applications. | CO5 | | An | 12 |
|  |  |  |  | |  |  |
| 22. | a. | Evaluate the animation of objects method in Virtual environment. | CO3 | | An | 6 |
|  | b. | Explain the design of aero engine in the field of Engineering. | CO3 | | U | 6 |
|  |  |  |  | |  |  |
| 23. | a. | Write a brief note on computer animation in the area of Entertainment. | CO5 | | A | 6 |
|  | b. | Identify the advantages of working in virtual domain as a flight simulator in training the pilots. | CO5 | | U | 4 |
|  | c. | Discuss the role of virtual reality in the treatment of psychological disorders | CO5 | | U | 2 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Correlate the Virtual Reality technique applied in the field of rehabilitation. | CO6 | | An | 6 |
|  | b. | Demonstrate the working of Virtual Reality in flight dynamics of an aircraft model. | CO5 | | A | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Recall basic concepts of virtual and augmented reality. |
| CO2 | Describe the geometric modelling and virtual environment. |
| CO3 | Work with virtual environment and augmented reality systems. |
| CO4 | Perform experiments with the hardware and software tools. |
| CO5 | Develop virtual reality applications. |
| CO6 | Summarize the applications of augmenting dental care, virtual reality for rehabilitation, medical model generation in Biomedical Application. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 13 | - | - | - | - | 17 |
| CO2 | 8 | 3 | 6 | - | - | - | 17 |
| CO3 | 1 | 10 | 12 | 6 | - | - | 29 |
| CO4 | 4 | 12 | 4 | - | - | - | 20 |
| CO5 | 3 | 7 | 12 | 12 | - | - | 34 |
| CO6 | - | 1 | - | 6 | - | - | 07 |
| CO | 20 | 46 | 34 | 24 | - | - | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **20BM2002** | **Duration** | **3hrs** |
| **Course Name** | **BIOCHEMISTRY FOR BIOMEDICAL ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Show the general molecular formula of carbohydrates. | | CO1 | U | | 1 |
| 2. | When the sugars are said to be reducing sugar? | | CO1 | R | | 1 |
| 3. | Recall the nucleotide base differences in DNA and RNA chains. | | CO2 | R | | 1 |
| 4. | Which is the organ where majority of the purine biosynthesis occurs? | | CO2 | R | | 1 |
| 5. | Relate the collagen maturation with Vitamin C. | | CO3 | U | | 1 |
| 6. | Infer on the significance of Selenium. | | CO3 | R | | 1 |
| 7. | Infer on the amino acids responsible for UV absorption of proteins. | | CO4 | U | | 1 |
| 8. | Where the fatty acid oxidation does takes place in a cell? | | CO4 | R | | 1 |
| 9. | Relate the defective enzyme in metabolic disorder named Albinism. | | CO5 | U | | 1 |
| 10. | Relate a compound lipid with its significance. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Analyze the significance of alternative glycolytic pathway. | | CO1 | | An | 3 |
| 12. | Relate one syndrome with inborn error of nucleic acid metabolism. | | CO2 | | U | 3 |
| 13. | List out the cationic macroelements of biological significance. | | CO3 | | An | 3 |
| 14. | Infer on the industrially significant artificial peptides. | | CO4 | | U | 3 |
| 15. | Analyze the anti-oxidant role of Vitamin E. | | CO5 | | An | 3 |
| 16. | Classify the fatty acids based on double bond and give examples. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Appraise the TCA cycle and the energy produced from it. | CO1 | | An | 12 |
|  |  |  |  | |  |  |
| 18. |  | Illustrate the structure of a purine nucleotide and explain the metabolism of purines. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 19. |  | Classify the fat soluble Vitamin and detail on any two of them. | CO3 | | An | 12 |
|  |  |  |  | |  |  |
| 20. |  | Summarize the classification of proteins based on their functions and give one example for each class. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 21. |  | Analyze the physical and chemical properties of fat. | CO5 | | An | 12 |
|  |  |  |  | |  |  |
| 22. |  | Recall the structure of DNA and elaborate the properties of nucleic acids. | CO2 | | R | 12 |
|  |  |  |  | |  |  |
| 23. |  | Compare the proteoglycan and glycoproteins. Add a note on the significance of glycosaminoglycan. | CO6 | | E | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Analyze the impact of Vitamin and mineral supplementations. | CO6 | | An | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge on structure, properties and biological functions of carbohydrates, lipids and proteins which help them to understand the significance of biomolecules in bioprocesses and biotechnology. |
| CO2 | Acquire knowledge on nucleic acids structure, properties and functions of nucleic acids. |
| CO3 | Assess the significance of Vitamins and mineral functions. |
| CO4 | Help them to analyze industrial-market value of these biomolecules and relate them with the scope of biotechnology. |
| CO5 | Justify the clinical and biological significance of these biomolecules. |
| CO6 | Understand the complexes of different biomolecules and their biomedical significance. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 |  | 15 |  |  | 17 |
| CO2 | 14 | 15 |  |  |  |  | 29 |
| CO3 | 1 | 1 |  | 15 |  |  | 17 |
| CO4 | 1 | 16 |  |  |  |  | 17 |
| CO5 | 1 | 15 |  |  |  |  | 16 |
| CO6 | 4 | 12 |  |  | 12 |  | 28 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **20BM2007** | **Duration** | **3hrs** |
| **Course Name** | **HOSPITAL AND EQUIPMENT MANAGEMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome / Pattern** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Define “Management by Objectives”. | CO1 / R | 1 |
| 2. | What is human relation in nursing? | CO1 / U | 1 |
| 3. | Mention the role of Joint Commission in the hospitals. | CO2 / R | 1 |
| 4. | What does NABL stand for? | CO2 / An | 1 |
| 5. | Why is supply chain management important in healthcare? | CO3 / U | 1 |
| 6. | List out the five different parts of supply chain management. | CO3 / R | 1 |
| 7. | Justify the need for healthcare professional registration. | CO4 / An | 1 |
| 8. | How do hospitals control the inventory? | CO4 / E | 1 |
| 9. | What are the items of personal safety equipment? | CO5 / R | 1 |
| 10. | Identify the international unit used for reporting the levels of radiations. | CO5 / R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Distinguish between a hospital and an industrial organization. | CO1/ An | 3 |
| 12. | Define the main objectives of NFPA and list out few NFPA codes and standards. | CO2/ R | 3 |
| 13. | What makes a supply chain sustainable and how important is sustainability in supply chains? | CO3 /An | 3 |
| 14. | Explain the importance of hospital support services. | CO4/ An | 3 |
| 15. | Enlist the various elements of a basic first aid kit. | CO5/ R | 3 |
| 16. | How do you evaluate the medical devices based on the safety criteria to environment? | CO6/ E | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is Compulsory)** | | | | |
| 17. | a. | Enumerate the role of administrators in the legal aspects of hospital management. | CO1/ U | 8 |
| b. | Portray the classification of hospitals with a neat block diagram. | CO1 / U | 4 |
|  |  |  |  |  |
| 18. | a. | Explain FDA’s role in regulating medical devices. | CO2 / U | 9 |
| b. | What are Class I, II, and III medical devices? | CO2 /An | 3 |
|  |  |  |  |  |
| 19. | a. | Elaborate on the essentials of healthcare supply chain management. | CO3 / U | 8 |
| b. | List the emerging trends in healthcare supply chain management. | CO4 /An | 4 |
|  |  |  |  |  |
| 20. | a. | Briefly describe the various components of the hospital surveillance system. | CO3 / U | 8 |
| b. | How to improve electric power management in hospitals? | CO4 /An | 4 |
|  |  |  |  |  |
| 21. | a. | Illustrate a suitable case study on “Safety Awareness”. | CO5 / A | 12 |
|  |  |  |  |  |
| 22. | a. | Analyze the functionality of “Risk management in Healthcare” with the help of a case study. | CO2 /An | 9 |
| b. | Write short notes on environmental regulation. | CO2/ R | 3 |
|  |  |  |  |  |
| 23. | a. | Discuss the techniques used for detecting the intensity and characteristics of radiations in hospitals. | CO5/ U | 9 |
| b. | Discuss the pros and cons in using RFID tags for inventory management. | CO4/ An | 3 |
|  |  | **COMPULSORY** | | |
| 24. | a. | Describe the biomedical equipment procurement procedure followed in healthcare systems. | CO6 / U | 7 |
| b. | How are medical staff trained on proper use of equipment and operating instructions? | CO6 /An | 5 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the principle of organizational structures and regulatory services |
| CO2 | Classify the types of codes followed and applications |
| CO3 | Modify the design to develop support systems |
| CO4 | Infer the most challenges in environment and market trends |
| CO5 | Evaluate the systems based on the safety criteria to environment |
| CO6 | Create the methodology for new equipment to user needs |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 13 | - | 3 | - | - | 17 |
| CO2 | 7 | 9 | - | 13 | - | - | 29 |
| CO3 | 1 | 17 | - | 3 | - | - | 21 |
| CO4 | - | - | - | 15 | 1 | - | 16 |
| CO5 | 5 | 9 | - | 12 | - | - | 26 |
| CO6 | - | 7 | - | 5 | 3 | - | 15 |
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| **Course Code:** | **21BM3001** | **Duration** | **3hrs** |
| **Course Name:** | **MEDICAL INSTRUMENTATION DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Describe the significance of muscular skeletal system. | CO1 | Remember | 10 |
|  | b. | Write brief on importance of digestive system. | CO1 | Understand | 6 |
|  |  |  |  |  |  |
| 2. | a. | Summarize the different characteristics of EEG signal and its wave patterns. | CO2 | Understand | 10 |
|  | b. | Microelectrode are preferred for bioelectric signal recording. Justify your answer. | CO2 | Analyze | 6 |
|  |  |  |  |  |  |
| 3. | a. | Write down the working principle of straingauge and classify the types of straingauge. | CO3 | Apply | 10 |
|  | b. | Define temperature. Explain the different types of types of thermometers. | CO3 | Remember | 6 |
|  |  |  |  |  |  |
| 4. |  | Discuss various method for blood pressure measurement with neat diagram. | CO4 | Understand | 16 |
|  |  |  |  |  |  |
| 5. | a. | Elucidate the mechanics of breathing. | CO5 | Understand | 8 |
|  | b. | Explain the various modes of artificial mechanical ventilation. | CO5 | Analyze | 8 |
|  |  |  |  |  |  |
| 6. | a. | With neat sketch explain the importance of nervous system. | CO1 | Understand | 12 |
|  | b. | Differentiate voluntary and involuntary action. | CO1 | Understand | 4 |
|  |  |  |  |  |  |
| 7. |  | Define bioelectric potentials and show how sodium potassium pump supports in generation of bioelectric potential. | CO2 | Understand | 16 |
|  |  |  |  |  |  |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | Design a real time measurement system to measure and analyze the brain impulses. Support your hardware design with a block diagram and the software development with a flow diagram. | CO6 | Create | 20 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the basic functions of various human physiological systems. |
| CO2 | Demonstrate an interfacing circuit for real time bio signal acquisition. |
| CO3 | Construct the suitable instrumentation technique for a specific illness. |
| CO4 | Categorize the medical devices based on its biomedical applications. |
| CO5 | Assess the various parameters, constraints in methodology for effective diagnosis. |
| CO6 | Design of advanced biomedical equipments for various diseases and ensure patient safety. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 10 | 22 | - | - | - | - | 32 |
| CO2 | - | 26 | - | 6 | - | - | 32 |
| CO3 | 6 | - | 10 | - | - | - | 16 |
| CO4 | - | 16 | - | - | - | - | 16 |
| CO5 | - | 8 | - | 8 | - | - | 16 |
| CO6 | - | - | - | - | - | 20 | 20 |
|  | | | | | | | **132** |



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| **Course Code** | **21BM3002** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED BIOMEDICAL SIGNAL PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the need for sampling and the conditions for avoiding aliasing with relevant illustrations. | CO1 | A | 8 |
|  | b. | Perform convolution of the two sequences, x(n)= {1,1,2,1}; h(n)={2,3,1,1}. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 2. | a. | Draw with a diagram and explain a DSP system. Explain about ADC and DAC briefly. | CO2 | U | 8 |
|  | b. | Explain about signal reconstruction or recovery. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 3. | a. | Explain about EEG and Event Related Potentials and interpret them. | CO3 | U | 10 |
|  | b. | Summarize the applications Artificial Intelligence in Biosignal Analysis. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 4. | a. | Illustrate the difficulties encountered in biomedical signal acquisition and analysis with examples. | CO4 | An | 8 |
|  | b. | Describe about synchronous averaging. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 5. | a. | Use the Wiener filtering approach for filtering and derive the expression for finding the optimal weight vector and estimated error. | CO5 | A | 10 |
|  | b. | Classify the different types of noise with suitable examples. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 6. | a. | Explain in details about VAG and VMG. | CO2 | U | 6 |
|  | b. | Illustrate the cancellation of maternal ECG from Fetal ECG. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Write short notes on time domain filtering. Explain the significance of Moving average filtering. | CO3 | R | 8 |
|  | b. | Illustrate the estimation of ST segment inclination. | CO5 | An | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Summarize the analysis of Ectopic beats using Pan-Tompkins Algorithm. | CO6 | U | 10 |
|  | b. | Construct the Template Matching technique in ECG QRS Detection. | CO5 | A | 10 |

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|  | **COURSE OUTCOMES** |
| CO1 | Summarize the basic concepts of digital signal processing techniques. |
| CO2 | Identify the nature of biomedical signals. |
| CO3 | Apply the Filtering Techniques. |
| CO4 | Analyze the Noise Cancellation Techniques for Biosignals. |
| CO5 | Understand various Techniques for Detection of Events. |
| CO6 | Develop systems for Biosignal Acquisition and Analysis |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 08 |  | 16 |  |  |  | 24 |
| CO2 |  | 14 |  |  |  |  | 14 |
| CO3 | 08 | 16 |  |  |  |  | 24 |
| CO4 | 08 |  |  | 18 |  |  | 26 |
| CO5 |  |  | 20 | 08 |  |  | 28 |
| CO6 |  | 16 |  |  |  |  | 16 |
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| **Course Code** | **21BM3004** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED HEALTHCARE SYSTEM DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | | |
| 1. | | a. | Comment on the uptake of e-health and m-health in medical industry. | CO3 | U | 8 |
|  | | b. | Discuss the current advancements in the usage of mobiles and 4G devices in health care sector. | CO2 | A | 8 |
|  | |  |  |  |  |  |
| 2. | | a. | List the standards used in health care with the significance of each standard. | CO4 | U | 8 |
|  | | b. | Illustrate various FDA medical device classifications and the regulations in designing and usage of devices. | CO5 | A | 8 |
|  | |  |  |  |  |  |
| 3. | | a. | Illustrate various laws and regulations in clinical healthcare department. | CO5 | A | 8 |
|  | | b. | Describe the barriers and strategies for innovating prototype models or a general medical instrumentation system. | CO3 | U | 8 |
|  | |  |  |  |  |  |
| 4. | | a. | Outline the process of design of medical instruments relative to the demand. | CO1 | AN | 8 |
|  | | b. | Enumerate the wearable devices used in the current scenario for personal and remote diagnosis. | CO1 | A | 8 |
|  | |  |  |  |  |  |
| 5. | | a. | Enumerate digital hospital and the essential components to digitize a hospital. | CO6 | A | 8 |
|  | | b. | Comment on the ethical issues connecting to the practices in digital health. | CO6 | A | 8 |
|  | |  |  |  |  |  |
| 6. | | a. | List various methods to select various projects that relates to  societal needs. | CO6 | U | 8 |
|  | | b. | Enumerate the applications of digital radiology with respect to  security and accessibility. | CO2 | A | 8 |
|  | |  |  |  |  |  |
| 7. | | a. | Illustrate various medical image archiving applications. | CO2 | U | 8 |
|  | | b. | Comment on the phenomenon of speech recognition for medical data recording. | CO6 | AN | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | | |
| 8. | | a. | Examine the effectiveness and outcome of enforcing security and privacy while digitizing medical sector. | CO6 | A | 10 |
|  | | b. | Outline the process of medical device design based on societal needs. | CO4 | AN | 10 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the available technology for wearable healthcare devices. |
| CO2 | Interpret the need for digital methods of handling medical records. |
| CO3 | Modify the tools and methods for work flow. |
| CO4 | Compare various standards for inter-operability of devices. |
| CO5 | Decide quality and safety standards for developing healthcare systems. |
| CO6 | Formulate advanced strategies for innovation to societal needs. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  |  | 8 | 8 |  |  | 16 |
| CO2 |  | 8 | 16 |  |  |  | 24 |
| CO3 |  | 16 |  |  |  |  | 16 |
| CO4 |  | 8 |  | 10 |  |  | 18 |
| CO5 |  | 8 | 16 | 8 |  |  | 32 |
| CO6 |  | 8 | 18 |  |  |  | 26 |
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| **Course Code** | **21BM3010** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL SENSORS AND MEMS TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Illustrate the pressure measurement system in humans. | CO1 | U | 12 |
|  | b. | Enlist the applications of microsensor in blood pressure measurement. | CO6 | R | 4 |
|  |  |  |  |  |  |
| 2. | a. | Analyze the steps involved in photolithography for micromachining. | CO2 | An | 12 |
|  | b. | Give notes on standards for clean room. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 3. | a. | Analyze the process of ion implantation for Microsensor. | CO1 | An | 12 |
|  | b. | List down the applications of doping in silicon based microsensor. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 4. |  | Evaluate the process of developing microstructure with high aspect ratio. | CO4 | E | 16 |
|  |  |  |  |  |  |
| 5. | a. | Enumerate the applications of polymers in MEMS. | CO2 | A | 4 |
|  | b. | Compare the merits of deep reactive ion etching process with wet etch techniques. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 6. | a. | Analyze the stepsinvolved in testing MEMS pressure sensor. | CO3 | An | 10 |
|  | b. | Classify the of software tools for analyzing the microsensor. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 7. |  | Develop the microsensor made of silicon material with proof mass 5 microgram, length of beam 700 micrometer, spring length of 600 micrometer, spring width= 5 micrometer, thickness of spring= 1 micrometer. Young’s modulus E=190 GPa. Evaluate the performance if (a) the beams are supported at ends and (b) the beams are rigidly fixed at ends. | CO6 | C | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Analyze the design process and parameters involved in material selection, process selection and solver methods in microsensor. | CO5 | An | 14 |
|  | b. | Evaluate the applications of machine learning techniques integrated with microsensorin medical applications. | CO6 | E | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the principle of medical sensors and its interfacing circuits. |
| CO2 | Classify the micro sensor materials, synthesis, fabrication and its characterization. |
| CO3 | Choose the design tools to test and develop products to required specifications. |
| CO4 | Infer the most relevant challenges facing in the fabrication process. |
| CO5 | Judge a sensor based on standard performance criteria and environmental impact. |
| CO6 | Construct the micro system for appropriateness for an application and user. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 12 |  | 12 |  |  | 24 |
| CO2 | 8 |  | 4 | 12 |  |  | 24 |
| CO3 |  |  |  | 16 |  |  | 16 |
| CO4 |  | 12 |  |  | 16 |  | 28 |
| CO5 |  |  |  | 14 |  |  | 14 |
| CO6 | 4 |  |  |  | 6 | 16 | 26 |
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| **Course Code** | **21BM3014** | **Duration :** | **3hrs** |
| **Course Name** | **FINITE ELEMENT MODELING FOR BIOMEDICAL ENGINEERS** | **Max. Marks :** | **100** |

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| **Q. No.** | **Sub Div.** | **Questions** | **Course Outcome** | **Bloom’sLevel** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Evaluate the modeling parameters of second order equations using mechanical system. | CO1 | E | 12 |
|  | b. | Explain the boundary conditions in three dimensional modeling technique. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 2. | a. | Illustrate the stress strain characteristics of human body implants. | CO2 | An | 12 |
|  | b. | Describe the applications of yield point on materials. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 3. |  | Develop the model of the beam and analyze the angle of beam deflection based on stiffness method. | CO3 | C | 16 |
|  |  |  |  |  |  |
| 4. |  | Design the bone implant and estimate the deformation under tensile loading:  Stress in each section of the implant subjected to an axial tensile load of 20 KiloNewtons. The central section is 30 mm square cross-section; the other portions are of circular section, their dimensions being indicated as: section A : length 250 mm, 20 mm diameter, section B: length 100 mm, width 30mm, section C: length 400 mm, diameter 15mm. For the implant material E = 210GN/m2. | CO6 | C | 16 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the bone implants based on non-linear modeling. | CO4 | An | 8 |
|  | b. | Discuss the types of bones and joints in physiological system. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 6. |  | Assess the material characteristics of bioimplants. | CO5 | An | 16 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the modeling of bone fracture based on Linear isotropic elasticity when subjected to compressive loads. | CO6 | C | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | Describe the applications of finite element analysis in bone implant. | CO6 | A | 20 |

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|  | **COURSE OUTCOMES** |
| CO1 | Define modeling using finite element formulation. |
| CO2 | Identify boundary conditions and mesh elements. |
| CO3 | Relate finite element analysis in biomechanical research. |
| CO4 | Select the tools and develop the models. |
| CO5 | Assess the models and observe the performance. |
| CO6 | Create physiological model for biomedical applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 |  |  |  | 12 |  | 16 |
| CO2 |  |  | 4 | 12 |  |  | 16 |
| CO3 |  |  |  |  |  | 16 | 16 |
| CO4 |  | 8 |  | 8 |  |  | 16 |
| CO5 |  |  |  | 16 |  |  | 16 |
| CO6 |  |  | 20 |  |  | 32 | 52 |
|  | 4 | 8 | 24 | 36 | 12 | 48 | **132** |



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| **Course Code** | **21BM3016** | **Duration** | **3hrs** |
| **Course Name** | **MACHINE LEARNING FOR HEALTHCARE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the functions of distance-based classifier with an example. | CO1 | A | 15 |
|  | b. | State the principle of Bayes theorem. | CO1 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain in detail about the steps involved for Principal Component Analysis. | CO2 | R | 15 |
|  | b. | Write the significance of matrix factorization. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 3. |  | Illustrate the role of different Ensemble methods used in machine learning for healthcare data analysis. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Summarize the features of deep learning techniques. | CO4 | R | 8 |
|  | b. | Describe the operation of CNN with an example. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 5. | a. | Explain in detail about the need for distributed learning methods. | CO5 | U | 10 |
|  | b. | Identify the difference between supervised and reinforcement learning methods. | CO5 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the methods involved for real time disease classification by support vector machine method. | CO2 | A | 20 |
|  |  |  |  |  |  |
| 7. |  | Illustrate the working principle of K means clustering algorithm with an example. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe the significance of time series data analysis in machine learning with an example. | CO6 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Design an IoMT based real time system for monitoring patient data with neat diagram and propose a method for classification of abnormalities. | CO6 | C | 20 |

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|  | **COURSE OUTCOMES** |
| CO1 | Describe features that can be used for a particular machine learning approach. |
| CO2 | Classify contrast pros and cons of various machine learning techniques. |
| CO3 | Illustrate various methods for developing the application. |
| CO4 | Infer various machine learning approaches and paradigms. |
| CO5 | Choose the methods towards challenges. |
| CO6 | Create solution to human problems in healthcare domain. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 5 | 15 |  |  |  | 20 |
| CO2 | 15 | 5 | 20 |  |  |  | 40 |
| CO3 |  |  | 20 |  |  |  | 20 |
| CO4 | 8 |  | 12 |  |  |  | 20 |
| CO5 | 10 | 10 |  | 20 |  |  | 40 |
| CO6 |  |  |  | 20 |  | 20 | 40 |
|  | | | | | | | **180** |

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| **Course Code** | **21BM3022** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL ETHICS AND SAFETY** | **Max. Marks** | **100** |

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| **Q. No.** | **Sub Div.** | **Questions** | **Course Outcome / Pattern** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | |
| 1. | a. | What is reliability? Give example. | CO1/ R | 2 |
|  | b. | Identify the causes of failure in medical devices. | CO1/ A | 6 |
|  | c. | Explain the essential principles of safety and effectiveness for medical devices. | CO1/ U | 6 |
|  | d. | Summarize the visual inspection. | CO2/ U | 2 |
|  |  |  |  |  |
| 2. | a. | What are the three classes of medical devices? | CO2/ R | 3 |
|  | b. | Explain the medical device handling and operating principle. | CO2 / U | 6 |
|  | c. | Write the general principles of clinical evaluation. | CO2 / U | 4 |
|  | d. | What is deep learning and examples? | CO2/ R | 3 |
|  |  |  |  |  |
| 3. | a. | Define micro and macro shock. | CO3 / R | 2 |
|  | b. | Explain the leakage currents. | CO3 / U | 8 |
|  | c. | List the precautions to minimize the electric shock hazards. | CO3 / A | 4 |
|  | d. | Define letgo current. | CO3 / U | 2 |
|  |  |  |  |  |
| 4. | a. | What are medical device standards? | CO4 /U | 2 |
|  | b. | List the importance of medical device regulation. | CO4 / U | 6 |
|  | c. | What does CE standards stand for? | CO4 / R | 2 |
|  | d. | Develop the good laboratory practices. | CO4 / A | 6 |
|  |  |  |  |  |
| 5. | a. | What are the 4 ethical theories? | CO5/R | 2 |
|  | b. | Explain the Ethical Issues in biomedical research. | CO5/ U | 8 |
|  | c. | What is a bioethical issue in healthcare? | CO5 / U | 3 |
|  | d. | What is autonomy and confidentiality? | CO5 /U | 3 |
|  |  |  |  |  |
| 6. | a. | Explain the concept of failure. | CO1/ U | 4 |
|  | b. | Identify the Types of Failures in Medical devices. | CO1/A | 4 |
|  | c. | Summarize the safety parameters in medical device testing. | CO1 /U | 4 |
|  | d. | Outline the Reliability’s effect on medical devices. | CO1 /A | 4 |
|  |  |  |  |  |
| 7. | a. | Define gross shock. | CO3/R | 2 |
|  | b. | Explain the effects of electric current on human body. | CO3/U | 10 |
|  | c. | What is ventricular fibrillation? | CO3/U | 2 |
|  | d. | What is patient leakage current? | CO3/ U | 2 |

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| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | |
| 8. | a. | Define Medical ethics. | CO6 /R | 4 |
|  | b. | Elaborate the Scope of ethics in medicine. | CO6 /U | 6 |
|  | c. | Summarize the American medical Association code of ethics. | CO6 /U | 6 |
|  | d. | What is the code of ethics? | CO6 /U | 4 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the mechanical and electrical safety standards of medical equipment |
| CO2 | Understand device specific safety goals |
| CO3 | Interpret reasonable, acceptable and effective remedies and counter measure |
| CO4 | Select the clinical suitability to the impact of the device on the environment |
| CO5 | Device more reliable medical equipment incorporating safety goals |
| CO6 | Combine new techniques for device management |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 14 | 14 | - | - | - | 30 |
| CO2 | 6 | 12 | - | - | - | - | 18 |
| CO3 | 4 | 24 | 4 | - | - | - | 32 |
| CO4 | 2 | 8 | 6 | - | - | - | 16 |
| CO5 | 2 | 14 | - | - | - | - | 16 |
| CO6 | 4 | 16 | - | - | - | - | 20 |
|  | | | | | | | **132** |



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| **Course Code** | **21BM3023** | **Duration** | **3hrs** |
| **Course Name** | **INTERNET OF THINGS IN HEALTHCARE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the OSI layers related to Communication technology. | CO1 | Remember | 10 |
|  | b. | Write a note on major topologies of Local area network. | CO1 | Remember | 6 |
|  |  |  |  |  |  |
| 2. | a. | Detail about logical design of IOT. | CO2 | Apply | 8 |
|  | b. | Explain the enabling technologies in internet of things. | CO2 | Understand | 8 |
|  |  |  |  |  |  |
| 3. | a. | Explain about embedded system based Health care monitoring system. | CO3 | Understand | 8 |
|  | b. | Explain the significance of analog to digital conversion in embedded system. | CO3 | Remember | 8 |
|  |  |  |  |  |  |
| 4. | a. | What is mean by digital health? Describe its importance. | CO4 | Understand | 8 |
|  | b. | How digital technology changed society in the era of health? | CO4 | Understand | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain the steps involved to determine confidentiality of personal health data. | CO5 | Understand | 10 |
|  | b. | Explain the principles of biomedical ethics. | CO5 | Understand | 6 |
|  |  |  |  |  |  |
| 6. | a. | Explain about Client / Server Architecture in DB System. | CO1 | Remember | 10 |
|  | b. | What is the difference between IOT and M2M. | CO2 | Understand | 6 |
|  |  |  |  |  |  |
| 7. | a. | Explain the steps involved to determine confidentiality of personal health data. | CO5 | Understand | 8 |
|  | b. | Give instances to show the physiological parameter monitoring apparatus. | CO6 | Apply | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Describe the significance of Social network analysis in social support and care. | CO6 | Apply | 10 |
|  | b. | Design aembedded based health care system for elderly people. | CO6 | Apply | 10 |

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|  | **COURSE OUTCOMES** |
| CO1 | Acquire the knowledge & concepts of IoT. |
| CO2 | Explain the basic concepts of IoT Protocols. |
| CO3 | Illustrate the concepts of embedded system for health care applications. |
| CO4 | Categorize the importance of digital health. |
| CO5 | Criticize the ethical issues in health care. |
| CO6 | Develop an application based on IoT in health care. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 26 | - | - | - | - | - | 26 |
| CO2 | - | 14 | 8 | - | - | - | 22 |
| CO3 | 8 | 8 | - | - | - | - | 16 |
| CO4 | - | 16 | - | - | - | - | 16 |
| CO5 | - | 24 | - | - | - | - | 24 |
| CO6 | - | - | 28 | - | - | - | 28 |
|  | | | | | | | **132** |

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| **Course Code** | **20BM2001** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL PHYSICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | The formation of a blood clot in a blood vessel causes \_\_\_\_\_\_\_\_\_\_. | | CO1 | R | | 1 |
| 2. | Define luminous flux. | | CO1 | R | | 1 |
| 3. | What is reverberation time? | | CO2 | R | | 1 |
| 4. | \_\_\_\_\_\_\_\_\_\_ is the procedure in which needles remove cells from an abnormal area for laboratory testing. | | CO2 | R | | 1 |
| 5. | Name the two sources of Radioisotopes. | | CO3 | R | | 1 |
| 6. | 99mTc is produced using \_\_\_\_\_\_\_\_\_\_\_ generator. | | CO3 | R | | 1 |
| 7. | What is pair production? | | CO4 | U | | 1 |
| 8. | Define Bremsstrahlung radiation. | | CO4 | R | | 1 |
| 9. | Identify the use of LD50. | | CO5 | R | | 1 |
| 10. | State the advantages of PET. | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Write down the applications of Non ionizing radiation. | | CO1 | | U | 3 |
| 12. | List the factors for controlling the reverberation time. | | CO2 | | U | 3 |
| 13. | Differentiate cosmic and internal radiation. | | CO3 | | U | 3 |
| 14. | Explain how gamma radiation is interacted using photoelectric effect. | | CO4 | | U | 3 |
| 15. | Write short note on Inverse Square Law. | | CO5 | | U | 3 |
| 16. | Name the different types of scans using ultrasound wave. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | Explain in detail the different types of Non-Ionizing Radiation. | CO1 | | U | 10 |
|  | b | Find the focal length if the object distance P = 0.5m and the image distance Q = 0.75m. | CO1 | | A | 2 |
|  |  |  |  | |  |  |
| 18. |  | Define acoustic sound. Classify the various types of sound waves and highlight its features. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 19. |  | Describe the features of different types of radioactive decay. | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 20. |  | Explain in detail the interaction of charged particles with matter. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 21. | a. | Write short notes on the stochastic (deterministic) effects of radiation. | CO5 | | U | 8 |
|  | b. | Define the term KERMA and Absorbed Dose. | CO5 | | U | 4 |
|  |  |  |  | |  |  |
| 22. |  | Discuss the effects of low frequency radiation in patient health. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 23. |  | Illustrate the different artifacts in scanning system. | CO2 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Gamma radiations can be applied in nuclear medicine. Justify your answer with an example. | CO6 | | U | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Illustrate the fundamentals of light. |
| CO2 | Assess the significance of sound in medicine. |
| CO3 | Comprehend radioactive nuclides. |
| CO4 | Outline the interaction of radiation with matter. |
| CO5 | Comprehend basic quantities of radiation. |
| CO6 | Understand the applications of light, sound and radiation in medicine. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 25 | 2 | - | - | - | 29 |
| CO2 | 2 | 27 | - | - | - | - | 29 |
| CO3 | 2 | 15 | - | - | - | - | 17 |
| CO4 | 1 | 16 | - | - | - | - | 17 |
| CO5 | 1 | 15 | - | - | - | - | 16 |
| CO6 | 1 | 15 | - | - | - | - | 16 |
|  | | | | | | | **124** |

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| **Course Code** | **22BM2029** | **Duration** | **3hrs** |
| **Course Name** | **ELECTRICAL AND ELECTRONICS FOR BIOMEDICAL ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | What is called the apparent power? | | CO1 | U | | 1 |
| 2. | Define Kirchhoff’s Voltage Law. | | CO1 | R | | 1 |
| 3. | What is the use of Commutator in DC generators? | | CO2 | R | | 1 |
| 4. | What is an electric motor? | | CO2 | R | | 1 |
| 5. | Differentiate with example linear and non-linear resistors. | | CO3 | U | | 1 |
| 6. | Sketch the symbol for Capacitor. | | CO3 | R | | 1 |
| 7. | Differentiate the canonical and non-canonical SOP form. | | CO4 | U | | 1 |
| 8. | Convert 78 decimal number to binary. | | CO4 | R | | 1 |
| 9. | List the functional elements of an instrument. | | CO5 | U | | 1 |
| 10. | Summarize about Electrocardiogram paper. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Compare Dependent & Independent sources. | | CO1 | | An | 3 |
| 12. | Differentiate between Generators & Motors. | | CO2 | | U | 3 |
| 13. | A resistor has given the value of Black, Brown, Red and Silver. Calculate the value of Resistor. | | CO3 | | An | 3 |
| 14. | Express the binary code “2 4 2 1 “. | | CO4 | | U | 3 |
| 15. | Outline the advantages of moving iron instruments. | | CO5 | | An | 3 |
| 16. | Describe the manual blood pressure measurement. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | Find the power loss in 10 ohm resistor using Mesh analysis. | CO1 | | U | 5 |
|  | b. | A solenoid with resistance 30ohm and inductance of 200mH is connected to 230V 50 Hz Ac power supply. Calculate  a. Solenoids impedance  b. the current consumed by the solenoid  c. the phase angle between the current and the applied voltage  d. average power consumed by the solenoid | CO1 | | U | 7 |
|  |  |  |  | |  |  |
| 18. | a. | Illustrate in detail the working of a DC motor. | CO2 | | A | 6 |
|  | b. | Derive the EMF equation for the DC Generator. | CO2 | | An | 6 |
|  |  |  |  | |  |  |
| 19. | a. | Classify the different types of resistors with neat diagrams. | CO3 | | U | 6 |
|  | b. | A P-N junction diode is having the forward voltage 0.7 v. What type of diode is it and explain its working in forward biased condition. | CO3 | | An | 6 |
|  |  |  |  | |  |  |
| 20. | a. | Simplify using K-map : y=∑f(0,1,3,4,5,7). Express the output using logic gates. | CO4 | | A | 6 |
|  | b. | Prove that the excess three code is self-complementing code. | CO4 | | U | 6 |
|  |  |  |  | |  |  |
| 21. | a. | Illustrate in detail the working principle of moving coil instruments. | CO5 | | R | 7 |
|  | b. | Compare moving coil and moving iron instruments. | CO5 | | An | 5 |
|  |  |  |  | |  |  |
| 22. | a. | Draw a diagram showing the constructional details of Silicon controlled Rectifier. Describe the working with the effect of increasing the gate voltage in SCR. | CO3 | | U | 7 |
|  | b. | Illustrate in detail the N-Channel JFET. | CO3 | | R | 5 |
|  |  |  |  | |  |  |
| 23. | a. | The message below coded in 7-bit Hamming code in even parity is transmitted through a noisy channel. Decode the message: 1001001011100111101100011011. | CO4 | | R | 6 |
|  | b. | Illustrate in detail the different types of combinational logic circuits. | CO4 | | U | 6 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Explain in detail about Blood gas analyzers. | CO6 | | R | 6 |
|  | b. | Summarize about Stethoscope. | CO6 | | U | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Compute electric circuit parameters for simple problems. |
| CO2 | Paraphrase the working principle and application of electrical machines. |
| CO3 | Analyze the characteristics of analogue electronic devices. |
| CO4 | Infer the basic concepts of digital electronics. |
| CO5 | Summarize the operating principles of measuring instruments. |
| CO6 | Outline the application of electronics in medical world. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 13 | - | 3 | - | - | 17 |
| CO2 | 2 | 3 | 6 | 6 | - | - | 17 |
| CO3 | 6 | 14 | - | 9 | - | - | 29 |
| CO4 | 7 | 16 | 6 | - | - | - | 29 |
| CO5 | 7 | 1 | - | 8 | - | - | 16 |
| CO6 | 6 | 10 | - | - | - | - | 16 |
|  | | | | | | | **124** |