# MUTHAYAMMAL ENGINEERING COLLEGE

**(An Autonomous Institution)**

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.


## MUST KNOW CONCEPTS | MKC

**BIOTECH** | **2020-21**

**Course Code & Course Name : 19BTD08 & Instrumental Methods of Analysis**

**Year/Sem/Sec : II/IV**

| S.No. | Term | Notation (Symbol) | Concept / Definition / Meaning / Units / Equation / Expression | Units |
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| **Unit-I : INTRODUCTION** | | | | |
| 1. | Analytical Techniques | | It's a method used for determination of a chemical or physical property of a chemical substance or mixture. | |
| 2. | Radiation | | It is the emission or transmission of energy in the form of waves or particles through space. | |
| 3. | Electromagnetic radiation | | Waves of electromagnetic field radiating through space | |
| 4. | Crest | | Highest point in a wave | |
| 5. | Trough | | Lowest point in a wave | |
| 6. | Wave Frequency | Nu | Number of waves that pass a fixed point in a given amount of time. | Hz |
| 7. | Amplitude | A | The maximum distance moved by a point on a wave measured from it's position | m |
| 8. | Reflection | | Change in direction of wavefront at an interface between two different media | |
| 9. | Spectrum | | A set of colors into which a beam of light can be separated | |
| 10. | Electromagnetic spectrum | | The range of frequencies of EM radiation and their respective wavelengths and photon energies | |
| 11. | Spectrophotometer | | To measure absorbed light intensity as a function of wavelength | |
| 12. | Photon | | Is a tiny particle that comprises waves of electromagnetic radiation | |
| 13. | Wavelength | $\lambda$ | The distance between two successive crests or troughs of a wave | nm |
| 14. | Optical instruments | | The devices which process light wave to enhance an image for more clear view | |
| 15. | Signal | | A sound that conveys the information or instructions | |
| 16. | Noise | | Indistinguishable from desired | |

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| | | | sound as both are vibrations through a medium | |
| 17. | FTIR | | Fourier Transform Infrared spectroscopy is a method used for identification of compounds in a sample | |
| 18. | Measurement error | ± | Difference between a measured quantity and it's true value | |
| 19. | Light | | It is a form of EM radiation of a wavelength detected by human eye | |
| 20. | velocity | c | The speed of light in vaccum | m/s |
| 21. | Scattering | | In which light rays get deviated from it's straight path on striking an obstacle. | |
| 22. | LASERS | | Light Amplification by Stimulated Emission of Radiation | |
| 23. | Prism | | A 3D shape with two identical shapes facing each other that refract light | |
| 24. | Spectral resolution | | The ability to define fine wavelength intervals | |
| 25. | Spectral bandwidth | | The band width of light at one-half the peak maximum | |
| **Unit-II : MOLECULAR SPECTROSCOPY** | | | | |
| 26. | Atomic absorption spectrometry | | Used for quantitative determination of chemical elements using the absorption of optical radiation by free atoms in gaseous state | |
| 27. | Molecular absorption spectrometry | | Absorption of light by molecules | |
| 28. | Absorbance | A | Quantity of light absorbed by a solution | |
| 29. | Transmittance | T | Quantity of light that passes through a solution | |
| 30. | Phosphorescence | | Light energy produced by a particular type of chemical reaction where the excess chemical energy of the reactants is given off as light energy | |
| 31. | Fluorescence | | Emission of light by a substance that has absorbed light or other EM radiation | |
| 32. | Transducers | | Device that converts energy from one form to another | |
| 33. | Transition | | The process of changing from one form to another form | |
| 34. | Bolometer | | Device used for detecting and measuring the heat and radiation of microwave energy | |
| 35. | Pyroelectric transducers | | It helps in detection of EM radiation in range of wavelength | |

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| 36. | Raman effect | | When a beam of light transverses a transparent sample of a compound a small fraction of light emerges in directions other than incident light | |
| 37. | Rayleigh scattering | | The scattering of light by particles in a medium without change in wavelength | |
| 38. | Monochromator | | Device that transmits a selectable narrow band of wavelengths of light chosen from a wider range of wavelengths | |
| 39. | Filters | | A device that removes some unwanted components or features from a signal | |
| 40. | Read outs | | Electronic device that displays information in a visual form | |
| 41. | Amplifier | | Device that turns the low volt signals to signal with enough gain | |
| 42. | Passive filters | | Consume the energy of the signal but no power gain is available | |
| 43. | Polychromatic radiation | | It consists of a mixture of different wavelengths | |
| 44. | Light intensity | | Amount of light produced by a specific lamp source | |
| 45. | Emission of light | | Process of elements releasing different photons of color as their atoms return to their lower energy levels. | |
| 46. | Sine wave | | Curve that defines a smooth periodic oscillation | |
| 47. | Cosine wave | | Signal waveform with a shape identical to that of a sine wave | |
| 48. | Sensors | | Device that detects and responds to some type of input from physical environment | |
| 49. | Phosphorimetry | | Phosphorescence of a sample is measured in conjunction with a pulsed source of radiation | |
| 50. | Fiber optics | | Technology that uses glass (or plastic) threads (fibers) to transmit data | |
| **Unit-III : MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY** | | | | |
| 51. | NMR spectroscopy | | Technique to observe local magnetic fields around atomic nuclei | |
| 52. | $^{1}H$ NMR | | With respect to hydrogen – 1 nuclei within the molecules of a substance | |
| 53. | $^{13}C$ NMR | | With respect to carbon – 13 nuclei within the molecules of a substance | |
| 54. | Chemical shift | | The resonant frequency of a nucleus relative to a standard in a magnetic field | ppm |

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| 55. | Mass spectrometer | | Analytical technique that measures the mass-to-charge ratio of ions | |
| 56. | MS spectrum | | Is an intensity vs. m/z plot representing a chemical analysis | |
| 57. | Desorption | | Release of an adsorbed substance from a surface | |
| 58. | Ionization energy | | The energy required to remove an electron from a gaseous atom or ion | |
| 59. | Probe | | Physically explore or examine with the hands or using an instrument | |
| 60. | Electron spectroscopy | | To study the electronic structure and it's dynamic in atoms and molecules | |
| 61. | Ion spectroscopy | | A technique in which a beam of ions are scattered by a surface | |
| 62. | Mass analyzers | | To determine the mass, formula and structure of the compound being analyzed | |
| 63. | Quadrupole Mass Analyzer | | Comprises of four parallel rods of circular or hyperbolic cross section | |
| 64. | Proton decoupling | | Irradiating the sample with radio frequencies to remove the splitting caused by protons | |
| 65. | TOF MS | | Time of flight mass spectrometry, in which an ion's mass to charge ratio is determined via time of flight measurement | |
| 66. | Electron paramagnetic resonance | | It is a method used for studying materials with unpaired electrons | |
| 67. | Detector | | An instrument designed to detect the presence of a particular object or sample | |
| 68. | g values | | The value of g is 5.586 and it has a different value for each nuclear spin | |
| 69. | Data processing system | | A set of inputs produce a defined set of outputs | |
| 70. | Magnetic sector Mass Analyzer | | A static electric or magnetic sector or some combination of the two as a mass analyzer | |
| 71. | Mass to charge ratio | m/z | Is a physical quantity most widely used in electrodynamics of charged particles | |
| 72. | Mass number | | Sum of protons and neutrons | |
| 73. | Atomic number | | Average number of protons and neutrons | |
| 74. | Isotope | | Is the variants of a particular element which differ in number f neutrons | |
| 75. | Precessional movement | | Change in the movement of axis when the atom spins | |
| **Unit-IV : SEPARATION METHODS** | | | | |

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| 76. | Chromatography | | Used to separate mixtures of substances into their components | |
| 77. | Retention time | $R_t$ | Measure of time taken for a solute to pass through a column | |
| 78. | Retention factor | $R_f$ | Measure of ratio of distance of spot moved to the distance the solvent front moved | |
| 79. | Liquid chromatography | | Separates molecules in a liquid mobile phase using a solid stationary phase | |
| 80. | Partition chromatography | | The separation of components between two liquid phases using a column | |
| 81. | Adsorption chromatography | | Separation is based on interaction of adsorbate with the adsorbent | |
| 82. | Ion exchange chromatography | | Separates ions and polar molecules based on their affinity to the ion exchanger | |
| 83. | Size exclusion chromatography | | Molecules in solution are separated by their size | |
| 84. | Affinity chromatography | | Separation of biochemical mixture based on high specific interaction between antigen and antibody | |
| 85. | Gas chromatography | | Separation and analysis of compounds that can be vaporized without decomposition | |
| 86. | Chemi -illuminesence | | Emission of light as the result of a chemical reaction | |
| 87. | HPLC | | High Performance Liquid Chromatography, used to separate, identify and quantify each component in a mixture | |
| 88. | Pneumatic pumps | | Use compressed air to create force that is used to move fluids through a piping system | |
| 89. | Flame ionization detector | | That measures analytes in a gas stream | |
| 90. | Solute | | Substance dissolved in another substance | |
| 91. | Solvent | | Liquid that dissolves a solid, liquid or gaseous solute | |
| 92. | Electrophoresis | | | |
| 93. | Buffer | | A solution which resists change in pH when acid or alkali is added to it | |
| 94. | Tris buffer | | Maintain the pH within a relatively narrow range | |
| 95. | Carrier gas | | Used in the mobile phase of gas-liquid chromatography | |
| 96. | UV radiations | | Light having wavelength more than 100 nm but below 400 nm | |
| 97. | Capillary electrophoresis | | Analytical technique that separates ions based on their electrophoretic | |

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| | | | mobility with the applied voltage | |
| 98. | Silica gel | | Amorphous and porous form of silicon dioxide consisting of irregular alternating of silicon and oxygen atoms | |
| 99. | C8 column | | C8 contains octyl carbon chain bonded to silica as the stationary phase | |
| 100. | C18 column | | C18 has octadecyl carbon chain bonded to silica as the stationary phase | |
| **Unit-V : ELECTRO ANALYSIS AND SURFACE MICROSCOPY** | | | | |
| 101. | Electrode | | A conductor through which electricity enters or leaves a substance | |
| 102. | Electrochemical cells | | A device capable of either generating electrical energy from chemical reactions | |
| 103. | Galvanic cell | | Derives electrical energy from spontaneous redox reactions taking place within the cell | |
| 104. | Electrolysis | | Which uses a direct electric current to drive non-spontaneous chemical reaction | |
| 105. | Potentiometry | | The measurement of electrical potential as a technique in chemical analysis | |
| 106. | Voltammetry | | Electroanalytical method used in analytical chemistry | |
| 107. | Electroanalytical | | Analyte by measuring the potential or current in an electrochemical cell containing the analyte | |
| 108. | Cyclic voltameter | | Is the potentiodynamic electrochemical measurement | |
| 109. | Pulse voltameter | | Which increases the pulse height that is applied at periodic intervals | |
| 110. | Microscope | | An optical instrument used for viewing very small objects | |
| 111. | Electron microscope | | It uses a beam of accelerated electrons as a source of illumination | |
| 112. | Optical microscope | | It uses a visible light and a system of lenses to magnify images of small objects | |
| 113. | Transmission electron microscope | | A beam of electrons is transmitted through a specimen to form an image | |
| 114. | Photon | | A particle representing a quantum of light or other EM radiation | |
| 115. | Scanning electron microscope | | It produces images of a sample by scanning the surface with a focused beam of electrons | |

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| 116. | Atomic force microscopy | | Used for the study of surface properties for both conductive and non-conductive samples | |
| 117. | Scanning tunneling microscope | | Instrument for imaging surfaces at the atomic level | |
| 118. | Fluorescent microscope | | To examine material that fluoresces under UV light | |
| 119. | Thermogravimetric analysis | | A thermal analysis in which the mass of a sample is measured over time | |
| 120. | Microscope condenser | | Which renders a divergent beam from a point source into a parallel beam | |
| 121. | Electro motive force | emf | Electrical action produced by a non-electrical source | |
| 122. | Diffusion | | The movement of substance from an area of high concentration to area of low concentration | |
| 123. | Concentration gradient | | Concentration of particles is higher in one area than another | |
| 124. | pH | | Is a scale used to specify the acidity or basicity of an aqueous solution | |
| 125. | Concentration gradient | | Concentration of particles is higher in one area than another | |
| **Placement Questions** | | | | |
| 126. | Velocity of light | c | $3.00 \times 10^8$ | m/s |
| 127. | Wavelength | $\lambda$ | The distance between one crest to another or one trough to another of a wave | m |
| 128. | Precessional movement | | A rotational movement from axis by atom | |
| 129. | Colorimeter | | A device which measures absorbance of specific colours | |
| 130. | Amplitude | | Fluctuation or displacement of a wave from it's mean value | m |
| 131. | Phosphorescence | | Photoluminescence related to fluorescence | |
| 132. | Sample container | | Flat or round shaped are often called as cuvettes | |
| 133. | Monochromator | | Which transmit mechanically selectable narrow band of wavelengths of light | |
| 134. | Beer lambert's law formula | | $A = \varepsilon lc$, A = absorbance, $\varepsilon$ = absorptivity, l = path length, c = concentration | |
| 135. | Frequency | f | The number of occurrences of a repeating event per unit of time | Hz |
| 136. | FTIR | | Fourier transform infra red for identification of compounds | |
| 137. | Fluorometers | | Measure parameters of visible spectrum fluorescence | |

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| 138. | Raman spectroscopy | | To determine vibrational, rotational and other low-frequency modes o molecules | |
| 139. | IR absorption spectroscopy | | Molecules absorbs frequencies that are characteristic of their structure | |
| 140. | Microwave | | An electromagnetic wave with a wavelength in the range 0.001-0.3 m | |
| 141. | Capillary electrophoresis | | separates ions based on their electrophoretic mobility | |
| 142. | Mobile phase | | Flows through stationary phase and carries the components of mixture with it | |
| 143. | Wash buffer | | Remove salt residues on the column | |
| 144. | Stationary phase | | Solid or liquid phase on which the material to be separated are selectively adsorbed | |
| 145. | Radiowave | | An EM wave of a frequency between about $10^4$ and $10^{11}$ or $10^{12}$ Hz | |
| 146. | Refractive index | n | Ratio of the velocity of light in a vacuum to it's velocity in a specified medium | |
| 147. | Concentration gradient | | Concentration of particles is higher in one area than another | |
| 148. | Nernst equation | | Reduction potential of An electrochemical reaction to the standard electrode potential of the chemical species undergoing reduction and oxidation | |
| 149. | Potentiostat | | An electronic hardware required to control a three electrode cell and run most electroanalytical experiments | |
| 150. | pH | | Is a scale used to specify the acidity or basicity of an aqueous solution | |

**Faculty Team Prepared** **Signatures**

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