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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Find the equivalent element for B in force-voltage analogy. | | CO1 | U | 1 |
| 2. | State the basic components in mechanical rotational system. | | CO1 | R | 1 |
| 3. | Define transfer function. | | CO2 | R | 1 |
| 4. | Sketch the diagram of unit ramp input signal. | | CO2 | A | 1 |
| 5. | Show the general form of output equation in state model. | | CO3 | U | 1 |
| 6. | Define state. | | CO3 | R | 1 |
| 7. | Recall the formula for centroid in root locus. | | CO4 | U | 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 | R | 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. | Distinguish time response and frequency response in a control system. | | CO2 | U | 3 |
| 13. | Write any three properties of state transition matrix φ(t). . | | CO3 | A | 3 |
| 14. | Apply RH criteria and check the 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 | An | 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 block diagram reduction | CO1 | A | 6 |
| 18. |  | Compute the rise time, peak time, maximum peak overshoot and settling time for the closed loop transfer function shown below: | CO2 | A | 12 |
| 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 | A | 4 |
| 20. |  | Determine phase margin and gain margin by drawing polar plot for the system whose open loop transfer function is:  G(S) = | CO4 | A | 12 |
| 21. |  | Evaluate static error constants Kp, Kv, Ka for the unity feedback system whose open loop transfer function is  . | CO2 | 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. | Identify the compensator depicted in the following figure and outline its characteristics, advantages and disadvantages. | CO5 | U | 8 |
|  | b. | Evaluate the following for a system whose damping ratio ϛ is 0.5 and natural frequency ωn is 8 rad/sec.  i) Resonant Peak  ii)Resonant frequency | CO2 | An | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Interpret the non-linearity in physical system. | CO6 | U | 8 |
|  | b. | Explain the performance indices in control system. | CO6 | A | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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. |

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| **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 | 25 | 4 |  |  | 33 |
| CO3 | 1 | 1 | 15 |  |  |  | 17 |
| CO4 | 1 | 1 | 27 |  |  |  | 29 |
| CO5 | 1 | 3 | 8 |  |  |  | 12 |
| CO6 |  | 12 | 4 |  |  |  | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **12EI249** | **Duration** | **3hrs** |
| **Course Name** | **AIRCRAFT INSTRUMENTATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name a display where the information is presented in pictorial form. | | CO1 | U | 1 |
| 2. | Summarize the use of red radial range markings in display. | | CO1 | R | 1 |
| 3. | Name the instrument that work based on the air data given by pitot tube. | | CO2 | U | 1 |
| 4. | Mention the use of heating element in the pitot and static tube. | | CO2 | R | 1 |
| 5. | List the components of gyroscope. | | CO3 | U | 1 |
| 6. | Infer the three degrees of freedom used in gyroscope. | | CO3 | R | 1 |
| 7. | List the types of aircraft magnetism. | | CO2 | U | 1 |
| 8. | Name the metals used in hard-iron magnetism**.** | | CO2 | U | 1 |
| 9. | Mention the two basic types of thermocouples employed in aircraft thermoelectric indicating. | | CO3 | U | 1 |
| 10. | Name the fuel gauging used for high-performance aircraft the measures of fuel quantity. | | CO3 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Summarize the purpose of a platform scale. | | CO1 | R | 3 |
| 12. | Draw a line diagram of a dual Pitot and static system. | | CO2 | U | 3 |
| 13. | Define precession. | | CO3 | U | 3 |
| 14. | Define rigidity. | | CO3 | U | 3 |
| 15. | Infer the term magnetic dip. | | CO2 | U | 3 |
| 16. | Explain how the Wheatstone bridge circuit may be utilized for the measurement of temperature. | | CO3 | 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. |  | Categorize the characteristics of display used in high-range measurements and explain any two in detail. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Show the principal components and instruments which comprise an aircraft Pitot static system. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the construction and operation of an airspeed indicator. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain briefly the principle of operation of a directional gyro. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the construction and operation of direct reading magnetic compasses. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the types of errors present in direct reading magnetic compasses. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the construction of a thermocouple probe used for turbine engine exhaust gas temperature measurement. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe the construction and operation of a float type and capacitor type of fuel quantity indicating system. | CO3 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Use Aircraft and the Display Equipment. |
| CO2 | Apply the sensors to be used in the Flight. |
| CO3 | Analyze Gyroscopic Instruments and Power Plant Instruments. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 25 |  |  |  |  | 29 |
| CO2 | 13 | 33 |  |  |  |  | 46 |
| CO3 | 1 | 36 | 12 |  |  |  | 49 |
|  | | | | | | | **124** |



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| **Course Code** | **17BM3001** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED MEDICAL INSTRUMENTATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe various sensory organs with neat sketch. | CO1 | R | 10 |
|  | b. | Justify the concepts of cardio vascular system. | CO1 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss about the advantages and limitations of ECG and EEG. | CO2 | U | 10 |
|  | b. | Differentiate between bipolar, unipolar electrode and surface electrode. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | List out the key differences and explain resting potentials and action potentials. | CO2 | U | 10 |
|  | b. | Explain the working of cell and its structure. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Evaluate the computerized versions of EMG and Tread Mill Test ECG. | CO3 | An | 10 |
|  | b. | Explain cardiac arrthymias and its monitoring through Hotler monitor. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Summarize the Bispectral Index EEG for depth of anesthesia monitoring. | CO3 | E | 10 |
|  | b. | Compare and contrast the Foetal monitor and Event monitors. | CO3 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss some key considerations and challenges of patient monitoring and pulse oximetry. | CO4 | U | 10 |
|  | b. | Explain the structure of anesthesia equipment and operating microscopes. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Examine the Electrical Safety and other safety aspects of medical equipment. | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate the scanning techniques used in ultrasound scanner. | CO5 | An | 10 |
|  | b. | Explain the concept of X-rays and color Doppler system. | CO5 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss the CT and MRI scanning techniques. | CO6 | U | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the basic need of various human physiology system |
| CO2 | Demonstrate an interfacing circuit for real time bio signal acquisition and processing |
| CO3 | Construct the suitable acquisition method for analyzing biomedical signal. |
| CO4 | Categorize the real time system models for biomedical applications |
| CO5 | Evaluate the various structure for patient safety |
| CO6 | Design real time biomedical system for diagnosing various diseases |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 |  |  |  | 10 |  | 20 |
| CO2 |  | 20 | 10 | 10 |  |  | 40 |
| CO3 |  |  | 10 | 10 | 20 |  | 40 |
| CO4 |  | 10 | 20 | 10 |  |  | 40 |
| CO5 |  |  | 10 | 10 |  |  | 20 |
| CO6 |  | 20 |  |  |  |  | 20 |
|  | | | | | | | **180** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**END SEMESTER EXAMINATION – NOVEMBER 2023**

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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List the Primary signal characteristics of the ECG Signal. | | CO1 | A | 1 |
| 2. | What types of microphones are used for recording phonocardiograms? | | CO1 | R | 1 |
| 3. | The maximum pressure reached during cardiac ejection is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the minimum pressure occurring at the end of a ventricular relaxation is termed \_\_\_\_\_\_\_\_\_\_. | | CO2 | U | 1 |
| 4. | How the heart rate is calculated by the average calculation method? | | CO2 | U | 1 |
| 5. | Identify the device used to measure volume displacement and the amount of gas moved in a specific time. | | CO3 | R | 1 |
| 6. | What is the need for a pacemaker? | | CO4 | U | 1 |
| 7. | What is ventricular fibrillation condition? | | CO4 | U | 1 |
| 8. | What is the use of nebulizer? | | CO5 | U | 1 |
| 9. | List the advantages of high-frequency energy in thermotherapy. | | CO6 | AN | 1 |
| 10. | Name the instrument that provides an electrical impulse required for electrotherapy to treat the pain. | | CO6 | AN | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Outline the Einthoven Triangle with its diagram. | | CO1 | U | 3 |
| 12. | Summarize the measurement of human body temperature using a thermistor. | | CO2 | U | 3 |
| 13. | State the principle of transmission oximetry. | | CO3 | U | 3 |
| 14. | Identify the need for a Pacemaker. | | CO4 | A | 3 |
| 15. | Draw the functional diagram of a positive pressure ventilator. | | CO5 | AN | 3 |
| 16. | Outline the principle of high-frequency heat therapy. | | CO6 | E | 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. | Identify the primary characteristics of ECG, EEG, and EMG. | CO1 | A | 3 |
|  | b. | Explain the standard lead system to record the ECG. | CO1 | U | 9 |
|  |  |  |  |  |  |
| 18. | a. | Explain the principle of impedance Pneumography with a neat diagram. | CO2 | U | 8 |
|  | b. | Illustrate the techniques used to calculate the heart rate. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | With neat diagram explains about basic water-sealed spirometer. | CO3 | U | 8 |
|  | b. | Summarize how the central monitors assist the hospital staff. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the demand for pacemakers. | CO4 | U | 6 |
|  | b. | Explain the Ventricular Inhibited Pacemaker. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain in detail about the artificial ventilation. | CO5 | E | 6 |
|  | b. | Explain the negative-pressure ventilators. | CO5 | E | 6 |
|  |  |  |  |  |  |
| 22. | a. | Categorize the different types of waveforms used for electrotherapy. | CO6 | AN | 6 |
|  | b. | Examine how the Interferential currents are produced. | CO6 | AN | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain about the need for a defibrillator. | CO4 | U | 6 |
|  | b. | Explain the DC Defibrillator. | CO4 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the Schematic diagram of an EEG machine. | CO1 | U | 10 |
|  | b. | List the electrodes used for EEG. | CO1 | U | 2 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the procedures for the 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 | Analyze the behavior of electrotherapy equipment |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 24 | 4 |  |  |  | 29 |
| CO2 |  | 17 |  |  |  |  | 17 |
| CO3 | 1 | 15 |  |  |  |  | 16 |
| CO4 |  | 26 | 3 |  |  |  | 29 |
| CO5 |  | 1 |  | 3 | 12 |  | 16 |
| CO6 |  |  |  | 14 | 3 |  | 17 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What does Electrocorticogram signify? | | CO1 | U | 1 |
| 2. | Name the bioelectric signal related to the muscle activity. | | CO1 | R | 1 |
| 3. | What does the ripple factor signify? | | CO2 | R | 1 |
| 4. | State the difference between the magnitude square response and the analogue transfer function. | | CO2 | R | 1 |
| 5. | What is flicker noise? | | CO3 | U | 1 |
| 6. | List the two common algorithms 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 there are no \_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 9. | What are the different components of an ECG wave? | | CO5 | U | 1 |
| 10. | State an abnormal condition in an ECG wave. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe what happens when we do not select a proper sampling frequency. | | 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. | Chebyshev vs Butterworth, Comment on which is advantageous? Give example. | | CO3 | An | 3 |
| 14. | Justify the usage of L’Hopital’s rule in finding the discrete time domain response of the FIR filter. | | 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. | a. | For X(k)={8,0,0,0,0,0,0,0}  Find x(n) using Decimation in Frequency FFT Algorithm | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. | a. | 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 using bilinear transformation. | CO3 | E | 7 |
|  | b. | Differentiate IIR and FIR Filters. | CO3 | An | 5 |
|  |  |  |  |  |  |
| 20. | a. | Plot the magnitude frequency response for N=7 in an ideal low pass FIR filter using Fourier Series method with | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the signal characteristics of EEG waveform. | CO5 | An | 4 |
|  | b. | Discuss an efficient algorithm for QRS complex detection in Electrocardiogram. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 22. | a. | Determine the transfer function H(z) for N=7 in an ideal bandpass filter using Blackmann Window with | CO4 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | For x(n)={4,0,0,0,4,0,0,0}  Find X(k) using Decimation in Time FFT Algorithm. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | For an ECG of a **Supraventricular 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 about 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 |
|  | | | | | | | **124** |



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| **Course Code** | **18BM2013** | **Duration** | **3hrs** |
| **Course Name** | **MODELING OF PHYSIOLOGICAL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | What is the law associated with the resistance in an electrical system? | | CO1 | U | 1 |
| 2. | Capacitance is otherwise known as \_\_\_\_\_\_\_\_\_\_\_ in a mechanical system. | | CO1 | R | 1 |
| 3. | What does Starling’s law define about? | | CO2 | U | 1 |
| 4. | What does Systemic vasodilation signify? | | CO2 | U | 1 |
| 5. | Justify the use of heparin in cardiopulmonary bypass. | | CO3 | U | 1 |
| 6. | Give any one goal of cardiopulmonary bypass. | | CO3 | R | 1 |
| 7. | What does effector response signify? | | CO4 | U | 1 |
| 8. | The range of the core body temperature is \_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 9. | What are two blood vessels entering the kidney? | | CO5 | R | 1 |
| 10. | The \_\_\_\_\_\_\_\_ pressure influences filtration process in the kidney. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Mention the formula associated with fluidic system for compliance. | | CO1 | R | 3 |
| 12. | Draw the linear model of muscle mechanics. | | CO2 | U | 3 |
| 13. | Mention the use of oxygenators in CPB. | | CO3 | U | 3 |
| 14. | List the various ways in which heat is lost through the skin. | | CO4 | R | 3 |
| 15. | How is Glomerular filtrate formed? | | CO5 | U | 3 |
| 16. | What are the factors affecting disassociation? | | 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. | Tabulate the various formulae associated with resistance and compliance of various physiological system with suitable illustrations. | CO1 | U | 6 |
|  | b. | Explain and derive the working of muscle stretch reflex with block diagram. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Derive the venous return volume Qr for patient undergoing Blood transfusion and plot the curve. Give Inferences in relation mean systemic pressure. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Write short notes on the various factors affecting blood flow. | CO3 | An | 6 |
|  | b. | List out indications and contraindications of Hemodynamic monitoring. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the various effects of general and regional anesthesia on the response thresholds of the thermoregulatory system. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the various functionalities of the nephron with neat diagrams. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the blood glucose regulation with proper substantiation. | CO2 | A | 8 |
|  | b. | Explain the series and parallel combination of resistance and compliance with suitable illustration | CO2 | A | 4 |
|  |  |  |  |  |  |
| 23. | a. | Derive the Cardiac Output Qc for patient with myocardial damage and plot the curve. Give Inferences. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Give detailed insights of how oxygen and carbon dioxide is transported inside the human body | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Analyze the concepts of modelling |
| CO2 | Differentiate the dynamics and static characteristics of physiological systems |
| CO3 | Assemble the various concepts in modelling of circulatory system |
| CO4 | Design and perform the modelling for physio thermo regulatory systems |
| CO5 | Create various models for human filtration system |
| CO6 | Evaluate the mass-balance concept for biological system |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 7 | - | 6 | - | - | 17 |
| CO2 | - | 5 | 12 | 24 | - | - | 41 |
| CO3 | 1 | 4 | 6 | 6 | - | - | 17 |
| CO4 | 4 | 1 | 12 | - | - | - | 17 |
| CO5 | 1 | 4 | - | 12 | - | - | 17 |
| CO6 | - | 3 | - | 12 | - | - | 15 |
|  | | | | | | | **124** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Distinguish between microprocessor and microcontroller. | | CO1 | U | 1 |
| 2. | Define embedded system. | | CO1 | R | 1 |
| 3. | Define the term real time operating system. | | CO2 | R | 1 |
| 4. | List the software development tools of embedded system. | | CO2 | R | 1 |
| 5. | Write the elements of C program. | | CO3 | A | 1 |
| 6. | Categorize the different types of embedded system. | | CO3 | An | 1 |
| 7. | Define wireless sensor technology. | | CO4 | R | 1 |
| 8. | Write the highlights of patient monitoring system. | | CO5 | A | 1 |
| 9. | List the applications of embedded system. | | CO5 | R | 1 |
| 10. | Discuss the applications of body sensor network. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe the function of A/D converters. | | CO1 | R | 3 |
| 12. | List the uses of analog to digital converter. | | CO2 | R | 3 |
| 13. | Illustrate the development process of embedded system. | | CO3 | An | 3 |
| 14. | List the applications of linking and locating software. | | CO4 | R | 3 |
| 15. | Illustrate the various purposes of timers and counters. | | CO5 | An | 3 |
| 16. | Distinguish between host and target machine. | | 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. | Discuss the architecture of embedded system. | CO1 | U | 6 |
|  | b. | Interpret the issues related to embedded software development. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the typical application scenario of embedded systems. | CO1 | U | 6 |
|  | b. | Explain the role of embedded hardware units and devices in a system. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Analyze the functions of RTOS. | CO2 | An | 6 |
|  | b. | Tabulate the main difference between the simulation and emulation of embedded systems. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 20. | a. | Interpret the performance of embedded systems in biomedical equipment. | CO3 | A | 6 |
|  | b. | Explain the challenges in embedded system design. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Differentiate between programming in assembly language and high level language. | CO4 | U | 6 |
|  | b. | Illustrate the techniques of state machine and state tables in embedded system design. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Evaluate the speed control of DC motor. | CO4 | E | 6 |
|  | b. | Explain the design of embedded based patient monitoring system. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the key features of wireless sensor technology. | CO5 | U | 6 |
|  | b. | Illustrate the interrupt routine in RTOS environment. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Enumerate the interfacing of keypad and LED. | CO6 | R | 6 |
|  | b. | Describe the interfacing of seven segment display. | CO6 | R | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 19 | 6 | - | - | - | 29 |
| CO2 | 11 | - | - | 6 | - | - | 17 |
| CO3 | - | 6 | 7 | 4 | - | - | 17 |
| CO4 | 4 | 12 | - | - | 6 | - | 22 |
| CO5 | 1 | 12 | 1 | 9 | - | - | 23 |
| CO6 | 12 | 4 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **18BM2015** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL DIAGNOSTICS AND THERAPEUTIC EQUIPMENT -II** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Differentiate macroshock and microshock. | | CO1 | U | 1 |
| 2. | Interpret the significance of lancet in glucometer. | | CO1 | U | 1 |
| 3. | Name common anesthetic agents used in anesthesia machine. | | CO2 | R | 1 |
| 4. | Trace the significance of soda lime use in anesthesia machine. | | CO2 | U | 1 |
| 5. | Explain the need for dialysis in humans. | | CO3 | An | 1 |
| 6. | State the working principle of short-wave diathermy. | | CO4 | R | 1 |
| 7. | State the frequency and wavelength of therapeutic microwaves. | | CO4 | R | 1 |
| 8. | Identify the term used for process that involves the nature of wave for extra-corporeal lithotripsy. | | CO5 | U | 1 |
| 9. | Name the small electronic device that you wear in or behind your ear for hearing disorders. | | CO5 | R | 1 |
| 10. | List the pumps used to deliver medium to large volume therapeutic fluids. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Compare holter monitor and event monitor. | | CO1 | U | 3 |
| 12. | State the clinic use of entonox apparatus. | | CO2 | R | 3 |
| 13. | Differentiate fistula and graft. | | CO3 | U | 3 |
| 14. | Classify the different methods of application of ultrasonic waves for therapy. | | CO4 | U | 3 |
| 15. | Identify the significance of biofeedback instrumentation. | | CO5 | U | 3 |
| 16. | Differentiate SXA and DXA. | | 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 the features of holter monitor. | CO1 | U | 6 |
|  | b. | Describe chromatograph and its working with a neat sketch. | CO1 | U | 6 |
| 18. | a. | Explain the pneumatic system and provide a clear layout for anesthesia machine. | CO2 | U | 12 |
| 19. | a. | Classify the types of dialysis and mention its working principle with relevant diagrams. | CO3 | U | 12 |
| 20. | a. | Summarize the characteristics of LASER and highlight the working principle of LASER with relevant sketches. | CO4 | U | 8 |
|  | b. | Illustrate the major milestones of LASER applications in biomedicine. | CO4 | U | 4 |
| 21. | a. | Explain the working of tonometer with a neat circuit. | CO5 | U | 6 |
|  | b. | Distinguish the types of ophthalmoscopes. | CO5 | U | 6 |
| 22. | a. | Explain the clinical working principle of microwaves and ultrasonic waves in diathermy equipment for treating musculoskeletal disorders. | CO4 | U | 12 |
| 23. | a. | Explain various types of BMD measurement techniques in detail. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate endoscope equipment and highlight the working principle of the equipment. | CO6 | U | 8 |
|  | b. | Explain the uses of various endoscope in specific medical application. | CO6 | An | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the principle involved in clinical and optical equipments. |
| CO2 | Identify the various therapeutic devices for pulmonary diseases. |
| CO3 | Apply the appropriate therapeutic device related to kidney ailment. |
| CO4 | Demonstrate the functions and applications of electrotherapy and lasers |
| CO5 | Assess the merits and demerits of the diagnostic equipments for basic senses. |
| CO6 | Design new therapeutic devices for particular application based on given specifications |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 17 |  | - |  |  | 17 |
| CO2 | 4 | 13 |  | - |  |  | 17 |
| CO3 | - | 15 |  | 1 |  |  | 16 |
| CO4 | 2 | 27 |  | - |  |  | 29 |
| CO5 | 1 | 16 |  | - |  |  | 17 |
| CO6 | 1 | 23 |  | 4 |  |  | 28 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **18BM3014** | **Duration** | **3hrs** |
| **Course Name** | **REHABILITATION ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the safety standards in Rehabilitation engineering. | CO1 | R | 12 |
|  | b. | Analyze the community-based models of rehabilitation. | CO1 | U | 8 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Summarize the Force and Proximity sensors with neat diagrams. | CO1 | R | 20 |
|  |  |  |  |  |  |
| 3. | a. | Describe the pneumatic and hydraulic actuators in Rehabilitation Engineering | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the design concepts of prosthetics. | CO2 | R | 12 |
|  | b. | Explain the exoskeleton applications of Upper and Lower Limb. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate the applications of microsensors for assessment of disability in human | CO3 | A | 12 |
|  | b. | Explain the electrical based actuator for Rehabilitation. | CO3 | R | 8 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the various Rehabilitation Training and Assessment in detail. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Explain the robot assisted Rehabilitation therapy with the relevant diagrams. | CO5 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the Deep Learning based design and analysis of Rehabilitation Engineering. | CO5 | A | 12 |
|  | b. | With neat sketch explain the different parts of wheel chair. | CO6 | R | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the Electromyogram based controls in detail. | CO6 | U | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the basic terminology in rehabilitation and models for societal applications |
| CO2 | Classify the sensors and actuators for particular applications. |
| CO3 | Discover the new methodology and systems for societal needs related to disability |
| CO4 | Compare the devices and methods under various environmental conditions |
| CO5 | Criticize the design, performance, cost, user need and affordability |
| CO6 | Develop the products based on cost effectiveness, user needs, environment friendly |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 32 | 8 | - | - | - | - | 40 |
| CO2 | 12 | 20 | - | - | - | - | 32 |
| CO3 | 8 | - | 12 | 8 | - | - | 28 |
| CO4 | - | 20 | - | - | - | - | 20 |
| CO5 | 20 | - | 12 | - | - | - | 32 |
| CO6 | 8 | 20 | - | - | - | - | 28 |
|  | | | | | | | **180** |



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| **Course Code** | **19BM2004** | **Duration** | **3hrs** |
| **Course Name** | **NUCLEAR MEDICINE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Cobalt-60 is also known as “gamma \_\_\_\_\_\_\_” | | CO2 | U | 1 |
| 2. | Give one application of Technitium-99m with one example equation | | CO2 | R | 1 |
| 3. | What does DOTATE signify? | | CO2 | U | 1 |
| 4. | Expand REM. | | CO2 | R | 1 |
| 5. | How many components are there in the gamma camera? | | CO3 | R | 1 |
| 6. | The collimator absorbs \_\_\_\_\_\_\_\_\_ rays. | | CO3 | R | 1 |
| 7. | Give an advantage for SPECT scan. | | CO3 | R | 1 |
| 8. | Give one positive radioiodine therapy for Thyrotoxicosis? | | CO3 | U | 1 |
| 9. | Give significance of Yttrium in Therapeutic application. | | CO6 | U | 1 |
| 10. | Give significance for receptor targeted therapy. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain any one gamma ray emission equation. | | CO2 | U | 3 |
| 12. | Define Targeted Radionuclide Therapy | | CO2 | U | 3 |
| 13. | State the principle of scintillator with diagram | | CO3 | R | 3 |
| 14. | What are Coincidence Circuits? | | CO3 | U | 3 |
| 15. | Write short notes on 1311-MIBG Therapy | | CO6 | R | 3 |
| 16. | List some precautionary measures before a PET/SPECT. | | 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. | a. | Write short notes on   1. Electron Capture 2. Compton Effect 3. Pair Production 4. Annihilation | CO2 | U | 8 |
|  | b. | Write short notes on   1. Positron Emission 2. Gamma Emission | CO2 | R | 4 |
|  |  |  |  |  |  |
| 18. | a. | Discuss any two radiopharmaceuticals used for prostate cancer diagnostics in detail. | CO2 | An | 6 |
|  | b | Discuss the generation of Technetium-99m with necessary equations. What does “milking” signify in Technetium production? | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Elaborate the construction and working of the gamma camera in detail with neat diagrams. | CO3 | An | 6 |
|  | b. | Discuss about the traces of Alpha, Beta and Gamma produced in a Wilson Cloud Chamber. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate with necessary diagrams the principle, construction and working of Positron Emission Tomography scans. | CO3 | A | 6 |
|  | b. | List out the clinical features related to Thyrotoxicosis. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Discuss about Targeted Internal Radiation in HCC:90 Y | CO6 | An | 6 |
|  | b | Discuss 1311-MIBG Therapy. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Imagine a SPECT system working without a collimator. Elaborate on the entire process of its working with suitable diagrams and highlight the differences. | CO3 | A | 6 |
|  | b. | Explain about the 32 P and 89 Strontium Dosage in Palliative Treatment for Bone Metastasis. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Briefly discuss the different types of Thyrotoxicosis and the treatment methods. | CO1 | U | 6 |
|  | b. | Give insights on Pulse Height Analyzers with block diagrams. | CO3 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss about BARC Regulations regarding radiation exposure. | CO4 | An | 6 |
|  | b | Write short notes on   1. Infertility caused by Ionizing radiations. 2. Role of National and International bodies in Radiation Safety. | CO4 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge about radiation activity in the living cells |
| CO2 | Identify the key principles of nuclear medicine and radioactivity. |
| CO3 | Analyze the working principle of advanced nuclear medicine imaging systems |
| CO4 | Interpret the effects of ionizing and non-ionizing radiations |
| CO5 | Analyze the effect of microwave on human organs and systems |
| CO6 | Suggest suitable therapeutic radiation for diseases without any side effects. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 6 | - | 6 | - | - | 12 |
| CO2 | 7 | 21 | - | 6 | - | - | 34 |
| CO3 | 5 | 11 | 18 | 6 | - | - | 40 |
| CO4 | 3 | 6 | - | 6 | - | - | 15 |
| CO5 | - | - | - | - | - | - | - |
| CO6 | 4 | 1 | 12 | 6 | - | - | 23 |
|  | | | | | | | **124** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the purpose of connector pane and icon in LabVIEW environment. | | CO1 | R | 1 |
| 2. | State any two advantages of LabVIEW programming. | | CO1 | U | 1 |
| 3. | Mention few block diagram objects. | | CO2 | R | 1 |
| 4. | List any two program control structures. | | CO2 | R | 1 |
| 5. | Interpret synchronization. | | CO4 | U | 1 |
| 6. | Recall the variable that is used to access front panel objects within the same VI. | | CO4 | U | 1 |
| 7. | Mention the need of documenting a VI. | | CO3 | R | 1 |
| 8. | Interpret modular programming. | | CO3 | U | 1 |
| 9. | Define VI metrics. | | CO5 | U | 1 |
| 10. | Represent the colour code for string data type. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Mention the step-by-step procedure in creating and saving a VI. | | CO1 | U | 3 |
| 12. | Distinguish between arrays and clusters. | | CO2 | U | 3 |
| 13. | Analyze the key differences in TCP and UDP for data transmission. | | CO3 | AN | 3 |
| 14. | Interpret the working of Functional Global variable. | | CO4 | U | 3 |
| 15. | Describe the working of WHILE loop with an example. | | CO6 | A | 3 |
| 16. | Discuss the role of LabVIEW in Biosignal processing. | | 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. | a. | Describe the components of virtual instrument and the steps to create an application. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Develop a LabVIEW program using flat sequence structure and stacked sequence structure to perform a sequence of events. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Demonstrate the use of notifiers in LabVIEW by creating a VI that sends notification to multiple recipients. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the different types of error handling VIs. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the datatype selection, Coercion and buffer allocation that helps in memory and performance management of a VI. | CO5 | AN | 12 |
|  |  |  |  |  |  |
| 22. | a. | Summarize the working of debugging tools and techniques in identifying and solving errors in LabVIEW. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Describe the working of user interface event handler. | CO4 | U | 6 |
|  | b. | Discuss the configuration of VI server. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Develop a LabVIEW program for displaying and monitoring the vital parameters of the human body. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the basics of LabVIEW programming |
| CO2 | Interface with real time signals |
| CO3 | Analyze 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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 16 |  |  |  |  | 17 |
| CO2 | 2 | 3 | 12 |  |  |  | 17 |
| CO3 | 1 | 25 |  | 3 |  |  | 29 |
| CO4 |  | 11 | 12 |  |  |  | 23 |
| CO5 | 1 | 7 | 3 | 12 |  |  | 23 |
| CO6 |  |  | 15 |  |  |  | 15 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the three primary components of microsystem. | | CO1 | R | 1 |
| 2. | Expand MEMS. | | CO1 | R | 1 |
| 3. | MOEMS have emerged to provide unparalleled functionality in which applications. | | CO2 | U | 1 |
| 4. | Expand BOEMS. | | CO2 | R | 1 |
| 5. | What kind of properties is exploited by Microfluidic devices? | | CO3 | U | 1 |
| 6. | Write a formula to calculate pressure | | CO3 | R | 1 |
| 7. | Write the three main parts involved in E-Nose technology. | | CO4 | R | 1 |
| 8. | What is the process of printing patterns? | | CO5 | U | 1 |
| 9. | Expand AFM. | | CO6 | R | 1 |
| 10. | Write the advantages of Carbon nano tube | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Sketch the cycle of microsystem process. | | CO1 | U | 3 |
| 12. | List the benefits of Optics. | | CO2 | U | 3 |
| 13. | Define electrothermal flow. | | CO3 | U | 3 |
| 14. | State Lab on a chip. | | CO4 | U | 3 |
| 15. | Explain clean room process in IC fabrication. | | CO5 | U | 3 |
| 16. | List the applications of Nano devices in biomedical field. | | 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 the appropriate diagrams, describe any three types of microsensors. | CO1 | An | 8 |
|  | b. | Write short notes on micro accelerometer. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the fundamental principle of MOEMS in detail. | CO2 | E | 6 |
|  | b. | Describe the grating light valve and the optical switch techniques. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate electrophoresis and Di electrophoresis method in detail. | CO3 | E | 6 |
|  | b. | Elaborate electrowetting, Opto electrowetting and electroosmosis flow. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Describe E-Tongue technology. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the fabrication process of IC in detail with suitable diagram. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Give a detailed explanation of any two common types of micro actuation using appropriate diagrams. | CO1 | An | 7 |
|  | b. | Explain optical switch and its types. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the concept of microdispenser. | CO3 | An | 6 |
|  | b. | Illustrate drug delivery system. | CO4 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the method of SEM technology in healthcare industry. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the principles of sensors and actuators. |
| CO2 | Summaries the optical devices and applications. |
| CO3 | Classify the performances of microfluidic 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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 7 | - | 15 | - | - | 24 |
| CO2 | 1 | 9 | - | 6 | 6 | - | 22 |
| CO3 | 1 | 4 | - | 6 | 12 | - | 23 |
| CO4 | 1 | 3 | - | 12 | 6 | - | 22 |
| CO5 | - | 4 | - | 12 | - | - | 16 |
| CO6 | 1 | 4 | - | - | 12 | - | 17 |
|  | | | | | | | **124** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Most specific hypothesis will be represented by……. | | CO1 | U | 1 |
| 2. | With the help of which model, the machine will make a prediction and take a decision without being explicitly programmed. | | CO1 | U | 1 |
| 3. | Information gain is calculated by ……….. | | CO2 | R | 1 |
| 4. | KNN algorithm stands for……. | | CO2 | R | 1 |
| 5. | Expand RNN. | | CO3 | R | 1 |
| 6. | What is the biological term for nodes? | | CO3 | U | 1 |
| 7. | Expand BAM. | | CO4 | R | 1 |
| 8. | Expand BPN and its features. | | CO4 | R | 1 |
| 9. | List the types of fuzzy operations. | | CO5 | U | 1 |
| 10. | Write down the operators of genetic algorithms. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List out the issues in Machine learning. | | CO1 | U | 3 |
| 12. | Define classification and Regression. | | CO2 | An | 3 |
| 13. | List out the types of Taxonomy of Artificial Neural Network. | | CO3 | U | 3 |
| 14. | Write down the applications of Auto associative network. | | CO4 | U | 3 |
| 15. | State the difference between classical set and fuzzy set | | CO5 | An | 3 |
| 16. | Apply the 3 point crossover method and find the value  100100  110011 | | CO6 | 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. | a. | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **Eg** | **A** | **B** | **C** | **D** | **E** | **Class** | | 1 | 90 | 70 | 60 | 80 | 100 | +ve | | 2 | 100 | 60 | 60 | 90 | 100 | -ve |   Apply the concept of version spaces and find out whether the values are consistent or inconsistent.  H1 = (90,?,?,?,100)  H2 = (?,?,70,?,90)  H3 = (100,?,?,80,?)  H4 = (90,70,60,?,100)  H5 = (?,70,?,?,80)  H6 = (?,?,?,?,?)  H7 = (100,70,?,?,100) | CO1 | A | 8 |
|  | b. | Elaborate in detail about designing a learning system with suitable block diagram. | CO1 | An | 4 |
|  |  |  |  |  |  |
| 18. |  | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **S.no** | **Age** | **Competition** | **Type** | **Profit (Target)** | | 1 | Old | Yes | S/w | Down | | 2 | Old | No | S/w | Down | | 3 | Old | No | H/W | Down | | 4 | Mid | Yes | S/W | Down | | 5 | Mid | Yes | H/W | Down | | 6 | Mid | No | H/W | Up | | 7 | Mid | No | S/W | Up | | 8 | New | Yes | S/W | Up | | 9 | New | No | H/W | Up |   Apply the concept of constructing decision tree and calculate the gain for any 2 attributes | CO2 | A | 12 |
|  |  |  |  |  |  |
| 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 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate a case study related to Rehabilitation device based on ANN | CO4 | C | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the fuzzy properties in detail. | CO5 | An | 8 |
|  | b. | Write Mamdani approaches in Fuzzy techniques. | CO5 | An | 4 |
|  |  |  |  |  |  |
| 22. | a. | |  |  |  | | --- | --- | --- | | **F1** | **F2** | **Target** | | A | X1 | YES | | B | 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 | A | 6 |
|  | b. | |  |  |  | | --- | --- | --- | | **History** | **Economics** | **Target** | | 4 | 3 | F | | 6 | 7 | P | | 7 | 8 | P | | 7 | 6 | P | | 8 | 8 | P |   By Using Euclidean formula find the 4 Nearest value w.r.t History=6, Economics=8. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain any two types of ANN. | CO4 | U | 6 |
|  | b. | 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) D1/D2  ii) D2/D1 | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Apply the concept of Genetic algorithm and maximize the function with Xin interval [0,31] | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 5 | 14 | 4 | - | - | 23 |
| CO2 | 2 |  | 18 | 3 |  |  | 23 |
| CO3 | 1 | 4 | 12 | - | - | - | 17 |
| CO4 | 2 | 9 | - | - | - | 12 | 23 |
| CO5 | - | 7 | - | 15 | - | - | 22 |
| CO6 | - | 1 | 15 | - | - | - | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Interpret the term “Teleconsultation”. | | CO1 | R | 1 |
| 2. | Give few examples of primary patient data. | | CO1 | R | 1 |
| 3. | Represent the configurations of firewall. | | CO2 | R | 1 |
| 4. | Mention an example for explicit consent. | | CO2 | R | 1 |
| 5. | List the different modes of propagation in satellite communication. | | CO3 | R | 1 |
| 6. | Mention the problems that occur in videoconferencing. | | CO3 | R | 1 |
| 7. | Name any two display systems. | | CO5 | R | 1 |
| 8. | List the disadvantages of magnetic tapes. | | CO5 | R | 1 |
| 9. | Interpret HL7. | | CO4 | U | 1 |
| 10. | Mention the need of PACS. | | CO4 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Summarize the benefits of telemedicine. | | CO1 | U | 3 |
| 12. | Mention the key conditions to be satisfied by a patentable item. | | CO2 | U | 3 |
| 13. | Discuss the different types of modulation techniques. | | CO3 | U | 3 |
| 14. | Describe the cameras used for data acquisition. | | CO5 | U | 3 |
| 15. | Demonstrate the types of substitution cryptography. | | CO4 | A | 3 |
| 16. | Discuss the application of telemedicine in healthcare and self care. | | CO6 | 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. | a. | Explain the functional diagram and essential parameters of telemedicine with necessary diagrams. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Discuss the security measures built in the telemedicine system. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Describe the communication through mobile technology with the different generations. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the different types of storage system in handling medical data. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the techniques adopted in wireless communication with its advantages and disadvantages. | CO3 | AN | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the layers of TCP/IP protocol in detail. | CO4 | U | 8 |
|  | b. | Illustrate the concept of cryptography with necessary diagrams. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 23. | a. | Analyze the standards to be followed in DICOM for transmitting medical images. | CO4 | AN | 8 |
|  | b. | Discuss the message structure and encoding schemes in HL7 standard. | CO4 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the processes involved in telepathology and its application in healthcare. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 |  |  |  |  | 17 |
| CO2 | 2 | 15 |  |  |  |  | 17 |
| CO3 | 2 | 19 |  | 12 |  |  | 33 |
| CO4 |  | 14 | 3 | 8 |  |  | 25 |
| CO5 | 2 | 15 |  |  |  |  | 17 |
| CO6 |  |  | 15 |  |  |  | 15 |
|  | | | | | | | **124** |



|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **19BM2010** | **Duration** | **3hrs** |
| **Course Name** | **BIOMATERIALS AND ARTIFICIAL ORGANS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List the classification of biomaterials. | | CO1 | R | 1 |
| 2. | Identify the primary purpose of biocompatibility testing for biomaterials. | | CO1 | A | 1 |
| 3. | What is meant by cell adhesion? | | CO2 | U | 1 |
| 4. | Hyaluronic acid plays an important role in \_\_\_\_\_\_\_\_\_\_\_\_ | | CO2 | E | 1 |
| 5. | Why is hemocompatibility testing important? | | CO3 | U | 1 |
| 6. | What are the infections associated with biofilm? | | CO3 | U | 1 |
| 7. | List some of the in vitro assays for assessing the inflammatory response to biomaterials. | | CO4 | R | 1 |
| 8. | Which metallic material is a commonly used metallic material for orthopedic implants? | | CO4 | R` | 1 |
| 9. | What biomaterials are used for heart valves? | | CO5 | R | 1 |
| 10. | \_\_\_\_\_\_ principle used in dialysis. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | What is Polymerization? | | CO1 | U | 3 |
| 12. | Conclude the mutual radiation grafting process. | | CO2 | E | 3 |
| 13. | Illustrate the methods and approaches to determine the cytocompatibility of biomaterials. | | CO3 | U | 3 |
| 14. | Label the Ideal features of soft tissue implants. | | CO4 | R | 3 |
| 15. | List the valves present in the heart. | | CO5 | R | 3 |
| 16. | Summarize the rotating disc-type oxygenators. | | 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. | Identify the basic characteristics of Biomaterials. | CO1 | A | 6 |
|  | b. | Explain the surface property of the biomaterials. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the surface modification process. | CO2 | E | 8 |
|  | b. | Interpret how cells interact with a substrate. | CO2 | E | 4 |
|  |  |  |  |  |  |
| 19. | a. | Explain the in vivo test method to check the biocompatibility of implants. | CO3 | U | 10 |
|  | b. | What is biomaterial-associated infection? | CO3 | U | 2 |
|  |  |  |  |  |  |
| 20. | a. | List the advantages and applications of metallic biomaterials. | CO4 | U | 6 |
|  | b. | Elaborate the Fibrous encapsulation of the healing process. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Show the working of bubble-type oxygenators. | CO5 | R | 6 |
|  | b. | Find the mechanism of air and bone conduction. | CO5 | R | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain about the artificial heart. | CO6 | U | 8 |
|  | b. | Identify the principle of Portable hemodialysis. | CO6 | A | 4 |
|  |  |  |  |  |  |
| 23. | a. | Apply any one technique to remove the waste products from the blood. | CO4 | A | 8 |
|  | b. | Explain the coil hemodialyzer. | CO4 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Show the structure of the ear. | CO5 | R | 10 |
|  | b. | List the different types of mechanical valves. | CO5 | R | 2 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify and know the structural variations in biomaterials. |
| CO2 | Determine and classify the various properties of biomaterials |
| CO3 | Explain the methods for testing implants with different aspects of biomaterials |
| CO4 | Recall the cell-biomaterial interactions for constructing artificial organs |
| CO5 | Remember the Interfacing materials and ethical implications. |
| CO6 | Apply the biomaterials in the healthcare sectors |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 9 | 7 |  |  |  | 17 |
| CO2 |  | 1 |  |  | 16 |  | 17 |
| CO3 |  | 17 |  |  |  |  | 17 |
| CO4 | 5 | 16 | 8 |  |  |  | 29 |
| CO5 | 28 |  |  |  |  |  | 28 |
| CO6 |  | 11 | 5 |  |  |  | 16 |
|  | | | | | | | **124** |



|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **19BM2012** | **Duration** | **3hrs** |
| **Course Name** | **ROBOTS IN HEALTHCARE** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | The left and right motion of the wrist is termed as ……………….. | | CO1 | U | 1 |
| 2. | List the three major components of Robot anatomy. | | CO2 | U | 1 |
| 3. | Mention the three degrees of freedom of Robot Wrist | | CO2 | U | 1 |
| 4. | Name the first ever Surgical Robot. | | CO1 | R | 1 |
| 5. | Define workspace in Robots. | | CO3 | R | 1 |
| 6. | When was the first Help Mate mobile autonomous robot used in hospitals? | | CO3 | R | 1 |
| 7. | Name the types of fiber optic cable that is classified based on the mode of propogation. | | CO4 | A | 1 |
| 8. | How does Laser range finder help in locating objects? | | CO5 | U | 1 |
| 9. | When is velocity planning required in autonomus robots? | | CO6 | R | 1 |
| 10. | List the different consoles of a surgical robot. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish open loop system and closed loop system and justify the need of closed loop system. | | CO1 | U | 3 |
| 12. | Comment on the term spatial manipulator. | | CO2 | R | 3 |
| 13. | Differentiate structured and unstructured environment in robot path planning. | | CO1 | U | 3 |
| 14. | Give the steps involved in image processing and analysis in computer vision. | | CO3 | A | 3 |
| 15. | List the challenges in developing a mobile robot. | | CO4 | U | 3 |
| 16. | Mention the design considerations of a gripper. | | 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 the three laws of robotics formulated by Issac Asimov. | CO1 | R | 2 |
|  | b. | With the help of the neat diagram explain the Anatomy of Robot and the four most common configurations of Robot. | CO2 | U | 10 |
| 18. | a. | Differentiate work space and joint space. | CO2 | U | 2 |
|  | b. | Derive the reverse transformation of a 2-Degree of freedom Robotic Arm with the vector for link 1 and link 2 defined as:  r1=[L1Cos Ɵ1 , L1Sin Ɵ1]  r2=[L2Cos (Ɵ1 + Ɵ2 ) , L1Sin (Ɵ1 + Ɵ2 ) ] | CO1 | A | 10 |
| 19. | a. | With necessary diagram discuss about the different types of manipulator joints. | CO2 | U | 6 |
|  | b. | Elaborate on the three different types of actuators and discuss its advantages and disadvantages. | CO3 | U | 6 |
| 20. | a. | Discuss in detail how an image is sensed and processed by a computer for image classification and identification | CO3 | U | 12 |
| 21. | a. | Differentiate a continuous controller from discrete controller. | CO4 | U | 2 |
|  | b. | Using Dijkstra Algorithm determine the shortest path from the source A to all vertices in the given graph to reach the destination F. | CO4 | A | 10 |
| 22. | a. | Comment on any four static characteristics of a sensor. | CO5 | U | 2 |
|  | b. | Elaborate on tactile sensors and proximity sensors with specific to robotic applications. | CO5 | A | 10 |
| 23. | a. | List the four common path planning algorithms and elaborate on A\* algorithm and compare the same with D\* algorithm, | CO5 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe in detail the Da Vinci Surgical robot and also its various field of application. | CO6 | A | 6 |
|  | b. | Discuss about the application of surgical robots in Cardiac Surgery. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the concepts of robotics, motion, joints |
| CO2 | Summarize the principles of sensors and actuators for robots |
| CO3 | Use the software tools for designing and analyzing the robot motion |
| CO4 | .Classify the performance to various sensors to its environment |
| CO5 | Recommend the suitable principles for specific conditions |
| CO6 | Create simple robots for surgical applications |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | 3 | 10 |  |  |  | 19 |
| CO2 | 2 | 3 | 18 |  |  |  | 23 |
| CO3 | 1 | 3 | 18 |  |  |  | 22 |
| CO4 | 3 | 2 | 10 |  |  |  | 15 |
| CO5 | 12 | 7 | 10 |  |  |  | 29 |
| CO6 | 1 | 3 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State ‘half period of radioactive material.’ | | CO1 | R | 1 |
| 2. | Mention the most important radio nuclide used for human body diagnosis. | | CO1 | R | 1 |
| 3. | List the MRI artifacts. | | CO2 | U | 1 |
| 4. | List few materials which exhibit piezo electric effect. | | CO2 | R | 1 |
| 5. | Record an application of M mode display of ultrasonic imaging. | | CO3 | U | 1 |
| 6. | List the pros and cons of ultrasound. | | CO3 | R | 1 |
| 7. | Give the different types of wave motion. | | CO4 | R | 1 |
| 8. | State the medical applications of thermography. | | CO5 | R | 1 |
| 9. | Expand : DICOM | | CO6 | R | 1 |
| 10. | Expand: ACR | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between gamma rays and X rays. | | CO1 | U | 3 |
| 12. | State the importance of CT Angiography. | | CO2 | R | 3 |
| 13. | List the applications of MRI. | | CO3 | R | 3 |
| 14. | Differentiate between thermal detector and photo detector. | | CO4 | U | 3 |
| 15. | Define emissivity. | | CO5 | R | 3 |
| 16. | Mention the characteristics of Liquid Crystal Thermography (LCT). | | 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. | Classify the various generations of computerized tomography. | CO2 | U | 12 |
| 18. | a. | Explain the concept of back projection algorithm employed in CT. | CO3 | U | 12 |
| 19. | a. | Analyze the concept of NMR principle. | CO1 | AN | 12 |
| 20. | a. | Highlight the physics of ultrasound. | CO4 | R | 12 |
| 21. | a. | Summarize the construction and working of vidicon camera. | CO6 | AN | 12 |
| 22. | a. | Explain the architecture of PACs with its applications. | CO6 | A | 12 |
| 23 | a. | Explain the working principle of an X-ray Machine with neat sketch of the block diagram. | CO1 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Elaborate on the concept of SPECT. | CO5 | A | 8 |
|  | b. | Differentiate between PET and SPECT. | CO5 | A | 4 |

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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 | 2 | 16 |  | 12 |  |  | 29 |
| CO2 | 5 | 12 |  |  |  |  | 17 |
| CO3 | 2 | 14 |  | 3 |  |  | 19 |
| CO4 | 12 | 3 |  |  |  |  | 15 |
| CO5 |  | 1 | 12 | 3 |  |  | 16 |
| CO6 |  | 4 | 12 | 12 |  |  | 28 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify few examples of qualitative and quantitative descriptors. | | CO1 | U | 1 |
| 2. | Illustrate two kinds of tools used for measuring kinetic quantities. | | CO1 | U | 1 |
| 3. | Restate Newton’s third law of motion. | | CO2 | U | 1 |
| 4. | Discuss the term kinesiology. | | CO2 | U | 1 |
| 5. | If a scale shows that an individual has a mass of 68 kg, what is that individual’s weight? | | CO3 | A | 1 |
| 6. | Indicate the Bone composites. | | CO3 | U | 1 |
| 7. | Describe the Muscle fatigue. | | CO4 | U | 1 |
| 8. | Discuss angular motion. | | CO4 | U | 1 |
| 9. | Construct the anatomy of the Hip joint. | | CO5 | A | 1 |
| 10. | Estimate major forces acting on the hip during static stance. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Summarize four main classes of friction. | | CO1 | U | 3 |
| 12. | Relate the coefficient of restitution and impact. | | CO2 | A | 3 |
| 13. | Compare Epiphysis and Diaphysis of human bone. | | CO3 | An | 3 |
| 14. | Write the differences between Newtonian and Non-Newtonian fluids. | | CO4 | A | 3 |
| 15. | Sketch the microstructure of filament of the muscle. | | CO5 | A | 3 |
| 16. | Discuss the movements and muscles of Hip joint. | | 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. | Compare the relationships between linear and angular motion. | CO1 | An | 8 |
|  | b. | A baseball player hits a triple to deep center field. As he is approaching third base, he notices that the incoming throw to the catcher is wild, and he decides to break for home plate. The catcher retrieves the ball 10 m from the plate and runs back toward the plate at a speed of 5 m/s. As the catcher starts running, the base runner, who is traveling at a speed of 9 m/s, is 15 m from the plate. Given that time 5 distance/speed, who will reach the plate first? | CO1 | E | 4 |
|  |  |  |  |  |  |
| 18. | a. | How much compressive stress is present on the L1, L2 vertebral disc of a 625 N woman, given that approximately 45% of body weight is supported by the disc (a) when she stands in anatomical position and (b) when she stands erect holding a 222 N suitcase? (Assume that the disc is oriented horizontally and that its surface area is 20 cm2.) | CO2 | E | 6 |
|  | b. | The tibia is the major weight-bearing bone in the lower extremity. If 88% of body mass is proximal to the knee joint, how much compressive force acts on each tibia when a 600 N person stands in anatomical position? How much compressive force acts on each tibia if the person holds a 20 N sack of groceries? | CO2 | E | 6 |
|  |  |  |  |  |  |
| 19. | a. | Experiment the viscoelastic behavior of Bone Ligament bone complex with Kelvin–Voight model with neat sketches. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Determine the structure and composition of blood vessel. | CO4 | A | 8 |
|  | b. | Differentiate between the laminar and turbulent flow. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the following terms: Shear Thinning fluid, Bingham plastic fluid & Shear Thickening fluids. | CO4 | U | 9 |
|  | b. | Discuss the rheological properties of human blood. | CO4 | U | 3 |
|  |  |  |  |  |  |
| 22. | a. | How much torque is produced at the elbow by the biceps brachii inserting at an angle of 60° on the radius when the tension in the muscle is 400 N? (Assume that the muscle attachment to the radius is 3 cm from the center of rotation at the elbow joint.) | CO5 | E | 6 |
|  | b. | How much force must be produced by the biceps brachii, attaching at 90° to the radius at 3 cm from the center of rotation at the elbow joint, to support a weight of 70 N held in the hand at a distance of 30 cm from the elbow joint? (Neglect the weight of the forearm, hand any action of other muscles.) | CO5 | E | 6 |
|  |  |  |  |  |  |
| 23. | a. | How much force must be produced by the brachioradialis and biceps (Fm) to maintain the 15 N forearm and hand in the position shown below, given moment arms of 5 cm for the muscles and 15 cm for the forearm/hand weight? What is the magnitude of the joint reaction force? (Note: - Assume the appropriate notations as shown in figure below) | CO6 | E | 6 |
|  | b. | Analyze the kinematics of spine with principal planes. | CO6 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Classify various movements that can be carried out at the hip joint with neat diagrams if any. | CO6 | An | 6 |
|  | b. | How much compression acts on the patellofemoral joint when the quadriceps exerts 300 N of tension and the angle between the quadriceps and the patellar tendon is (a) 160° and (b) 90°? | CO6 | E | 6 |

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|  | **COURSE OUTCOMES** |
|  | The student will be able to |
| 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 | - | 5 | - | 8 | 4 | - | 17 |
| CO2 | - | 2 | 3 | - | 12 | - | 17 |
| CO3 | - | 1 | 1 | 15 | - | - | 17 |
| CO4 | - | 18 | 11 | - | - | - | 29 |
| CO5 | - | - | 4 | - | 12 | - | 16 |
| CO6 | - | 4 | - | 12 | 12 | - | 28 |
|  | | | | | | | **124** |

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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Expand Cos(nπ) | | CO1 | U | 1 |
| 2. | Time shifting can also be called as \_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | CO1 | R | 1 |
| 3. | State the formula for trigonometric fourier series expansion. | | CO2 | R | 1 |
| 4. | How is the frequency response of a filter represented as? | | CO2 | R | 1 |
| 5. | Substantiate for Wigner Ville and Pseudo-Wigner Transform. | | CO3 | U | 1 |
| 6. | What is the use of Gabor Transform? | | CO3 | R | 1 |
| 7. | State the way to find the number of zeros in Laplace Transform. | | CO4 | U | 1 |
| 8. | Give substantiation for scaling 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 impulse function | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Give expressions for unit impulse and unit step function with examples. | | CO1 | R | 3 |
| 12. | List the conditions for the existence of Fourier Series | | CO2 | U | 3 |
| 13. | Define the most efficient Joint Time Frequency Analysis algorithm. | | CO3 | R | 3 |
| 14. | Define poles and zeros. Give representation. | | 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. | Write short notes on  i) Time Scaling ii) Time Reversal iii) Amplitude Scaling | CO1 | R | 6 |
|  | b. | Explain briefly about any three types of classifications of systems. | 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. | 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 heart sounds to detect valve pathologies inside the heart | 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 considering the x(n) as   1. Causal Signal ii) Anti-Causal Signal | CO5 | E | 12 |
|  |  |  |  |  |  |
| 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 Discrete Time 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) = cos Ω0t | CO4 | E | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | State the properties of Physiological Systems. | CO6 | R | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Identify the nature of biomedical signals |
| CO2 | Analyze the spectral characteristics of continuous-time periodic and aperiodic 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. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 | 1 | - | - | - | - | 17 |
| CO2 | 4 | 3 | 2 | - | 28 | - | 37 |
| CO3 | 4 | 7 | - | 6 | - | - | 17 |
| CO4 | 1 | 4 | - | - | 16 | - | 21 |
| CO5 | 4 | 1 | - | - | 12 | - | 17 |
| CO6 | 15 | - | - | - | - | - | 15 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List the types of biomedical measurement. | | CO1 | R | 1 |
| 2. | Name the term that deals with the structure of body and its parts. | | CO1 | R | 1 |
| 3. | Write down the output impedance of an ideal operational amplifier. | | CO2 | U | 1 |
| 4. | Sketch the diagram for positive feedback amplifier. | | CO2 | A | 1 |
| 5. | Indicate the use of low pass filter. | | CO3 | U | 1 |
| 6. | Trace the overall gain of the filter when individual filters are cascaded in higher-order filter circuit. | | CO3 | U | 1 |
| 7. | Memorize the function of analog to digital converter. | | CO4 | R | 1 |
| 8. | Define duty cycle. | | CO4 | R | 1 |
| 9. | Recite free running mode in phase locked loop. | | CO5 | R | 1 |
| 10. | List the types of modulation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the expression for Nernst equation. | | CO1 | A | 3 |
| 12. | Compare the terms input offset voltage and input offset current. | | CO2 | An | 3 |
| 13. | Calculate the cutoff frequency of the given circuit. | | CO3 | A | 3 |
| 14. | Distinguish between inverting and non-inverting comparators. | | CO4 | U | 3 |
| 15. | Classify the types of voltage controlled oscillators. | | CO5 | An | 3 |
| 16. | Identify the role of signal conditioning circuits for biomedical applications. | | 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 about the working of sodium potassium pump. | CO1 | U | 6 |
|  | b. | Summarize the different interfacing stages involved in recording electrodes. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the circuit configuration and working principle of an integrator with neat sketch | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the working principle of an instrumentation amplifier with neat circuit diagram. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the following:   1. Binary Weighted type DAC 2. R-2R Ladder type DAC | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain in detail about the construction and operation of a phase locked loop. | CO5 | A | 8 |
|  | b. | Differentiate between analog and digital phase detectors. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Express the output voltage equation of non-inverting summing amplifier and highlight its features. | CO2 | U | 8 |
|  | b. | Discuss about the preamplifier circuit. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 23. | a. | Describe the circuit schematic and working of an astable multivibrator with necessary diagram. | CO4 | R | 10 |
|  | b. | Define multivibrator. | CO4 | R | 2 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the features of medical instrumentation system with neat diagram. | CO6 | U | 8 |
|  | b. | Examine the measurement constraints involved in instrumentation system. | CO6 | A | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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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 equipments using different ICs |
| CO6 | Recommend the various safety standards in biomedical instrumentation |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 12 | 3 | - | - | - | 17 |
| CO2 | - | 25 | 1 | 3 | - | - | 29 |
| CO3 | - | 2 | 15 | - | - | - | 17 |
| CO4 | 14 | 15 | - | - | - | - | 29 |
| CO5 | 1 | 4 | 8 | 3 | - | - | 16 |
| CO6 | 1 | 11 | 4 | - | - | - | 16 |
|  | | | | | | | **124** |



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

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the rule for eliminating feedback loop. | | CO1 | R | 1 |
| 2. | Define non-touching loop. | | CO1 | R | 1 |
| 3. | Memorize damping ratio. | | CO2 | R | 1 |
| 4. | Determine the type and order of the following system transfer function  . | | CO2 | U | 1 |
| 5. | Recall Bandwidth. | | CO3 | R | 1 |
| 6. | Sketch the polar plot of G(s) = 1/ s2(1+sT1)(1+sT2)(1+sT3). | | CO3 | R | 1 |
| 7. | List the time domain specifications. | | CO4 | R | 1 |
| 8. | Reproduce the formula to determine centroid. | | CO4 | R | 1 |
| 9. | Sketch the schematic illustration of muscle stretch reflex. | | CO5 | U | 1 |
| 10. | Define the unit for ventilator flow rate. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 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 | U | 3 |
| 13. | State the advantages of frequency response analysis. | | CO3 | R | 3 |
| 14. | Discuss the procedure to plot root locus on real axis. | | CO4 | R | 3 |
| 15. | Sketch the simplified model of limb dynamics, muscle model and muscle spindle . | | CO5 | A | 3 |
| 16. | Explain 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. | a. | Apply Mason’s gain formula for determining the overall transfer function of the system shown below. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | (i) A unity feedback control system has an open loop transfer function G(s)=10/(s(s+2)). Determine the rise time, Percentage overshoot, peak time and settling time for a step input.  (ii) For a unity feedback control system, the open loop transfer function G(s) =10(s+2)/s2(s+1). Determine the position, velocity and acceleration error constants. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | (i) Sketch bode plot for the following transfer function  G(s) = Ks2/(1+0.2s)(1+0.02s)  (ii) Determine the system gain K for the gain cross over frequency to be 5 rad/sec. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | The open loop transfer function of a unity feedback system is given by G(s) = 1/s(1+s)(1+2s).   1. Sketch the polar plot 2. Determine the gain margin and phase margin. | CO3 | AN | 12 |
|  |  |  |  |  |  |
| 21. | a. | Sketch the root locus of the system whose open loop transfer function is  G(s) = K/s(s+2)(s+4). | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | (i)Apply routh criterion to determine the stability of the system represented by the characteristic equation s4 +8s3 +18s2 + 16s +5 =0. Comment on the location of the roots of characteristic equation.  (ii)Determine the range of K for stability of unity feedback system whose open loop transfer function is G(s) = K/s(s+1)(s+2). | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Elaborate on the linear model of respiratory mechanics. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | (i) Derive the mathematical model of chemical regulation of ventilation.  (ii) Analyze the regulation of cardiac output. | CO6 | AN | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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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. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 |  |  |  |  | 17 |
| CO2 | 1 | 4 | 12 |  |  |  | 17 |
| CO3 | 5 |  | 12 | 12 |  |  | 29 |
| CO4 | 5 | 12 | 12 |  |  |  | 29 |
| CO5 |  | 1 | 15 |  |  |  | 16 |
| CO6 | 1 | 3 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **19BM2023** | **Duration** | **3hrs** |
| **Course Name** | **IMAGE PROCESSING FOR MEDICAL APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Illumination originate from a source of? | | CO1 | R | 1 |
| 2. | Digitizing the coordinate value is called as? | | CO1 | R | 1 |
| 3. | List down the three methods of image enhancement. | | CO2 | U | 1 |
| 4. | Graphical representation of an image is? | | CO2 | R | 1 |
| 5. | Comment briefly on band pass filter. | | CO3 | R | 1 |
| 6. | Define ROI. | | CO3 | An | 1 |
| 7. | Partitioning of digital images into multiple region is called as? | | CO4 | U | 1 |
| 8. | Explain the process of Hough transform. | | CO5 | An | 1 |
| 9. | Filters that block all components below certain frequency are called as? | | CO5 | U | 1 |
| 10. | Boundary segments decomposes boundary into? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List out the advantages offered by the digital image processing. | | CO1 | R | 3 |
| 12. | Define mask. | | CO2 | U | 3 |
| 13. | Comment briefly on optimum notch filter. | | CO3 | U | 3 |
| 14. | Explain the issues with inverse filtering. | | CO4 | R | 3 |
| 15. | Sketch out the general representation of image compression. | | CO5 | An | 3 |
| 16. | Discuss the convex hull in detail. | | 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. | Describe the components of digital image processing. | CO1 | A | 10 |
|  | b. | Explain the three principal categories of digital storage for image processing. | CO1 | U | 2 |
|  |  |  |  |  |  |
| 18. | a. | With neat diagram, explain the different hardware-oriented models. | CO1 | U | 9 |
|  | b. | Illustrate the difference between sampling and quantization. | CO1 | R | 3 |
|  |  |  |  |  |  |
| 19. | a. | Perform histogram equalization on the given image.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 4 | 4 | 4 | 4 | 4 | | 3 | 4 | 5 | 4 | 3 | | 3 | 5 | 5 | 5 | 3 | | 3 | 4 | 5 | 4 | 3 | | 4 | 4 | 4 | 4 | 4 | |  |  |  |  |  | | CO2 | An | 10 |
|  | b. | Give an example of histogram equalization. | CO2 | A | 2 |
|  |  |  |  |  |  |
| 20. | a. | Describe the following smoothing spatial filters in detail.  i)Box Filter ii)Weighted Average Filter iii)Gaussian Filter  iv)Order Statistic Filter | CO3 | A | 10 |
|  | b. | Differentiate between spatial correlation and spatial convolution. | CO3 | U | 2 |
|  |  |  |  |  |  |
| 21. | a. | Write short note on  i)Arithmetic mean filter ii)Geometric mean filter  iii)Harmonic mean filter iv)Contra Harmonic mean filter | CO4 | An | 10 |
|  | b. | Distinguish between max and min filter | CO4 | U | 2 |
|  |  |  |  |  |  |
| 22. | a. | Describe the following detection of discontinuities in detail.  i)Point ii)Line iii)Edge | CO4 | A | 10 |
|  | b. | Describe image segmentation with example. | CO5 | R | 2 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate the classification of redundancy in images. | CO5 | R | 10 |
|  | b. | Discuss about the data compression. | CO5 | An | 2 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the image representation in terms of signature. | CO6 | U | 10 |
|  | b. | Describe the uses of boundary segments. | CO6 | U | 2 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Describe the digital image fundamentals for a given condition. |
| CO2 | Illustrate the effect of image enhancement techniques on images. |
| CO3 | Distinguish between image restoration filters. |
| CO4 | Discuss about the image segmentation procedure. |
| CO5 | Compute the level of compression achieved for the given image data. |
| CO6 | Explain and compute features useful for image representation and recognition. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 8 | 11 | 10 | 0 | 0 | 0 | 29 |
| CO2 | 1 | 4 | 2 | 10 | 0 | 0 | 17 |
| CO3 | 1 | 3 | 10 | 1 | 0 | 0 | 17 |
| CO4 | 3 | 2 | 10 | 10 | 0 | 0 | 26 |
| CO5 | 12 | 1 | 0 | 3 | 0 | 0 | 19 |
| CO6 | 0 | 13 | 0 | 3 | 0 | 0 | 16 |
|  | | | | | | | **124** |



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name an embedded system which is designed with 16-bit microcontroller. | | CO1 | R | 1 |
| 2. | Identify the register to hold the memory address of the next instruction. | | CO1 | R | 1 |
| 3. | Select the software tools to perform line by line translation to machine executable codes. | | CO2 | R | 1 |
| 4. | Give examples of host and target machine in an embedded system. | | CO2 | U | 1 |
| 5. | Estimate the largest value that can be loaded in an 8-bit microcontroller register. | | CO3 | U | 1 |
| 6. | Indicate the use of the prescalar in the operation of timer. | | CO5 | U | 1 |
| 7. | Write an embedded C instruction for reading the data from PORT A. | | CO4 | A | 1 |
| 8. | Identify the different modes of an operating system. | | CO5 | R | 1 |
| 9. | List the functional elements involved in state diagram. | | CO5 | R | 1 |
| 10. | Define step angle. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the characteristics of an embedded systems. | | CO1 | R | 3 |
| 12. | Identify the role of microcontroller for designing an embedded system. | | CO2 | U | 3 |
| 13. | Sketch the schematic diagram of switch interface with microcontroller. | | CO3 | A | 3 |
| 14. | State the necessity of data types in an embedded C programming. | | CO4 | R | 3 |
| 15. | List the basic services provided by an operating system. | | CO5 | R | 3 |
| 16. | Write the working principle of DC motor. | | CO6 | 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. | a. | Describe the features of various hardware elements involved in embedded system design. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the various design process of an embedded system. | CO2 | U | 8 |
|  | b. | Classify the different types of an embedded system. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the interfacing of LED with microcontroller. | CO3 | U | 8 |
|  | b. | Sketch the schematic diagram of R-2R Ladder network type DAC. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Write the significance of various C programming elements. | CO4 | A | 10 |
|  | b. | List the advantages of Java programming. | CO4 | R | 2 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the different methods of handling interrupt services in RTOS environment. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Sketch the hardware connection between microcontroller and seven segment display. | CO3 | A | 6 |
|  | b. | Write an embedded C program to activate switches using microcontroller. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the software development tools used in real time system. | CO2 | U | 6 |
|  | b. | Describe the process of converting an embedded C code into machine code. | CO2 | R | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the different drive methods of stepper motor interfacing with neat diagram. | CO6 | A | 8 |
|  | b. | Sketch the schematic diagram of wireless patient monitoring system. | CO6 | A | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 17 | - | - | - | - | - | 17 |
| CO2 | 7 | 22 | - | - | - | - | 29 |
| CO3 | - | 9 | 13 | - | - | - | 22 |
| CO4 | 5 | - | 17 | - | - | - | 22 |
| CO5 | 5 | 1 | 12 | - | - | - | 18 |
| CO6 | 1 | - | 15 | - | - | - | 16 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **19BM2028** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL IMAGING TECHNIQUES** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the nature of x-rays. | | CO1 | U | 1 |
| 2. | Describe on digital fluoroscopy. | | CO1 | R | 1 |
| 3. | Interpret the methods of image reconstruction in computed tomography. | | CO3 | An | 1 |
| 4. | Illustrate the radionuclide used for brain examination. | | CO3 | A | 1 |
| 5. | Write a note on applications of Geiger Muller Counter. | | CO2 | A | 1 |
| 6. | Infer the detectors in single photon emission computed tomography. | | CO1 | An | 1 |
| 7. | Write the applications of ultrasound scanners in medical diagnosis. | | CO2 | A | 1 |
| 8. | Infer the importance of attenuation correction in SPECT imaging. | | CO6 | An | 1 |
| 9. | Infer the advantages of using a computer in radiological machines. | | CO3 | An | 1 |
| 10. | Distinguish the imaging system for detecting tumour cells in human. | | CO4 | E | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Illustrate the merits of mobile x-rays. | | CO5 | U | 3 |
| 12. | Compare computed tomography with x-rays diagnosis. | | CO4 | An | 3 |
| 13. | List few materials that produce ultrasound. | | CO3 | R | 3 |
| 14. | Identify the components of nuclear magnetic resonance imaging method. | | CO2 | U | 3 |
| 15. | State principles of optical coherence tomography. | | CO1 | R | 3 |
| 16. | Write the computer applications in medical imaging. | | CO6 | 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. | a. | Analyze the production of x-rays from the evacuated setup. | CO1 | An | 8 |
|  | b. | Interpret the merits of radiographic imaging techniques. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Write a note on applications of mammography. | CO1 | A | 6 |
|  | b. | Explain the medical applications of computed tomography. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Classify and explain the radiation detection methods used in modern nuclear imaging equipment. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the construction details of positron emission tomography scanner. | CO2 | An | 8 |
|  | b. | Evaluate the significance of positron emission tomography in medical applications. | CO2 | E | 4 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the applications of gamma camera in medical diagnosis. | CO6 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Analyze the working of infrared thermographic scanning system. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Evaluate the safety measures for hospital authority to control the effects of radiation during medical diagnosis. | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Evaluate the applications of optical coherence tomography in medical field. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 5 | 6 | 9 | - |  | 24 |
| CO2 | - | 3 | 8 | 8 | 4 |  | 23 |
| CO3 | 3 | - | 1 | 14 | - |  | 18 |
| CO4 | - | - | - | 15 | 1 |  | 16 |
| CO5 | - | 3 | - | - | 12 |  | 15 |
| CO6 | - | - | 3 | 1 | 24 |  | 28 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **19BM2029** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL EQUIPMENT MAINTENANCE AND TROUBLESHOOTING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State the use of PWRVIEW software. | | CO1 | R | 1 |
| 2. | List the various modes of testing available in electronic load. | | CO1 | R | 1 |
| 3. | List the 3 ways to calibrate digital sensor probe. | | CO2 | R | 1 |
| 4. | State how much time is required to warm-up by the display while running the calibration tool. | | CO2 | R | 1 |
| 5. | Classify the 3 major components of CBP machine. | | CO3 | U | 1 |
| 6. | Describe the methods to check the condition of scavenging in Anesthesia machine. | | CO3 | U | 1 |
| 7. | State the ways to resolve ‘guide rail jamming’ issue in X ray machine. | | CO4 | R | 1 |
| 8. | Differentiate warmer and incubator. | | CO4 | U | 1 |
| 9. | Indicate the minimum agreement period of MES. | | CO5 | U | 1 |
| 10. | Interpret Reliability in your own words. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe the ways to find whether an equipment is grounded or not. | | CO1 | U | 3 |
| 12. | Discuss about the calibration procedure for testing digital sensor probe. | | CO2 | U | 3 |
| 13. | Discuss about how the ventilators are being tested. | | CO3 | U | 3 |
| 14. | Summarize vendor services. | | CO4 | U | 3 |
| 15. | List the steps in decision making. | | CO5 | R | 3 |
| 16. | Summarize the factors that are required to reduce human errors. | | 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 the techniques involved in testing the effectiveness of shielding. | CO1 | An | 6 |
|  | b. | Write a note on testing of CT and PT transformers. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Write a note on cable standards prescribed by International Electrotechnical Commission. | CO2 | A | 7 |
|  | b. | Discriminate different types of Fuses and explain their role in medical equipment design. | CO2 | An | 5 |
|  |  |  |  |  |  |
| 19. | a. | Explain about troubleshooting of surgical lights. | CO3 | An | 6 |
|  | b. | Explain how a Patient monitoring system is tested. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the ways to troubleshoot an incubators. | CO4 | An | 8 |
|  | b. | Write a note on annual and comprehensive contract requirements. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the factors that influence cost of medical equipment. | CO5 | E | 9 |
|  | b. | Write a short note on managed equipment service. | CO5 | A | 3 |
|  |  |  |  |  |  |
| 22. | a. | Explain in detail about troubleshooting of surgical tools. | CO3 | An | 7 |
|  | b. | Write note on the maintenance procedures of HLM. | CO3 | A | 5 |
|  |  |  |  |  |  |
| 23. | a. | Assess the Medtronic’s product lifecycle management systems case study and conclude it with your opinion. | CO6 | An | 6 |
|  | b. | Summarize the computerized maintenance management system. | CO6 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain FEMA and fault tree analysis. | CO6 | An | 7 |
|  | b. | Write a note on quality assurance through ISO regulatory compliance. | CO6 | A | 5 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the reasons for equipment failure. |
| CO2 | Interpret the need for grounding aspects, maintenance and troubleshooting |
| CO3 | Construct the test bench, tools and methods for troubleshooting |
| CO4 | Compare various standards and specifications |
| CO5 | Decide quality and safety standards |
| CO6 | Formulate advanced methods to solve critical problems |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | 6 | 6 | - | - | 17 |
| CO2 | 2 | 3 | 7 | 5 | - | - | 17 |
| CO3 | - | 5 | 5 | 19 | - |  | 29 |
| CO4 | 1 | 4 | 4 | 8 | - | - | 17 |
| CO5 | 3 | 1 | 3 | - | 9 | - | 16 |
| CO6 | - | 4 | 5 | 19 | - | - | 28 |
|  | | | | | | | **124** |



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| **Course Code** | **DATA ANALYTICS FOR BIOMEDICAL ENGINEERING** | **Duration** | **3hrs** |
| **Course Name** | **19BM2034** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | In the data mining context, ETL stands for\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | The appropriate data retention policies and archiving strategies are determined by \_\_\_. | | CO1 | U | 1 |
| 3. | Correlation coefficients have the value from\_\_\_\_. | | CO2 | R | 1 |
| 4. | \_\_\_\_\_\_\_\_\_ Package offers optimized verbs for filtering, arranging, summarizing, and joining data frames. | | CO3 | U | 1 |
| 5. | \_\_\_\_\_\_\_\_\_ function is used to calculate the number’s absolute value in R programming. | | CO3 | R | 1 |
| 6. | In R programming ‘col’ indicates to\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 7. | Boxplots are created in R by using the \_\_\_\_ function. | | CO4 | U | 1 |
| 8. | When fitting a linear regression model, the coefficients α and β are often estimated using the \_\_\_\_\_\_\_\_ method, which minimizes the sum of squared residuals. | | CO5 | U | 1 |
| 9. | The \_\_\_\_\_\_\_\_\_\_\_ assumption in regression models assumes that the error terms are normally distributed with a mean of 0. | | CO5 | U | 1 |
| 10. | Precision medicine aims to tailor medical treatments to individual patients based on their \_\_\_\_\_\_\_ characteristics. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define data munging. | | CO1 | R | 3 |
| 12. | Describe the significance of learning to rank approach. | | CO2 | U | 3 |
| 13. | List the attributes of factors in R programming. | | CO3 | R | 3 |
| 14. | Write an R programming to generate simple pie chart. | | CO4 | A | 3 |
| 15. | Predict the probability of pass for the student who studied 33 hours. Consider (B0=-64, B1=2) | | CO5 | A | 3 |
| 16. | List the application of big data analytics. | | 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 the different types of dashboard used for data analytics. | CO1 | U | 5 |
|  | b. | Describe the steps involved in the SEMMA methodology. | CO1 | U | 7 |
|  |  |  |  |  |  |
| 18. | a. | Explain the data pre-processing techniques in detail. | CO2 | U | 6 |
|  | b. | Describe the steps used in supervised regression. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the different types of Factors used in R programming with its syntax and example. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Write an R programming to create 2D and 3D Pie chart with its parameter. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Apply linear regression technique to predict the 7th week sales.  Consider the five weeks sales data is given as shown in table.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | X | 1 | 2 | 3 | 4 | 5 | | Y | 1.2 | 1.8 | 2.6 | 3.4 | 3.8 | | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the need for Machine learning in data analytics. | CO1 | U | 5 |
|  | b. | Determine the standard deviation for the diastolic blood pressure was as follows : 83,75,81,79,71,95,77,84,90. | CO2 | A | 7 |
|  |  |  |  |  |  |
| 23. | a. | Calculate the probability of pass for the student who studied 33 hours from the given data of 29, 15,33,28,39. (Assume b0=--64, b1=2) | CO5 | A | 6 |
|  | b. | Explain different types of regression model in detail. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the role of big data analytics in precision medicine. | CO6 | U | 6 |
|  | b. | Describe the key aspects of the medical imaging in big data analytics. | CO6 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate fundamental knowledge of Big data analytics. |
| CO2 | Explore different types of data from different sources. |
| CO3 | Modify the design to develop support systems |
| CO4 | Write R script to analyse data from data interface. |
| CO5 | Perform various statistical analysis using R packages for given data set. |
| CO6 | Apply knowledge of big data analytics on bioinformatics and health care data set |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 17 | - | - | - | - | 21 |
| CO2 | 1 | 16 | 7 | - | - | - | 24 |
| CO3 | 4 | 13 | - | - | - | - | 17 |
| CO4 | 1 | 1 | 15 | - | - | - | 17 |
| CO5 | - | 8 | 21 | - | - | - | 29 |
| CO6 | 3 | 13 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define irradiance. | | CO1 | R | 1 |
| 2. | List the modes of vibration in near infrared spectroscopy. | | CO1 | R | 1 |
| 3. | Write down the expression for Snell’s law. | | CO2 | A | 1 |
| 4. | State Doppler effect. | | CO2 | R | 1 |
| 5. | Show the alpha decay process of Uranium-238 | | CO3 | U | 1 |
| 6. | Identify the features of isotones. | | CO3 | U | 1 |
| 7. | Express the term linear energy transfer. | | CO4 | U | 1 |
| 8. | Define Compton effect. | | CO4 | R | 1 |
| 9. | Identify the use of lethal dose-50 (LD50). | | CO5 | U | 1 |
| 10. | List any two applications of gamma radiation in nuclear medicine. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write down the application of visible light in medicine. | | CO1 | A | 3 |
| 12. | Identify the role ultrasound cavitation in medicine. | | CO2 | U | 3 |
| 13. | Differentiate between controlled chain reaction and uncontrolled chain reaction. | | CO3 | U | 3 |
| 14. | Relate photon scattering and photon disappearing. | | CO4 | A | 3 |
| 15. | Show the relationship between energy fluence and kerma. | | CO5 | U | 3 |
| 16. | Indicate the applications of Doppler in medical sector. | | 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. | Illustrate the working principle of thermographic unit with neat diagram. | CO1 | A | 8 |
|  | b. | List the advantages and disadvantages of LASER. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 18. | a. | Describe the procedure for generating ultrasonic sound using piezoelectric effect with neat diagram. | CO2 | U | 9 |
|  | b. | Compare the frequency and pitch characteristics of the musical sound. | CO2 | U | 3 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the different approaches for decaying radioactive elements. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the interaction of charged particles with matter. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the concept of Inverse square law with neat sketch. | CO5 | U | 10 |
|  | b. | Define roentgen. | CO5 | R | 2 |
|  |  |  |  |  |  |
| 22. | a. | Discuss any four effects of high frequency radiation in patient health with an example. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Classify the various ultrasonic waves based on its direction of propagation and highlight its features. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Radionuclides can be applied in nuclear medicine. Justify your answer with an example. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | 12 | 11 | - | - | - | 29 |
| CO2 | 1 | 15 | 1 | 12 | - | - | 29 |
| CO3 | - | 17 | - | - | - | - | 17 |
| CO4 | 1 | 12 | 4 | - | - | - | 17 |
| CO5 | 2 | 13 | 1 | - | - | - | 16 |
| CO6 | 1 | 3 | - | - | 16 | - | 16 |
|  | | | | | | | **124** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | \_\_\_\_\_\_ is the metabolic process that converts glucose into pyruvic acid. | | CO1 | U | 1 |
| 2. | Isomerism exhibited by compounds possessing asymmetric carbon atom like monosaccharide, is\_\_\_\_\_\_\_\_\_\_\_\_ | | CO1 | R | 1 |
| 3. | Which lipid facilitates cell–cell interactions | | CO6 | R | 1 |
| 4. | What enzyme regulates cholesterol synthesis? | | CO6 | R | 1 |
| 5. | Amino acids with the aliphatic ‘R’ group are\_\_\_\_\_\_ | | CO4 | U | 1 |
| 6. | Amino acids are mostly synthesised from\_\_\_\_. | | CO2 | U | 1 |
| 7. | A DNA segment contains 100 Adeniene and 100 cytosines, how many neuclotides are present the segment. | | CO4 | U | 1 |
| 8. | RNA contains repeating units of \_\_\_. | | CO2 | R | 1 |
| 9. | **Which nutrient deficiency causes megaloblastic anaemia?** | | CO3 | U | 1 |
| 10. | **Which mineral deficiency may result into impaired growth and development, skin lesions and loss of appetite** | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain Fischer & Haworth projection with examples | | CO6 | U | 3 |
| 12. | What is mean by derived lipids? | | CO1 | R | 3 |
| 13. | What is mean by amide linkage? Write with its molecular structure. | | CO4 | U | 3 |
| 14. | Write the composition of nucleotide. | | CO2 | R | 3 |
| 15. | Which vitamin deficiency is associated with egg white injury? | | CO3 | R | 3 |
| 16. | What is meant by integration of metabolism? | | 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 in detail about the Glycolysis process. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe the function of fatty acids, its structure and its classification. | CO6 | R | 8 |
|  | b. | What is the main function of complex lipids and derived lipids? | CO6 | R | 4 |
|  |  |  |  |  |  |
| 19. | a. | What are the four levels of protein structure? Explain each levels with pictorial representation | CO2 | U | 8 |
|  | b. | Illustrate the significance of Ramar plot. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the composition, structure and properties of DNA. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain in detail about Vitamin A structure, its sources and its function. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the mechanism of Urea cycle. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the structure, classification and properties of oligo and polysaccharides. | CO1 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write down the benefits of the minerals to our body. | CO3 | U | 6 |
|  | b. | Tabulate the functions of micro minerals. | CO3 | R | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 25 | - | - | - | - | 29 |
| CO2 | 8 | 9 | - | - | - | - | 17 |
| CO3 | 21 | 7 | - | - | - | - | 28 |
| CO4 | 0 | 17 | - | - | - | - | 17 |
| CO5 | 1 | 3 | - | - | - | - | 4 |
| CO6 | 14 | 15 | - | - | - | - | 29 |
|  | | | | | | | **124** |



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| **Course Code** | **20BM2004** | **Duration** | **3hrs** |
| **Course Name** | **CANCER BIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Discuss the two major functional regions of a cell. | | CO1 | U | 1 |
| 2. | Analyze the applications of flow cytometry in cancer research. | | CO1 | An | 1 |
| 3. | Define cytokinesis. | | CO2 | R | 1 |
| 4. | Describe the role of signal molecules in cell cycle regulation. | | CO2 | R | 1 |
| 5. | Examine the primary function of platelet derived growth factor. | | CO3 | R | 1 |
| 6. | Identify the functions of proto-oncogene. | | CO3 | U | 1 |
| 7. | List the types of proteinases. | | CO4 | R | 1 |
| 8. | Define the term cancer nanotechnology. | | CO5 | R | 1 |
| 9. | Discuss the role of DNA repair mechanism. | | CO5 | U | 1 |
| 10. | List the techniques of genomic screening. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define the characteristics of sarcoma. | | CO1 | U | 3 |
| 12. | Interpret the mutations affecting apoptosis. | | CO2 | U | 3 |
| 13. | Examine the concepts of Boveri theory. | | CO3 | R | 3 |
| 14. | Analyze the result of oncogenes activation. | | CO4 | An | 3 |
| 15. | List the categories of cancer. | | CO5 | R | 3 |
| 16. | Analyze the telomerase inhibitors in cancer therapies. | | 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. | Interpret the M-phase of cell cycle. | CO1 | U | 6 |
|  | b. | Illustrate the biochemical assays in cancer detection. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the cellular theories. | CO1 | U | 6 |
|  | b. | Summarize the theory of chemical carcinogenesis. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Analyze the structure and function of epidermal growth factor. | CO2 | An | 6 |
|  | b. | Discuss the cellular mechanisms involved in metastatic cascade and the common sites of metastasis. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Examine the three step theory of invasion. | CO3 | R | 6 |
|  | b. | Illustrate the invasion in cancer metastasis. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the effects of DNA damage and the strategies for DNA protection. | CO4 | An | 6 |
|  | b. | Discuss the role of epidemiology in cancer research. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Interpret the chemotherapy for cancer. | CO4 | U | 6 |
|  | b. | Discriminate the methods and technologies used in cancer detection. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the gene therapy for cancer. | CO5 | U | 6 |
|  | b. | Analyze the prediction of aggressiveness of cancer. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize the radiation therapy for cancer. | CO6 | U | 6 |
|  | b. | Evaluate the use of signal targets towards the therapy of cancer. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Describe the molecular and cellular mechanisms that lead to cancer |
| CO2 | Analyze the primarily focus on the role of growth factors that leads to cancer |
| CO3 | Evaluate the role of gene mutation in the development of cancer |
| CO4 | Discuss on oncogenes, tumor suppressor genes, angiogenesis and signal transduction mechanisms in tumor formation |
| CO5 | Understand the fundamental principles behind cancer diagnosis and prevention |
| CO6 | Explain the various therapeutic management system for cancer biology |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 22 | - | 7 | - | - | 29 |
| CO2 | 2 | 9 | - | 6 | - | - | 17 |
| CO3 | 10 | 1 | - | 6 | - | - | 17 |
| CO4 | 1 | 12 | - | 9 | - | - | 22 |
| CO5 | 4 | 7 | - | 12 | - | - | 23 |
| CO6 | 1 | 6 | - | 9 | - | - | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Hospital management involves the five key functions of planning, organizing, staffing, directing, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | Hospital management must adhere to various legal and regulatory requirements, including licensing, patient confidentiality \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ liability, and labor laws. | | CO1 | U | 1 |
| 3. | NABL provides accreditation for laboratories to ensure they meet specific \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ standards. | | CO2 | R | 1 |
| 4. | ISO 13485 is an international standard for the quality management system for \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 | U | 1 |
| 5. | Efforts to increase supply chain \_\_\_\_\_\_\_\_\_\_ focus on minimizing disruptions and ensuring the availability of critical medical supplies, even during emergencies. | | CO3 | U | 1 |
| 6. | The "Triple Bottom Line" concept considers \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ impacts on evaluating supply chain sustainability. | | CO3 | U | 1 |
| 7. | \_\_\_\_\_\_\_\_services accepted and integrated into healthcare delivery. | | CO4 | R | 1 |
| 8. | A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a critical piece of safety equipment used to protect individuals from inhaling harmful gases. | | CO5 | U | 1 |
| 9. | Name the basic first aid kits. | | CO5 | U | 1 |
| 10. | The biomedical equipment procurement procedure involves the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of appropriate medical devices. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe the importance of technical services in healthcare sector. | | CO1 | U | 3 |
| 12. | List out the advantages of ISO Certification. | | CO2 | R | 3 |
| 13. | Explain the benefits of supply chain management. | | CO3 | U | 3 |
| 14. | State the need for telemedicine in healthcare. | | CO4 | R | 3 |
| 15. | List the use of gas mask in healthcare. | | CO5 | R | 3 |
| 16. | State the importance of budget management in hospital | | 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 Health care system organization in India. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the importance of FDA in healthcare. | CO2 | U | 6 |
|  | b. | Illustrate the accreditation process of Joint commission International. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the performance metrices to access healthcare supply chain management. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the steps involved in the professional registration of a clinic. | CO4 | U | 8 |
|  | b. | List the advantage of Digital health and personalized medicine. | CO4 | R | 4 |
|  |  |  |  |  |  |
| 21. | a. | Explain the operations on safety devices in detail. | CO5 | U | 6 |
|  | b. | Explain the personal protective equipment’s used in healthcare. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Define MBO. Write short note on its importance. | CO1 | U | 6 |
|  | b. | Illustrate the important of ISO-13485 standard. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the safety measures used in radiation measures. | CO5 | U | 6 |
|  | b. | Explain in detail about waste management in hospital. | CO4 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the steps involved to test and install the medical equipment. | CO6 | U | 6 |
|  | b. | Explain the contract maintenance and budgeting of medical equipment. | CO6 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 22 | - | - | - | - | 23 |
| CO2 | 4 | 19 | - | - | - | - | 23 |
| CO3 | - | 17 | - | - | - | - | 17 |
| CO4 | 8 | 14 | - | - | - | - | 22 |
| CO5 | 3 | 20 | - | - | - | - | 23 |
| CO6 | 3 | 13 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **21BM3001** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL INSTRUMENTATION DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Analyze the physiology of circulatory system. | CO1 | U | 10 |
|  | b. | Sketch the structure of human cell and explain its functions. | CO2 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Summarize the concept of action potential. | CO2 | U | 10 |
|  | b. | Elaborate on the design aspects of instrumentation involved in the measurement of ECG. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | A wheatstone bridge is excited by a 12V dc source and has the following resistances R1 = 1.2KΏ, R2 = 3 K Ώ ,R3 = 2.2 K Ώ and R4 = 5 K Ώ.Find the output voltage. | CO3 | A | 10 |
|  | b. | Elaborate on the concept of LVDT. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Compare the features of different types of temperature transducers. | CO3 | U | 10 |
|  | b. | Differentiate between Internal and External pacemakers. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Elaborate on the trouble shooting maintenance of ventilators. | CO5 | U | 10 |
|  | b. | Explain the mechanics of breathing. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the physiology of excretory system. | CO1 | U | 10 |
|  | b. | Analyze the functions of sensory organs. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Find the output voltage of a temperature transducer in the given circuit if IC1 = 2 mA; IC2 = 1 mA and the temperature is 37 oC.  K = Boltzman’s Constant = 1.38 x10-23J/K  T = Temperature in Kelvin  IC1 = Collector current of BJT 1 mA  IC2 = Collector current of BJT 2 mA  q = Coulomb’s charge = 1.6 x10 -19 coulombs/electron | CO3 | A | 10 |
|  | b. | Explain the working principle of different types of strain gauges. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Summarize the concept of Heart Lung Machine. | CO4 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Design the interfacing circuit for Wireless EEG. | CO6 | A | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 equipment for various diseases and ensure patient safety |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 30 |  |  |  |  | 30 |
| CO2 | 10 | 10 | 10 |  |  |  | 30 |
| CO3 |  | 30 | 20 |  |  |  | 50 |
| CO4 |  | 30 |  |  |  |  | 30 |
| CO5 |  | 20 |  |  |  |  | 20 |
| CO6 |  |  | 20 |  |  |  | 20 |
|  | | | | | | | **180** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Using appropriate examples, describe the necessity of sampling and the requirements for avoiding aliasing | CO1 | A | 08 |
|  | b. | Perform convolution of the two sequences, x(n)= {1,1,2,1}; h(n)={2,3,1,1} | CO1 | A | 08 |
|  |  |  |  |  |  |
| 2. | a. | Explain a DSP system using a diagram and describe the functioning of ADC and DAC. | CO2 | U | 08 |
|  | b. | Explain about signal reconstruction or recovery. | CO1 | R | 08 |
|  |  |  |  |  |  |
| 3. | a. | Explain about EEG and ERPs and interpret them for clinical significance. | CO2 | U | 10 |
|  | b. | Summarize the applications Artificial Intelligence in Biosignal Analysis. | CO6 | U | 06 |
|  |  |  |  |  |  |
| 4. | a. | Illustrate the difficulties encountered in biomedical signal acquisition and analysis with examples. | CO4 | An | 08 |
|  | b. | Describe about synchronous averaging. | CO4 | R | 08 |
|  |  |  |  |  |  |
| 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. | Explain about the waves and intervals in ECG and a method to detect the QRS complex | CO3 | U | 06 |
|  |  |  |  |  |  |
| 6. | a. | Design a Butterworth digital IIR low pass filter using bilinear transformation by taking T =0.1 second, to satisfy the following specifications. | CO3 | A | 10 |
|  | b. | Illustrate the cancellation of maternal ECG from Fetal ECG. | CO4 | An | 06 |
|  |  |  |  |  |  |
| 7. | a. | Write short notes on time domain filtering. Explain the significance of Moving average filtering. | CO3 | R | 08 |
|  | b. | Illustrate the estimation of ST segment inclination. | CO5 | An | 08 |
| **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 |  | 18 |  |  |  |  | 18 |
| CO3 | 08 | 06 | 10 |  |  |  | 24 |
| CO4 | 08 |  |  | 14 |  |  | 22 |
| CO5 |  |  | 20 | 08 |  |  | 28 |
| CO6 |  | 16 |  |  |  |  | 16 |
|  | | | | | | | **132** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Illustrate the sensors used for motion measurement. | CO1 | U | 12 |
|  | b. | List the various electrical measurement parameters used in sensor technology. | CO1 | R | 4 |
| 2. | a. | Explain the principle of MEMS Gyroscope with neat sketches. | CO2 | An | 12 |
|  | b. | Describe any two dielectrics materials used in MEMS application. | CO2 | R | 4 |
| 3. | a. | Analyze the various properties and application of any four materials used in micro fabrication. | CO3 | An | 14 |
|  | b. | Compare sensors and microsensors. | CO3 | E | 2 |
| 4. | a. | Define surface micromachining and explain the process steps involved in micromachining. | CO4 | A | 14 |
|  | b. | List down the different classes of cleanroom. | CO4 | R | 2 |
| 5. | a. | Discuss the various steps involved in micro motor design based on LIGA process. | CO5 | U | 12 |
|  | b. | Write the various applications of micro needle. | CO5 | A | 4 |
| 6. | a. | Explain the various design parameters used in MATLAB Simulink for pressure sensor. | CO6 | C | 16 |
| 7. | a. | Elaborate the direct pressure measurement sensors with neat diagrams. | CO1 | A | 12 |
|  | b. | Sketch the physiological pressure ranges and measurement sites in detail. | CO1 | A | 4 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Write the various machine learning approaches used in the material characterization of MEMS devices. | CO2 | A | 10 |
|  | b. | Sketch the various steps involved in the X-ray Lithography process and explain in detail. | CO4 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 12 | 16 | - | - | - | 32 |
| CO2 | 4 | - | 10 | 12 | - | - | 26 |
| CO3 | - | - | - | 14 | 2 | - | 16 |
| CO4 | 2 | - | 24 | - | - | - | 26 |
| CO5 | - | 12 | 4 | - | - | - | 16 |
| CO6 | - | - | - | - | - | 16 | 16 |
|  | | | | | | | **132** |



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| **Course Code** | **21BM3013** | **Duration** | **3hrs** |
| **Course Name** | **COGNITIVE TECHNOLOGY FOR BIOMEDICAL**  **ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Demonstrate Multiple Adaptive Linear Neuron. | CO1 | U | 10 |
|  | b. | Explain any two Supervised Learning Networks briefly. | CO1 | U | 10 |
|  |  | (OR) |  |  |  |
| 2. | a. | Explain about Back Propagation Multilayer Neural Network with its learning rule. | CO2 | U | 10 |
|  | b. | Discuss Kohonen-Self Organizing Network with various assumed weights briefly. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. |  | Below figure shows the schematic view of an ANFIS used to model a process having two inputs: I1, I2 and one output O. The network consists of six layers. Two linguistic terms, such as LW (Low), H (High) have been utilized to represent first input I1. Similarly, the second input I2 has been expressed using two other linguistic terms, namely SM (small) and LR (Large). | CO3 | A | 10 |
|  | b. | Define defuzzification and illustrate an example using 3 fuzzy sets. | CO3 | R | 10 |
|  |  | (OR) |  |  |  |
| 4. | a. (i) | Discuss about Genetic Algorithm and search space in brief. | CO4 | U | 5 |
| a.(ii) | Simplify Tree Encoding technique used in Genetic Algorithm. | CO4 | A | 5 |
|  | b. | Elaborate Bit-wise Operators in Genetic Algorithm. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate a case study on biomedical applications using hybrid soft computing techniques. | CO5 | U | 10 |
|  | b. | Construct a structure of Simplified Fuzzy ARTMAP based Pattern Recognizer. | CO5 | A | 10 |
|  |  | (OR) |  |  |  |
| 6. | a. | Interpret ART2 Architecture and its Algorithm. | CO2 | U | 10 |
|  | b. | Experiment e-Binary Associative Memory with an example. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain hybrid soft computing systems. | CO5 | U | 10 |
|  | b. | Discuss Simplified Fuzzy ARTMAP and its working. | CO5 | U | 10 |
|  |  | (OR) |  |  |  |
| 8. | a. | Demonstrate MADLINE architecture. | CO1 | U | 10 |
|  | b. | Give an outline on Multi-level Optimization in Genetic Algorithm. | CO4 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 9. | a. | Evaluate an optimization of travelling salesman problem using genetic algorithm approach. | CO6 | E | 10 |
|  | b. | Discuss a case study on biomedical applications under cognitive technology computing techniques. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Identify various soft computing frame works |
| CO2 | Interpret various neural networks and fuzzy logic methods |
| CO3 | Relate genetic programming and hybrid soft computing |
| CO4 | Select computing techniques for biomedical applications |
| CO5 | Assess hybrid techniques |
| CO6 | Design diagnostic and therapeutic methods |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 30 |  |  |  |  | 30 |
| CO2 |  | 20 | 10 | 10 |  |  | 40 |
| CO3 | 10 |  | 10 |  |  |  | 20 |
| CO4 |  | 25 | 5 |  |  |  | 30 |
| CO5 |  | 30 | 10 |  |  |  | 40 |
| CO6 |  |  | 10 |  | 10 |  | 20 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **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 | R | 14 |
|  | b. | List the various steps involved in KNN algorithm. | CO1 | R | 6 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss the following:   1. Linear Regression 2. Logistic Regression | CO1 | U | 20 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the functions of SVM algorithm and their role in biomedical application with an example. | CO3 | A | 14 |
|  | b. | Write the significance of matrix factorization and matrix completion. | CO2 | A | 6 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain in detail about different types of ensemble learning algorithm with neat diagram. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 5. | a. | Enumerate the various steps involved in principal component analysis method. | CO3 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Illustrate the working of random forest algorithm for disease classification with an example. | CO3 | A | 10 |
|  | b. | Explain the functional blocks involved in deep learning architecture with neat diagram. | CO5 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Describe the role of time series analysis in machine learning techniques with an example. | CO4 | R | 12 |
|  | b. | Write the significance of Bayesian learning method. | CO4 | A | 8 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Analyze the steps involved in decision tree algorithm for predicting the class of the given dataset. | CO5 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | IoMT based rehabilitation system could be best solution for monitoring health status of paralyzed patients. Justify your answer with an example. | CO6 | E | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 20 | 20 | - | - | - | - | 40 |
| CO2 | - | 20 | 6 | - | - | - | 26 |
| CO3 | 20 | - | 24 | - | - | - | 44 |
| CO4 | 12 | - | 8 | - | - | - | 20 |
| CO5 | - | 10 | - | 20 | - | - | 30 |
| CO6 | - | - | - | - | 20 | - | 20 |
|  | | | | | | | **180** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Describe the working principle of Support Vector Machine algorithm with an example. | CO1 | R | 14 |
|  | b. | Classify the types of machine learning. | CO1 | U | 2 |
|  |  |  |  |  |  |
| 2. |  | Illustrate the various steps involved in K means clustering algorithm with an example. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 3. |  | Explain the working principle of various type of ensemble learning method with neat diagram. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 4. | a. | Identify the role and features of deep learning techniques. | CO2 | R | 8 |
|  | b. | Describe the operation of ANN with an example. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 5. | a. | Write the significance of Bayesian learning method. | CO5 | A | 8 |
|  | b. | Identify the difference between supervised and reinforcement learning methods. | CO5 | R | 4 |
|  | c. | List the advantages of distributed learning methods. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 6. | a. | Describe the steps involved in decision tree algorithm for predicting the class of the given dataset. | CO4 | U | 8 |
|  | b. | Summarize the features of linear regression principle. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 7 | a. | Describe the features of Gaussian mixture model and their role in machine learning. | CO1 | U | 10 |
|  | b. | List the steps involved in PCA algorithm. | CO1 | R | 6 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | Design an IoMT based physiological signal monitoring system to detect heart abnormalities with neat diagram and propose a method for classification of abnormalities. | CO6 | C | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 20 | 12 | 16 | - | - | - | 48 |
| CO2 | 12 | - | - | - | - | - | 12 |
| CO3 | - | 16 | - | - | - | - | 16 |
| CO4 | 8 | 16 | - | - | - | - | 24 |
| CO5 | 4 | - | 8 | - | - | - | 12 |
| CO6 | - | - | - | - | - | 20 | 20 |
|  | | | | | | | **132** |



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| **Course Code** | **21BM3018** | **Duration** | **3hrs** |
| **Course Name** | **TELEHEALTH TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Analyze the role of various data acquisition devices (e.g., wearable sensors, IoT devices) in telehealth data collection. | CO1 | An | 10 |
|  | b. | Discuss the role of user interface design in telehealth applications. | CO1 | U | 10 |
|  |  | (OR) |  |  |  |
| 2. | a. | Explain the concept of protocol hierarchies in telehealth for multimedia communication. | CO2 | U | 10 |
|  | b. | Explain the principles of audio and video compression and their impact on telehealth services. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Evaluate the use of email applications in telehealth for communication. | CO3 | E | 10 |
|  | b. | Discuss the challenges associated with email communication in telehealth. | CO3 | U | 10 |
|  |  | (OR) |  |  |  |
| 4. | a. | Analyze the deontological application of patient confidentiality in telehealth consultations. | CO4 | An | 10 |
|  | b. | Discuss the challenges of securing telehealth applications on mobile devices. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the strategic planning process required for the successful implementation of a telehealth program within a healthcare organization. | CO5 | An | 10 |
|  | b. | Discuss the economic and societal benefits of telehealth. | CO5 | U | 10 |
|  |  | (OR) |  |  |  |
| 6. | a. | Describe the role of telemedicine needs assessments in healthcare organizations. | CO3 | U | 10 |
|  | b. | Evaluate the significance of Quality of Service (QoS) in telehealth networks. | CO3 | E | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the importance of secure software development practices in telehealth applications. | CO4 | U | 10 |
|  | b. | Discuss the ethical considerations in telehealth data security. | CO4 | U | 10 |
|  |  | (OR) |  |  |  |
| 8. | a. | Assess the impact of tele-home care in enabling elderly and chronic patients to receive healthcare services at home. | CO6 | E | 10 |
|  | b. | Evaluate the effectiveness of telepsychiatry in improving mental health access and reducing disparities in mental healthcare delivery. | CO6 | E | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 9. | a. | Evaluate the role of telephonic medicine in providing healthcare services through voice communication and remote consultation. | CO6 | E | 10 |
|  | b. | Analyze the integration of IoT (Internet of Things) devices in healthcare for remote patient monitoring and real-time data collection. | CO6 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Justify the need of telemedicine |
| CO2 | Comprehend the various types of information |
| CO3 | Realize the various data acquisition and storage system |
| CO4 | Describe the issues in data handling and strategic Planning |
| CO5 | Describe the role of Internet in telemedicine |
| CO6 | Apply telemedicine in different fields like cardiology, oncology, pathology etc. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 10 |  | 10 |  |  | 20 |
| CO2 |  | 20 |  |  |  |  | 20 |
| CO3 |  | 20 |  |  | 20 |  | 40 |
| CO4 |  | 30 |  | 10 |  |  | 40 |
| CO5 |  | 10 |  | 10 |  |  | 20 |
| CO6 |  |  |  | 20 | 20 |  | 40 |
|  | | | | | | | **180** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Discuss any one data analytics method in medical data processing. | CO1 | U | 10 |
|  | b. | Categorize the Internet concept capability and limitations. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the six IoT levels. | CO2 | U | 10 |
|  | b. | Distinguish IoT and M2M. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the types of sensors and actuators. | CO3 | U | 10 |
|  | b. | Design and illustrate an embedded system based physiological monitoring system. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Summarize ethical framework and guideline in digital health. | CO4 | U | 10 |
|  | b. | Distinguish the principles of Biomedical Ethics. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. (i) | Classify the IoT based Healthcare Ecosystem. | CO5 | U | 5 |
|  | a.(ii) | Predict and evaluate the future challenges in healthcare ecosystem using IoT. | CO5 | E | 5 |
|  | b. | Analyze any of the AI applications in the field of healthcare. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Propose a model of implementing IOT with any microcontroller. | CO3 | C | 10 |
|  | b. | Assess the Significance of digital health in detail. | CO3 | E | 10 |
|  |  |  |  |  |  |
| 7. | a. | Simplify the IoT design methodology specification integrations. | CO2 | An | 10 |
|  | b. | Explain IoT system management. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Formulate DES Symmetric key algorithm. | CO1 | U | 10 |
|  | b. | Explain briefly about social network analysis in healthcare embedded system for senior resident using IoT. | CO6 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 9. | a. | Discuss the health benefits that can be derived from the combination of social network analysis and IoT in senior healthcare. | CO6 | U | 10 |
|  | b. | Explain the strategies that can be employed to address potential usability challenges in healthcare for senior residents. | CO6 | R | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Acquire the knowledge &amp; 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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 20 |  | 10 |  |  | 30 |
| CO2 |  | 20 |  | 20 |  |  | 40 |
| CO3 |  | 20 |  |  | 10 | 10 | 40 |
| CO4 |  | 10 |  | 10 |  |  | 20 |
| CO5 |  | 6 |  | 10 | 4 |  | 20 |
| CO6 | 10 | 20 |  |  |  |  | 30 |
|  | | | | | | | **180** |



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| **Course Code** | **21BM3024** | **Duration** | **3hrs** |
| **Course Name** | **NANOTECHNOLOGY IN MEDICINE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the role of synthesis, characterization and properties of nanomaterials in healthcare applications with an example. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain in detail about the biofunctionalization of nanomaterials. | CO2 | U | 16 |
|  | b. | List the medical applications of nano materials. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 3. | a. | Identify the importance of protein-based nanostructures in healthcare applications. | CO3 | R | 14 |
|  | b. | Write the significance of nano bioelectronic devices. | CO3 | A | 6 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | List the properties of DNA Oligomers. | CO3 | R | 5 |
|  | b. | Indicate the use of DNA molecules in nano mechanics. | CO3 | U | 5 |
|  | c. | Summarize the properties and applications of gold nanoparticles. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the role of nanoparticles in diagnostics of cardiovascular diseases with an example. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Illustrate the various ethical issues and toxicology of nano materials. | CO5 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Compare the properties of PET and micro-PET. | CO4 | U | 8 |
|  | b. | Enumerate the importance of nano materials for optical imaging with an example. | CO4 | R | 12 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Analyze the use of deep learning approaches in healthcare applications with an example. | CO6 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Design a nano material based medical device for detecting skin cancer. Support your hardware design with a block diagram and software development with a flow diagram. | CO6 | C | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Define the newest findings in the area of nanomedicine. |
| CO2 | Classify the materials for nano therapeutics. |
| CO3 | Show the advanced methods of nano synthesis. |
| CO4 | Explain the characteristics of nanoparticles in diagnosis. |
| CO5 | Choose nanotechnology in appropriate medical applications. |
| CO6 | Implement the perspectives in own research. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 20 | - | - | - | - | - | 20 |
| CO2 | 4 | 16 | - | - | - | - | 20 |
| CO3 | 19 | 15 | 6 | - | - | - | 40 |
| CO4 | 12 | 8 | - | - | - | - | 20 |
| CO5 | - | 20 | - | 20 | - | - | 40 |
| CO6 | - | -- | - | 20 | - | 20 | 40 |
|  | | | | | | | **180** |



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| **Course Code** | **21BM3025** | **Duration** | **3hrs** |
| **Course Name** | **BIOMEDICAL ENGINERING ENTREPRENEURSHIP** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the scope of biomedical entrepreneurship. | CO1 | U | 10 |
|  | b. | Identify the impact of innovation in medical devices. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the applications of artificial intelligence in medical diagnosis. | CO2 | U | 10 |
|  | b. | List few applications of biomedical implants. | CO2 | R | 10 |
|  |  |  |  |  |  |
| 3. | a. | Determine the process in developing as an entrepreneur. | CO3 | E | 10 |
|  | b. | Compile the market survey for a wearable health device. | CO3 | C | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Design the customer feedback survey on a medical device. | CO4 | C | 10 |
|  | b. | Infer the classifications of medical device based on risk. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Summarize the investigational device exemptions for medical devices. | CO5 | U | 10 |
|  | b. | Compose the detailed market research with statistical evidences. | CO3 | C | 10 |
|  |  |  |  |  |  |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Build the business model for the new medical device. | CO3 | C | 10 |
|  | b. | Categorize the international regulations on medical devices. | CO5 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the role of quality council of India in medical regulation. | CO6 | A | 10 |
|  | b. | Analyze the ISO regulations for the medical device. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Choose the funding agencies for supporting entrepreneurs. | CO4 | A | 10 |
|  | b. | Evaluate the ethical clearance for medical devices. | CO4 | E | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Elaborate the importance of intellectual property for medical devices. | CO6 | C | 10 |
|  | b. | Formulate the environmental concerns for disposal of medical devices. | CO6 | C | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the role of biomedical engineers in entrepreneurship |
| CO2 | Interpret the background for biomedical engineers in entrepreneurship |
| CO3 | Acquire the skills and techniques required towards innovation |
| CO4 | Categorize the resources and funding agencies |
| CO5 | Judge the right product based on market needs |
| CO6 | Compile and quantify the opportunities and challenges |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 10 | 10 |  |  |  | 20 |
| CO2 | 10 | 10 |  |  |  |  | 20 |
| CO3 |  |  |  |  | 10 | 30 | 40 |
| CO4 |  | 10 | 10 |  | 10 | 10 | 40 |
| CO5 |  | 10 |  | 20 |  |  | 30 |
| CO6 |  |  | 10 |  |  | 20 | 30 |
|  | | | | | | | **180** |



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| --- | --- | --- | --- |
| **Course Code** | **21BM3025** | **Duration** | **3hrs** |
| **Course Name** | **BIOMEDICAL ENGINEERING ENTREPRENEURSHIP** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Outline the progression of entrepreneurship. | CO1 | U | 12 |
|  | b. | List out the supporting organizations for promoting entrepreneurship. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 2. | a. | Explain the working principle of devices that can adopt internet of things technology in medical devices. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 3. | a. | Identify various regulations pertaining to medical devices. | CO3 | A | 8 |
|  | b. | Organize the safety parameters for operating a medical sphygmomanometer. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | Identify the process of market survey schemes. | CO4 | A | 12 |
|  | b. | List the challenges in resourcing fund for startups. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 5. | a. | Examine the best practices governing product development. | CO5 | An | 12 |
|  | b. | Categorize the merits and demerits of angels for entrepreneurship. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 6. | a. | Criticize various medical products and manufacturing companies dominant in medical field. | CO5 | E | 16 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the applications of machine learning in medical devices. | CO6 | C | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Elaborate the management of waste and health hazards due to medical devices. | CO6 | C | 10 |
|  | b. | Formulate the environmental apprehensions on medical devices. | CO6 | C | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the role of biomedical engineers in entrepreneurship |
| CO2 | Interpret the background for biomedical engineers in entrepreneurship |
| CO3 | Acquire the skills and techniques required towards innovation |
| CO4 | Categorize the resources and funding agencies |
| CO5 | Judge the right product based on market needs |
| CO6 | Compile and quantify the opportunities and challenges |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 12 |  |  |  |  | 16 |
| CO2 |  | 16 | 8 |  |  |  | 24 |
| CO3 |  |  | 8 |  |  |  | 8 |
| CO4 |  |  | 12 | 8 |  |  | 20 |
| CO5 |  |  |  | 12 | 16 |  | 28 |
| CO6 |  |  |  |  |  | 36 | 36 |
|  | | | | | | | **132** |



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| **Course Code** | **21BM3028** | **Duration** | **3hrs** |
| **Course Name** | **ARTIFICIAL INTELLIGENCE IN HEALTHCARE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Sketch the schematic representation of an AI based biomedical system model and highlight its features. | CO1 | A | 10 |
|  | b. | Write the significance of system approach to artificial intelligence in healthcare network. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Identify the role of search space in AI algorithm. | CO2 | R | 4 |
|  | b. | Enumerate the various state space representations in search strategy. | CO2 | R | 16 |
|  |  |  |  |  |  |
| 3. | a. | Analyze the need for developing a rule-based systems in healthcare applications with an example. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe the functional steps involved in support vector machine algorithm for real time disease classification. | CO3 | R | 20 |
|  |  |  |  |  |  |
| 5. | a. | Write the significance of first order predicate logic. | CO3 | A | 10 |
|  | b. | Describe the features of ontology in AI based system. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Illustrate the working principle of decision tree algorithm with an example. | CO5 | A | 20 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the role of agent communication and their semantics for transfer of information. | CO4 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Summarize the features of various types of an agent architecture with necessary diagram. | CO4 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Design an AI based robot control system for surgical application. Support your hardware design with a block diagram and software development with a flow diagram. | CO6 | C | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the basics of Artificial Intelligence. |
| CO2 | Summarize the appropriate search algorithms for medical problem. |
| CO3 | Represent a problem using behavioral logics. |
| CO4 | Apply AI problem solving techniques. |
| CO5 | Develop simple intelligent system for medical diagnosis. |
| CO6 | Application development for healthcare problems in society. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 20 | - | - | - | 20 |
| CO2 | 20 | - | - | - | - | - | 20 |
| CO3 | 30 | - | 10 | 20 | - | - | 60 |
| CO4 | - | 40 | - | - | - | - | 40 |
| CO5 | - | - | 20 | - | - | - | 20 |
| CO6 | - | - | - | - |  | 20 | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **22BM2002** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL ETHICS AND STANDARDS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define ethics. | | CO1 | R | 1 |
| 2. | Name the physician who crafted the first modern code of medical ethics. | | CO1 | R | 1 |
| 3. | Indicate the use of genetic test. | | CO2 | U | 1 |
| 4. | Identify the ethical principles in healthcare. | | CO2 | R | 1 |
| 5. | Identify an ANSI standard used for exchanging healthcare data between computer systems. | | CO3 | R | 1 |
| 6. | Memorize the goal of the Health Insurance Portability and Accountability Act (HIPAA). | | CO3 | R | 1 |
| 7. | Name any two major aspects of healthcare delivery by NABH standards. | | CO4 | R | 1 |
| 8. | Give examples of JCAHO Standards. | | CO4 | U | 1 |
| 9. | List any two fire alarm system that provides notification to fire department. | | CO5 | R | 1 |
| 10. | Give examples of class I medical devices. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate medical ethics and bioethics. | | CO1 | U | 3 |
| 12. | Define presymptomatic testing. | | CO2 | U | 3 |
| 13. | Generalize the procedure in developing the medical standards. | | CO3 | U | 3 |
| 14. | Sketch the structure of Quality Council of India for accreditation. | | CO4 | A | 3 |
| 15. | Write down the significance of patient-centered model. | | CO5 | A | 3 |
| 16. | Identify the stages in the lifecycle of medical device. | | 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. | Identify the exemplified virtues by the physician according to CMA code of medical ethics. | CO1 | U | 5 |
|  | b. | Discuss the term professional independence in medical ethics. | CO1 | U | 7 |
|  |  |  |  |  |  |
| 18. | a. | Summarize the features of various ethical theories used in medical ethics. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Enumerate the techniques involved in Digital Imaging and Communications in Medicine (DICOM). | CO3 | R | 9 |
|  | b. | Identify the challenges in HIPAA medical standard. | CO3 | U | 3 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the role of JCI Accreditation and highlight its policies. | CO4 | An | 8 |
|  | b. | Write down the significance of accreditation in healthcare. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the safety measures for protecting the hospital environment from fire, smoke, and heat with one case study. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain in detail about the functional responsibilities of a doctor towards their patients. | CO1 | U | 9 |
|  | b. | List down the need for medical ethics. | CO1 | R | 3 |
|  |  |  |  |  |  |
| 23. | a. | Examine the confidentiality issues in medical practice. | CO2 | A | 8 |
|  | b. | Write down the significance of autonomy principle in medical ethics. | CO2 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the role of IEC 60601 standards in medical electrical equipment. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the scope of medical ethics |
| CO2 | Illustrate the concepts of ethical theories and moral principles for the healthcare providers |
| CO3 | Paraphrase 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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 24 | - | - | - | - | 29 |
| CO2 | 1 | 16 | 12 | - | - | - | 29 |
| CO3 | 11 | 6 | - | - | - | - | 17 |
| CO4 | 1 | 1 | 7 | 8 | - | - | 17 |
| CO5 | 1 | - | 3 | 12 | - | - | 16 |
| CO6 | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **22BM2008** | **Duration** | **3hrs** |
| **Course Name** | **INTRODUCTION TO BIOMEDICAL ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define the term ‘Noise’. | | CO1 | U | 1 |
| 2. | Label the signal obtained by injecting sinusoidal current in the tissue and measuring the voltage drop generated by the tissue impedance. | | CO2 | R | 1 |
| 3. | Why the Tungsten is used in Xray tubes? | | CO3 | An | 1 |
| 4. | Explain the Einthoven Triangle. | | CO4 | U | 1 |
| 5. | Define Institutional Review Board. | | CO5 | U | 1 |
| 6. | Define Morality. | | CO6 | R | 1 |
| 7. | Name the problem solver in the field of Biomedical Engineers. | | CO1 | R | 1 |
| 8. | List the most powerful tool of research scientists. | | CO1 | R | 1 |
| 9. | Define the term transducer. | | CO2 | U | 1 |
| 10. | Identify an energy source in basic medical instrumentation system. | | CO2 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Compare Biomechanical & Bio acoustic signals. | | CO1 | U | 3 |
| 12. | Define the term ‘measurand’. | | CO2 | U | 3 |
| 13. | Demonstrate the technology that excites and detects the change in the direction of the rotational axis of protons found in the water that makes up living tissues. | | CO3 | An | 3 |
| 14. | Analyze the terms repolarization & depolarization. | | CO4 | An | 3 |
| 15. | Express the need of regulations & Standards in health care sector. | | CO5 | U | 3 |
| 16. | Describe the term ‘Ethics’. | | 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. | Describe Biomedical instrumentation systems. | CO1 | U | 7 |
|  | b. | Explain the role of Biomedical engineers in various domains. | CO1 | U | 5 |
|  |  |  |  |  |  |
| 18. | a. | Determine the different general constraints in the design of medical instrumentation systems. | CO2 | 7 | R |
|  | b. | Explain the performance requirements for the medical devices. | CO2 | 5 | U |
|  |  |  |  |  |  |
| 19. | a. | Discuss in detail Magnetic Resonance Imaging. | CO3 | 6 | U |
|  | b. | Describe the working of Positron Emission Tomography. | CO3 | 6 | R |
|  |  |  |  |  |  |
| 20. | a. | Generalize the different types of Cardiac Pacemakers. | CO4 | 6 | U |
|  | b. | Explain ‘Dialysers. | CO4 | 6 | U |
|  |  |  |  |  |  |
| 21. | a. | Explain the different types of standards used in medical devices. | CO5 | 6 | U |
|  | b. | List some of the good laboratory practices in medical research labs. | CO5 | 6 | R |
|  |  |  |  |  |  |
| 22. | a. | Describe Nuclear medical imaging. | CO3 | 7 | U |
|  | b. | Explain the thermal imaging systems. | CO3 | 5 | U |
|  |  |  |  |  |  |
| 23. | a. | Summarize the different types of cardiac pacemakers. | CO4 | 7 | U |
|  | b. | Discuss the types of ventilators. | CO4 | 5 | U |
| **COMPULSORY QUESTION** | | | | | |  | **COMPULSORY QUESTION** |
| 24. | a. | Recognize the code of Ethics for biomedical engineers. | CO6 | U | 7 |
|  | b. | Discuss the ethical issues in the treatment process. | CO6 | U | 5 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Interpret the role of biomedical engineering in society |
| CO2 | Demonstrate the principles of various diagnostic devices. |
| CO3 | Identify the various techniques used in diagnosis though imaging. |
| CO4 | Describe the working principles of various therapeutic and assist devices. |
| CO5 | Understand device specific safety goals and standards. |
| CO6 | Illustrate the concepts of ethical theories and moral principles for the health professions |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 16 | - | - | - | - | 18 |
| CO2 | 9 | 9 |  |  |  |  | 18 |
| CO3 | 6 | 18 |  | 4 |  |  | 28 |
| CO4 |  | 25 |  | 3 |  |  | 28 |
| CO5 | 6 | 10 |  |  |  |  | 16 |
| CO6 | 1 | 15 |  |  |  |  | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **22BM2013** | **Duration** | **3hrs** |
| **Course Name** | **ELECTRON DEVICES AND CIRCUITS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define drift current. | | CO1 | U | 1 |
| 2. | Name the diode that is constructed by the combination of metal-to-N junction. | | CO1 | U | 1 |
| 3. | Calculate the peak voltage of a center tapped FWR circuit if its RMS value is 5V. | | CO4 | AN | 1 |
| 4. | Draw the symbol of Tunnel diode. | | CO2 | R | 1 |
| 5. | DIAC behaves as unidirectional Switch True/False. | | CO4 | R | 1 |
| 6. | Name the diode that is widely used for high frequency switching applications. | | CO3 | R | 1 |
| 7. | What is the efficiency of half wave rectifier? | | CO4 | R | 1 |
| 8. | Name the type of power amplifier that can amplify both positive and negative half cycles of the input signal. | | CO3 | U | 1 |
| 9. | List the diodes that exhibit negative resistance effect. | | CO5 | R | 1 |
| 10. | Mention the function of bypass resistor in a RC amplifier. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | If the drift velocity of holes under a field gradient of 400v/m is 20m/sec. Find its mobility. | | CO1 | A | 3 |
| 12. | Mention the significance of calculating efficiency in rectifiers. | | CO2 | A | 3 |
| 13. | Draw the output characteristics graph of CB configuration of a BJT and Justify the statement that BJT is a current control device. | | CO3 | U | 3 |
| 14. | Draw the schematic of a transistor series voltage regulator. | | CO4 | U | 3 |
| 15. | Consider a 2-stage RC oscillator which has of equal resistors. Assume the capacitance value as 0.1pF capacitors. As the frequency of oscillation is given as 4kHz, calculate the value of the resistors. | | CO6 | A | 3 |
| 16. | List the ideal characteristics of an Oscillator. | | 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. | Elaborate on the different methods of electron hole generation and recombination | CO1 | R | 6 |
|  | b. | Compare the features of the different types of semiconductor materials used widely. | CO1 | R | 6 |
| 18. | a. | With neat diagram explain the construction and working of Silicon controlled rectifier. | CO1 | U | 8 |
|  | b. | A bipolar NPN transistor has a DC current gain value , β = 99. Calculate the base current Ib required to switch a resistive load of 10mA. Also calculate current gain α | CO1 | AN | 4 |
| 19. | a. | Describe in detail about the principle and working of a Light Emitting Diode (LED). | CO5 | U | 6 |
|  | b. | Draw the block diagram of a regulated power supply rationalize the need of voltage regulators in it. | CO6 | U | 6 |
| 20. | a. | Derive the efficiency and ripple factor of a full wave rectifier circuit | CO2 | AN | 6 |
|  | b. | Justify the need of filters in rectifiers and discuss about the types of filters used. | CO4 | U | 6 |
| 21. | a. | With neat diagram explain the different types of biasing circuits used in transistors. | CO2 | U | 8 |
|  | b. | A full-wave rectifier uses two diodes, the internal resistance of each diode may be assumed constant at 10 Ω. The transformer r.m.s. secondary voltage from center tap to each end of secondary is 50 V and load resistance is 980 Ω. Find : (i) the mean load current (ii) the r.m.s. value of load current. | CO5 | A | 4 |
| 22. | a. | Compare the VI characteristics of a transistor in CB and CE configuration and derive their input output parameters. | CO5 | U | 6 |
|  | b. | Discuss how a transistor is used as a series voltage regulator. | CO3 | U | 6 |
| 23. | a. | Elaborate on Class A and Class B type of power amplifier and compare its performance with Class AB amplifier. | CO3 | U | 8 |
|  | b. | Comment on the need of differential amplifiers. | CO4 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the construction and working of a RC phase shift Oscillator and derive the expression fo calculating the frequency of oscillation. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Paraphrase the basic properties of solid state devices like diode, transistor and FET. |
| CO2 | Identify and differentiate rectifiers, amplifiers and oscillators. |
| CO3 | Analyze the amplitude and frequency response of general amplifier circuits. |
| CO4 | Sketch the types of power amplifiers and their transfer characteristics. |
| CO5 | Classify the power amplifiers to meet certain specifications. |
| CO6 | Distinguish between amplifiers and oscillators. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 8 | - | 4 | - | - | 22 |
| CO2 | 1 | 17 | 3 | 3 | - | - | 24 |
| CO3 | 4 | 10 | 8 | - | - | - | 22 |
| CO4 | 2 | 13 | - | 4 | - | - | 19 |
| CO5 | 1 | 12 | 4 | - | - | - | 17 |
| CO6 | 4 | 16 | - | - | - | - | 20 |
|  | | | | | | | **124** |



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| **Course Code** | **22BM2016** | **Duration** | **3hrs** |
| **Course Name** | **ELECTRICAL CIRCUIT ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Ohm’s law. | | CO1 | R | 1 |
| 2. | Examine the current (I) in the given circuit. | | CO1 | A | 1 |
| 3. | State reciprocity theorem. | | CO2 | R | 1 |
| 4. | Indicate the outcome of Millman’s Theorem. | | CO2 | U | 1 |
| 5. | Calculate the bandwidth of a series RLC circuit with R=10Ω, L=10mH, C=100μF and supply voltage of 100V. | | CO3 | A | 1 |
| 6. | List the initial conditions of RLC series circuit. | | CO3 | R | 1 |
| 7. | Show the relation between frequency (f) and angular frequency (ω). | | CO4 | U | 1 |
| 8. | Calculate the negative phase angle in the given phasor diagram. | | CO4 | A | 1 |
| 9. | Examine the Laplace transform of an impulse signal. | | CO5 | R | 1 |
| 10. | Write the expression for the impedance parameter. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Sketch the duality circuit for the given network. | | CO1 | A | 3 |
| 12. | List the various steps involved in the process of Nortons theorem. | | CO2 | R | 3 |
| 13. | Discuss the overdamped condition of RLC parallel circuit. | | CO3 | U | 3 |
| 14. | Write the average value of sinusoidal wave. | | CO4 | A | 3 |
| 15. | Examine the initial value of the Laplace transform function, V(s)= | | CO5 | A | 3 |
| 16. | Determine the z parameters for the given circuit shown in below. | | CO6 | 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. | a. | Calculate the current and voltage across each resistance in the given circuit. | CO1 | A | 7 |
|  | b. | Determine the equivalent resistance in the given circuit. | CO1 | A | 5 |
|  |  |  |  |  |  |
| 18. | a. | Sketch the Thevenin’s equivalent circuit for the given network and find the Thevenin’s voltage which can be obtained across the terminals ‘a’ and ‘b’. Also, calculate the current through RL=5Ω and RL= 8Ω. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Analyse the transient response of RC series circuit with necessary diagram. | CO3 | An | 10 |
|  | b. | Differentiate between natural response and forced response. | CO3 | U | 2 |
|  |  |  |  |  |  |
| 20. | a. | Estimate the corresponding current and power of a given circuit. | CO4 | U | 4 |
|  | b. | Calculate the following parameters of the given circuit.   1. Circuit impedance 2. Overall current 3. Voltage across the resistor 4. Apparent power 5. Active power 6. Reactive power 7. Power factor | CO4 | A | 8 |
|  |  |  |  |  |  |
| 21. | a. | Determine the frequency response of given RC series circuit with R=5 Ω and C=0.5 F. | CO5 | A | 9 |
|  | b. | Estimate the initial and final values of time domain function which is expressed by, i(t)=2(1-e-5t). | CO5 | U | 3 |
|  |  |  |  |  |  |
| 22. | a. | Explain the conversion of star network into delta network with neat diagram. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Determine the frequency response of RLC parallel circuit with necessary diagram. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Calculate the y parameter of given two-port network. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Comprehend and design AC/DC circuits |
| CO2 | Develop and understand AC/DC circuits |
| CO3 | Evaluate AC/DC circuits |
| CO4 | Analyse electrical circuits |
| CO5 | Apply circuit theorems in real time |
| CO6 | Apply network theorems to DC circuits |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | - | 16 | - | - | - | 17 |
| CO2 | 4 | 13 | 12 | - | - | - | 29 |
| CO3 | 1 | 5 | 13 | 10 | - | - | 29 |
| CO4 | - | 5 | 12 | - | - | - | 17 |
| CO5 | 1 | 3 | 12 | - | - | - | 16 |
| CO6 | - | - | 16 | - | - | - | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **22BM2019** | **Duration** | **3hrs** |
| **Course Name** | **HUMAN ANATOMY AND PHYSIOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Human cell is a tiny biological battery. Justify the statement. | | CO1 | An | 1 |
| 2. | Comment on bone marrow. | | CO2 | U | 1 |
| 3. | Define membrane potential of a cell. | | CO1 | R | 1 |
| 4. | Differentiate pericardium and myocardium. | | CO4 | U | 1 |
| 5. | Comment on the role of alveoli. | | CO3 | U | 1 |
| 6. | Compare granular and agranular leucocytes. | | CO3 | U | 1 |
| 7. | Sketch ECG waveform and enlist the segments. | | CO4 | R | 1 |
| 8. | Enlist the ossicles of a human ear. | | CO5 | R | 1 |
| 9. | Enlist any two neurotransmitters. | | CO6 | R | 1 |
| 10. | Mention the three layers of eyeball. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Enlist the type of tissues and give example for each. | | CO1 | R | 3 |
| 12. | Brief the role of tendons and ligaments. | | CO2 | R | 3 |
| 13. | Differentiate aerobic and anaerobic respiration. | | CO3 | U | 3 |
| 14. | Illustrate the electrical activity of the human heart. | | CO4 | R | 3 |
| 15. | State the significance of semicircular canals in ear. | | CO5 | U | 3 |
| 16. | Mention the importance of medulla oblongata. | | 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. | Portray a clear layout of cell structure, its organelles and explain the functions of each organelle. | CO1 | R | 8 |
|  | b. | Describe the structure and functions of epithelial tissues. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Elaborate the types of joints associated with various body movements and mention the location of joints in the human body. | CO2 | U | 8 |
|  | b. | Enlist the principal bones of axial and appendicular skeleton. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 19. | a. | Enumerate the process of gas exchange through capillaries with relevant diagrams. | CO3 | U | 4 |
|  | b. | Describe the structure of lungs with a neat sketch. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 20. | a. | Portray the structure of human eye, outline its basic anatomical features. | CO5 | U | 8 |
|  | b. | Explain the process of image formation in human eye. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 21. | a. | Enumerate a cardiac cycle and the subsequent events in the cycle for a subject having 75 beats per minute with neat sketch. | CO4 | An | 8 |
|  | b. | Compare and contrast various blood groups. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 22. | a. | Sketch the structure of a nephron and describe the various blood vessels in henle’s loop. | CO5 | U | 8 |
|  | b. | Explain the process of urine formation. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 23. | a. | Write a note on rare blood groups. | CO4 | U | 4 |
|  | b. | Describe the physiology of heart with a neat sketch. | CO4 | U | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Sketch a neuron and describe the mechanism of action potential conduction by neuron. | CO6 | U | 8 |
|  | b. | Explain the concept of reflex mechanism. | CO6 | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 and understand their functions. |
| CO4 | Recognize the major organs and vessels of the cardiovascular system and understand their functions. |
| CO5 | Summarize 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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 12 | 4 |  | 1 |  |  | 17 |
| CO2 | 7 | 9 |  |  |  |  | 16 |
| CO3 |  | 17 |  |  |  |  | 17 |
| CO4 | 5 | 12 |  | 12 |  |  | 29 |
| CO5 | 2 | 27 |  |  |  |  | 29 |
| CO6 | 1 | 15 |  |  |  |  | 16 |
|  | | | | | | | **124** |



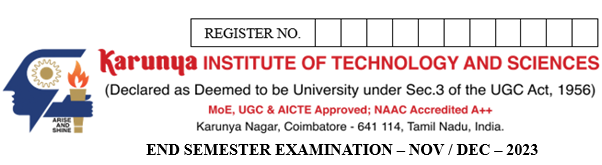
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| --- | --- | --- | --- |
| **Course Code** | **22BM2021** | **Duration** | **3hrs** |
| **Course Name** | **BIOMEDICAL SENSORS** | **Max. marks** | **100** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | | **Questions** | | **CO** | | **BL** | **Marks** | |
|  | | **PART-A(10X1=10 MARKS)** | | | | | | |
| 1. | | Calculate the capacitance of a capacitive transducer if the movable plate is kept at a distance of 2m from the fixed plate and the Area of the plate is 4m2. Consider the permitivity of air to be 8.85×10−12 F/m. | | CO2 | | A | 1 | |
| 2. | | Determine the sensitivity of thermocouple in mV/0C if the ouput changes by 2v for 0.5 0C raise in temperature. | | CO1 | | A | 1 | |
| 3. | | How does precision and accuracy help in determining the static characteristics of a system. | | CO4 | | U | 1 | |
| 4. | | Name the metals used for making electrodes. | | CO5 | | R | 1 | |
| 5. | | Mention the types of biosensors classified under biorecognition element. | | CO6 | | R | 1 | |
| 6. | | In a LVDT when the core is at the center, what is the effective emf.? | | CO1 | | R | 1 | |
| 7. | | In measurement systems, which of the following are undesirable static characteristics:   * Sensitivity and accuracy * Drift, static error, and dead zone * Reproducibility and non-linearity * Drift, static error, dead zone, and non-linearity99 | | CO4 | | A | 1 | |
| 8. | | List the synthetic or biological capture agents used in Affinity-based biosensors incorporate to specifically capture the biologically-relevant target. | | CO3 | | U | 1 | |
| 9. | | Name the sensor used in digital thermometer. | | CO5 | | R | 1 | |
| 10. | | Specify the resistance range of a dry skin. | | CO4 | | R | 1 | |
|  | **PART B (6 X 3= 18 MARKS)** | | | | | | | |
| 11. | Comprehend the principle of ultrasound sensors | | | | CO1 | U | | 3 |
| 12. | Define baro receptors. | | | | CO2 | R | | 3 |
| 13. | Write about capacitive sensor with neat sketch. | | | | CO5 | U | | 3 |
| 14. | Write the roles of rods and cones in image formation. | | | | CO6 | A | | 3 |
| 15. | Define Rise time. | | | | CO4 | U | | 3 |
| 16. | Differentiate between J type and K type thermocouple. | | | | CO3 | U | | 3 |
|  | **PART C (6 X 12= 60 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is a Compulsory Question)** | | | | | | | |
| 17. | a. | | Discuss the Static characteristics of a sensor. | | CO2 | R | | 8 |
|  | b. | | Sketch the block diagram of Medical Instrumentation system. | | CO1 | U | | 4 |
| 18. | a. | | Explain in detail about the osmo recetors of human Body. | | CO1 | U | | 8 |
|  | b. | | Differentiate Rods and Cones in photo receptors. | | CO4 | U | | 4 |
| 19. | a. | | Elaborate on the transduction type and biorecognition type bio sensor. | | CO1 | U | | 12 |
| 20. | a. | | Explain potentiometers and elaborate on using potentiometer for displacement measurement. | | CO3 | U | | 8 |
|  | b. | | Draw the schematic of piezo electric sensor. | | CO3 | U | | 4 |
| 21. | a. | | Explain the principle of fiber optics measurement system with a general block diagram and also discuss about any one source and detector used in fiber optic sensing. | | CO4 | U | | 12 |
| 22. | a. | | Describe on electrochemical type bio sensor used in detecting blood glucose. | | CO3 | A | | 8 |
|  | b. | | Brief on biomedical applications of piezo electric sensor. | | CO4 | A | | 4 |
| 23. | a. | | Discuss the measurement of temperature using thermocouple and justify the need of cold junction compensation circuit. | | CO5 | U | | 8 |
|  | b | | Draw the schematic of capacitive type of proximity ,measurement system. | | CO4 | R | | 4 |
|  |  | | **Compulsory:** | | | | | |
| 24. | a. | | List the types of Electrodes and elaborate on the types of surface electrodes. | | CO6 | A | | 8 |
|  | b | | Comment on the terminology ‘Electrode – Electrolyte’ interface and ‘Electrolyte – Skin Interface’. | | CO6 | A | | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Identify the need of a closed loop system with feedback and appreciate the use of sensors. |
| CO2 | Interpret the errors in measurement by analyzing the performance characteristics of the sensors. |
| CO3 | Develop advanced medical sensors based on the basic transduction principles. |
| CO4 | Demonstrate the advanced sensor approach based on light and sound |
| CO5 | Apply the suitable design criteria for developing a medical sensor for a particular application. |
| CO6 | Summarize the use of electrodes in measuring electrical potential in human body |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 26 | 1 |  |  |  | 28 |
| CO2 | 11 | 12 | 2 |  |  |  | 25 |
| CO3 | - | 16 | 8 |  |  |  | 24 |
| CO4 | 2 | 18 | 1 |  |  |  | 21 |
| CO5 | 2 | 11 | - |  |  |  | 13 |
| CO6 | 1 | - | 12 |  |  |  | 13 |
|  | | | | | | | **124** |



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| **Course Code** | **22BM2025** | **Duration** | **3hrs** |
| **Course Name** | **DIGITAL ELECTRONICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | The binary number 10101 is equivalent to a decimal number ………….. | | CO1 | R | 1 |
| 2. | Name the Universal gate. | | CO1 | R | 1 |
| 3. | Which of the gates has the exact inverse output of the OR gate for all possible input combinations? | | CO2 | R | 1 |
| 4. | If a 3-input NOR gate has eight input possibilities, how many of those possibilities will result in a HIGH output? | | CO2 | R | 1 |
| 5. | Which combinational circuit is renowned for selecting a single input from multiple inputs & directing the binary information to the output line? | | CO3 | R | 1 |
| 6. | Which generates a particular binary word or number in a combinational logic circuit? | | CO3 | R | 1 |
| 7. | What is the bit storage binary information capacity of any flipflop? | | CO4 | R | 1 |
| 8. | What is the required relationship between a number of flip flops and the timing signals in Johnson Counter? | | CO4 | R | 1 |
| 9. | What are the three output conditions of a three-state buffer? | | CO5 | R | 1 |
| 10. | In TTL logic, the input transistor has a number of \_\_\_\_\_\_\_\_ equal to the desired fan-in of the circuit. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | State the associative property of Boolean algebra. | | CO1 | R | 3 |
| 12. | List out the advantages and disadvantages of the Quine-Mc Cluskey method. | | CO2 | R | 3 |
| 13. | Convert a two-to-four line decoder with enabled input to 1 X 4 DE- multiplexer. | | CO3 | U | 3 |
| 14. | How many flip-flops are required to build a binary counter that counts from 0 to 1023? | | CO | R | 3 |
| 15. | Write the Steps or Design Procedure for Synchronous Counter. | | CO | R | 3 |
| 16. | Implement a 2-bit multiplier using ROM. | | CO | 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. | Simplify the Boolean expression using tabulation method. 𝐹=Σ(0,1,2,8,10,11,14,15) and verify the result using K-map method. | CO1 | A | 08 |
|  | b. | What are the types of numbering systems? | CO1 | R | 04 |
|  |  |  |  |  |  |
| 18. | a. | Explain 2,3 and 4 variable Karnaugh Map Minimization (K-Map) with an example. | CO2 | U | 10 |
|  | b. | What are the advantages of a tabular method than K- map method? | CO2 | R | 02 |
|  |  |  |  |  |  |
| 19. | a. | Implement the Boolean function Ʃm(0,2,3,6,8,10,11,12,13,14) using 8x1 multiplexer. | CO3 | U | 10 |
|  | b. | Give the logic expressions for sum and carry in Full adder circuit. | CO3 | R | 02 |
|  |  |  |  |  |  |
| 20. | a. | Using T Flip-flop design binary counter which counts in the sequence 000, 001, 010, 011, 100, 101, 110, 111, 000 | CO4 | A | 10 |
|  | b. | Draw the D-latch with the truth table. | CO4 | R | 02 |
|  |  |  |  |  |  |
| 21. | a. | Compare 4-bit SISO SIPO, PIPO, and PISO shift register. | CO5 | U | 10 |
|  | b. | Compare the Asynchronous and Modulus counter. | CO5 | U | 02 |
|  |  |  |  |  |  |
| 22. | a. | Implement the following two Boolean functions with a PLA:  F1(A, B, C) = ∑ (0, 1, 2, 4)  F2(A, B, C) = ∑(0, 5, 6, 7) | CO6 | U | 10 |
|  | b. | Write about the logic families. | CO6 | R | 02 |
|  |  |  |  |  |  |
| 23. | a. | Explain about DE multiplexer circuit. | CO2 | U | 10 |
|  | b. | Give the logic expressions for sum and carry in Full subtractor circuit. | CO2 | R | 02 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Simplify the function in SOP and POS using k-map Σ(0,2,4,5,8,14,15)+ d(7,10,13) | CO1 | A | 10 |
|  | b. | Simplify the Boolean function 𝑌 = 𝐴(𝐴 +𝐵’) | CO1 | A | 02 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Compute the Number of System Conversions |
| CO2 | Simplify the Boolean Expression Using Various Simplification Techniques |
| CO3 | Design various Combinational Circuits |
| CO4 | Simulate various Sequential Circuits |
| CO5 | Implement Combinational Circuits Using PLD |
| CO6 | Analyze Different Digital Logic Families |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 9 | - | 20 | - | - | - | 29 |
| CO2 | 9 | 20 | - | - | - | - | 29 |
| CO3 | 4 | 13 | - | - | - | - | 17 |
| CO4 | 7 | - | 10 | - | - | - | 17 |
| CO5 | 4 | 12 | - | - | - | - | 16 |
| CO6 | 3 | 13 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** | |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | | |
| 1. | Discuss the advantages of AC. | | CO1 | U | 1 | |
| 2. | Define the term form factor. | | CO1 | R | 1 | |
| 3. | Describe the major characteristics of capacitor. | | CO2 | R | 1 | |
| 4. | State the principles of kirchoff voltage law. | | CO2 | R | 1 | |
| 5. | Sketch the electronic symbol of two types of resistor. | | CO3 | A | 1 | |
| 6. | Analyze the significance of dependent sources. | | CO3 | An | 1 | |
| 7. | Define the term current. | | CO4 | R | 1 | |
| 8. | Ohm’s law was discovered by \_\_\_\_\_\_\_\_\_. | | CO5 | A | 1 | |
| 9. | List the causes of hunting in DC motor. | | CO5 | R | 1 | |
| 10. | Summarize the key features of field effect transistor. | | CO6 | U | 1 | |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | | |
| 11. | Tabulate the main difference between average voltage graphical method and average voltage analytical method. | | CO1 | R | 3 | |
| 12. | Examine the node analysis procedure. | | CO2 | R | 3 | |
| 13. | A 4V battery is placed in a series circuit with 2 ohm resistor. Calculate the total current that flows through the circuit. | | CO3 | An | 3 | |
| 14. | List the applications of DC parallel circuit. | | CO4 | R | 3 | |
| 15. | A 220V is connected in parallel with the load. It has a resistance of 50 ohms and 100 ohm. Find I1 and I2. | | CO5 | An | 3 | |
| 16. | Identify the applications of DC generator. | | 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. | Differentiate between RMS voltage graphical method and RMS voltage analytical method. | CO1 | U | | 6 | |
|  | b. | An inductor coil having a resistance of 20 ohm, and inductance of 60 mH is connected to 220V, 5 Hz supply. Calculate the current, real power, reactive power and apparent power. | CO1 | A | | 6 | |
|  |  |  |  |  | |  | |
| 18. | a. | Interpret the types of conductor. | CO1 | U | | 6 | |
|  | b. | Explain the kirchoff current law with example. | CO1 | U | | 6 | |
|  |  |  |  |  | |  | |
| 19. | a. | Analyze the mesh analysis procedure. | CO2 | An | | 6 | |
|  | b. | Examine the behavior of AC when passing through a pure resistance. | CO2 | R | | 6 | |
|  |  |  |  |  | |  | |
| 20. | a. | A voltage of 125 V at 50 Hz is applied across a non-inductive circuit. A resistance connected in series with a capacitance. The current is 2.2A. The power loss in resistance is 96.8 watts. Calculate R and C. | CO3 | A | | 6 | |
|  | b. | Explain the key components of DC parallel circuit. | CO3 | U | | 6 | |
|  |  |  |  |  | |  | |
| 21. | a. | Compare the key difference between independent and dependent sources. | CO4 | U | | 6 | |
|  | b. | Illustrate the working principles of DC generator. | CO4 | U | | 6 | |
|  |  |  |  |  | |  | |
| 22. | a. | Discriminate the biasing of BJT. | CO4 | E | | 6 | |
|  | b. | Explain the working of silicon controlled rectifier. | CO5 | U | | 6 | |
|  |  |  |  |  | |  | |
| 23. | a. | Discuss the operation of enhancement type MOSFET. | CO5 | U | | 6 | |
|  | b. | Illustrate the construction and working of Zener diode. | CO5 | An | | 6 | |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Enumerate the key features of digital thermometer. | CO6 | R | | 6 | |
|  | b. | Describe the components of stethoscope. | CO6 | R | | 6 | |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 19 | 6 | - | - | - | 29 |
| CO2 | 11 | - | - | 6 | - | - | 17 |
| CO3 | - | 6 | 7 | 4 | - | - | 17 |
| CO4 | 4 | 12 | - | - | 6 | - | 22 |
| CO5 | 1 | 12 | 1 | 9 | - | - | 23 |
| CO6 | 12 | 4 | - | - | - | - | 16 |
|  | | | | | | | **124** |



|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23BM3001** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL INSTRUMENTATION DESIGN** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Analyze the physiology of circulatory system. | CO1 | U | 8 |
|  | b. | Explain the functions of digestive system. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Compare the different types of electrodes. | CO2 | U | 8 |
|  | b. | Summarize the concept of action potential. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 3. | a. | Differentiate between direct and indirect measurement of blood pressure. | CO4 | U | 8 |
|  | b. | Summarize the functions of hardware modules involved in the design of heart lung machine. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Explain the concept of artificial mechanical ventilation. | CO5 | U | 8 |
|  | b. | A wheatstone bridge is excited by a 12V dc source and has the following resistances R1 = 1.2KΏ, R2 = 3 K Ώ ,R3 = 2.2 K Ώ and R4 = 5 K Ώ.Find the output voltage. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 5. | a. | Design the interfacing circuit for EEG measurement. | CO3 | A | 8 |
|  | b. | Explain the concept of Neurophysiology. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | Thin wire has a length of 30 mm and a cross sectional area of 0.01 mm2 and a resistance of 1.5Ώ. A force is applied to the wire that increases the length by 10 mm and decreases cross sectional area by 0.0027 mm2. Determine the change in resistance h.  Note: ρ = resistivity = 5 x 10-7 Ώm | CO5 | A | 8 |
|  | b. | Analyze the mechanism of breathing. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Classify the different methods of blood flow measurement. | CO4 | U | 8 |
|  | b. | Describe the method to monitor the bispectral index in EEG. | CO3 | U | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Explain the physiological effects of electricity on the human body. | CO6 | U | 10 |
|  | b. | Design the circuits related to the origin and increased leakage current with filters. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 neurological illness |
| CO4 | Categorize the medical devices based on cardiovascular applications |
| CO5 | Assess the various parameters, constraints in methodology for effective diagnosis of respiratory systems |
| CO6 | Design of biomedical equipment and ensure patient safety |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 |  |  |  |  | 16 |
| CO2 |  | 16 |  |  |  |  | 16 |
| CO3 |  | 16 | 8 |  |  |  | 24 |
| CO4 |  | 24 |  |  |  |  | 24 |
| CO5 |  | 16 | 16 |  |  |  | 32 |
| CO6 |  | 20 |  |  |  |  | 20 |
|  | | | | | | | **132** |