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| **Course Code** | **12PH209** | **Duration :** | **3hrs** |
| **Course Name** | **THIN FILMS TECHNOLOGY FOR ENGINEERS** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **CO/BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Insulators cannot be deposited by \_\_\_\_\_\_\_\_\_\_ sputtering. | CO1 / U | 1 |
| 2. | Mention a gauge which works on the principle of Boyle’s law. | CO1 / R | 1 |
| 3. | In MBE the source material is sublimated from \_\_\_\_\_\_\_\_\_\_ cells. | CO1 / U | 1 |
| 4. | The gauge that works for sensing low pressure is \_\_\_\_\_\_\_\_\_\_\_\_. | CO1 / U | 1 |
| 5. | Mention the Debye Scherrer formula to determine the crystallite size. | CO1 / U | 1 |
| 6. | \_\_\_\_\_\_\_\_\_\_ forces causes physisorption. | CO1 / R | 1 |
| 7. | In epitaxial growth \_\_\_\_\_\_\_\_\_\_ is a measure of structural compatibility between different materials. | CO1 / U | 1 |
| 8. | Majority carrier type, concentration and mobility can be determined by \_\_\_\_\_\_\_\_\_\_. | CO1 / R | 1 |
| 9. | |  | | --- | | The type of adsorption due to the formation of chemical bond is called \_\_\_\_\_\_. | | CO1 / R | 1 |
| 10. | NEMS is the acronym for \_\_\_\_\_\_\_\_\_\_\_. | CO1 / U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Define thin film. | CO1 / U | 3 |
| 12. | Write short notes on diffusion pump. | CO1 / U | 3 |
| 13. | Define epitaxy. Differentiate homo and hetero epitaxy. | CO1 / U | 3 |
| 14. | What are the main reasons for loss of film adhesion? | CO1 / U | 3 |
| 15. | Differentiate hard and soft magnetic materials. | CO1 / U | 3 |
| 16. | Mentions the applications of Thin films in electronic devices. | CO1 / U | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is Compulsory)** | | | | | |
| 17. |  | | Explain with suitable diagram the working of rotary pump and list its drawbacks. | CO1 / U | 12 |
|  |  | |  |  |  |
| 18. |  | | With a neat sketch, explain in detail the construction and working of pirani guage. | CO1 / U | 12 |
|  |  | |  |  |  |
| 19. | a. | | Explain magnetron sputtering method with necessary diagram. | CO1 / U | 6 |
| b. | | Explain the process of LASER ablation and mention its benefits. | CO1 / U | 6 |
|  |  | |  |  |  |
| 20. |  | | With suitable diagram, explain the construction and working of molecular beam epitaxy. | CO1 / U | 12 |
|  |  | |  |  |  |
| 21. | |  | Define lattice mismatch. With adequate diagram, explain the different types of lattice mismatch in detail. | CO1 / U | 12 |
|  | |  |  |  |  |
| 22. | |  | Describe how the structure of a material and the particle size are determined by X- ray diffraction studies. | CO1 / U | 12 |
|  | |  |  |  |  |
| 23. | |  | Explain in detail, the construction and working of UV-Visible spectrophotometer. | CO1 / U | 12 |
|  | |  | **COMPULSORY QUESTION** | | |
| 24. | |  | Explain the steps in fabrication of thin film transistors. Mention the various types of transistors. | CO1 / U | 12 |

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

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|  | **COURSE OUTCOME** |
| CO1 | To demonstrate and execute the process of thin film for various applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 96 |  |  | - | - | 100 |
|  | | | | | | | **100** |



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| **Course Code** | **14PH2010/17PH2012** | **Duration** | **3hrs** |
| **Course Name** | **VACUUM AND THIN FILM TECHNOLOGY** | **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 pumping mechanism of rotary pump with suitable sketch. | CO1 | U | 5 |
|  | b. | Explain with suitable diagram the principle, instrumentation and pumping mechanism of turbo molecular pump. | CO2 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the construction of diffusion pump with a suitable sketch. | CO1 | U | 5 |
|  | b. | Explain with suitable diagram the principle, instrumentation and pumping mechanism of cryogenic pump. | CO2 | U | 15 |
|  |  |  |  |  |  |
| 3. | a. | Describe the principle of operation and construction of Bourdon gauge. | CO3 | U | 10 |
|  | b. | Describe the principle of operation and construction of diaphragm gauge. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain in detail the principle, construction and working of penning gauge with a suitable sketch. | CO3 | U | 10 |
|  | b. | Explain in detail the principle, construction and working of pirani gauge with a suitable sketch. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Define spray pyrolysis and explain the different steps involved in this process of thin film deposition with a suitable diagram. | CO4 | U | 10 |
|  | b. | Describe the sol-gel method in material processing with suitable sketch. List the advantages and applications of this process. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | With a neat sketch, explain in detail the various stages of thin film growth. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Define Bragg’s law. Describe how the structure of a material and the particle size are determined by X- ray diffraction studies. | CO5 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the determination of transmittance and absorbance of thin films using UV- Visible spectrophotometer with suitable equations and a schematic sketch of the instrument. | CO5 | U | 20 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Discuss in detail the different structures of thin film transistor and the various steps involved in fabrication of thin film transistors. | CO6 | U | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the importance of vacuum in thin film technology. |
| CO2 | Identify the suitable pumping systems to obtain the required level of vacuum. |
| CO3 | Appreciate the measurement of vacuum using suitable pressure gauges. |
| CO4 | Understand the process of thin film growth. |
| CO5 | Compare the vacuum and non-vacuum techniques for thin film deposition. |
| CO6 | Apply thin film technologies in fabricating various metal and optical coatings. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 10 | - | - | - | - | 10 |
| CO2 | - | 30 | - | - | - | - | 30 |
| CO3 | - | 40 | - | - | - | - | 40 |
| CO4 | - | 40 | - | - | - | - | 40 |
| CO5 | - | 40 | - | - | - | - | 40 |
| CO6 | - | 20 | - | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **17PH2013 / 14PH2019** | **Duration** | **3hrs** |
| **Course Name** | **CONDENSED MATTER PHYSICS** | **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. | Briefly describe phonons in a crystal solid. | CO1 | U | 5 |
|  | b. | Explain in detail the band theory of solids. | CO1 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Compare and contrast dielectric materials and insulators. | CO4 | U | 5 |
|  | b. | Derive the expression for electrical conductivity of conductors. | CO1 | U | 15 |
|  |  |  |  |  |  |
| 3. | a. | Compare and contrast direct and indirect band gap semiconductors. | CO2 | U | 5 |
|  | b. | Derive Classius-Mosotti relation to relate the macroscopic dielectric constant with microscopic polarizabilities. | CO4 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Mention the Fermi-Dirac distribution function f(E) and define all the symbols in the relation. | CO5 | R | 5 |
|  | b. | Explain the temperature dependence of magnetism and ferromagnetism in detail. | CO6 | U | 15 |
|  |  |  |  |  |  |
| 5. | a. | Differentiate type I and type II superconductors. | CO3 | U | 5 |
|  | b. | Explain in detail the properties and concepts of Para, ferro and antiferro magnetic materials with adequate diagram. | CO6 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Define the term ‘Coercivity’ and ‘Retentivity’ | CO6 | R | 5 |
|  | b. | Explain the ferroelectric hysteresis loop with a suitable sketch describing the domain movement. | CO5 | U | 15 |
|  |  |  |  |  |  |
| 7. | a. | Briefly describe types of crystal defects occur in solids. Explain line defect and point defects and its underlying principle with adequate diagram in detail. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe Barkhausen effect in detail. | CO3 | R | 5 |
|  | b. | Explain the internal field or local field in liquids and solids with suitable sketch. | CO4 | U | 15 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | | |
| 9. |  | Derive the equation for net magnetization using quantum theory of magnetism. | CO6 | U&A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the band theory of solids. |
| CO2 | Interpret the different types of semiconductors. |
| CO3 | Define and explain the properties of superconductors. |
| CO4 | Gain knowledge on dielectrics. |
| CO5 | Appreciate the properties of ferroelectrics. |
| CO6 | Explain the different types of magnetic materials. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 35 | - |  |  |  | 35 |
| CO2 | - | 25 | - |  |  |  | 25 |
| CO3 | 5 | 05 | - |  |  |  | 10 |
| CO4 | - | 35 | - |  |  |  | 35 |
| CO5 | 5 | 15 | - |  |  |  | 20 |
| CO6 | 5 | 40 | 10 |  |  |  | 55 |
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| **Course Code** | **17PH3005** | **Duration** | **3hrs** |
| **Course Name** | **QUANTUM MECHANICS-I** | **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. | Write a note on Hermitian operator and discuss any two of its property in detail. | CO1 | R | 10 |
|  | b. | Arrive at the equation that is used to observe the integrals of motion of the systems in quantum mechanics. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | In Schrodinger picture the state vectors and operators are time dependent and independent respectively. Discuss. | CO1 | R | 15 |
|  | b. | According to the interaction picture both the state vector and operator are time dependent. Validate. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 3. | a. | For a particle in a one dimensional potential well, obtain its energy and wave function using Schrodinger time independent wave equation. | CO3 | A | 15 |
|  | b. | Calculate the energy required for an electron in a potential well of length 10-15 m to jump from the first excited state to the sixth excited state. | CO3 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Find the Schrodinger wave equation for hydrogen atom and solve its radial part. | CO3 | A | 15 |
|  | b. | Derive the equation which represents the rotational energy eigen values of the rigid rotator. | CO3 | A | 5 |
|  |  |  |  |  |  |
| 5. | a. | Obtain the commutation relations of total angular momentum with components. | CO4 | A | 15 |
|  | b. | Discuss about the angular momentum operator in terms of position representation. | CO4 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the explicit form of the angular momentum matrices in detail. | CO4 | U | 15 |
|  | b. | Using the ladder operators arrive at the eigen values of J+ and J-. | CO4 | A | 5 |
|  |  |  |  |  |  |
| 7. | a. | The stationary perturbation theory is concerned in finding the change in the energy value and eigen functions of a non-degenerate system under small perturbation. Discuss in detail. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe the WKB approximation method. Discuss its validity and principle in detail. | CO5 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss how the many electron systems were treated using Thomas-Fermi model of atom. | CO6 | An | 10 |
|  | b. | Explain the various concepts of Hartree-Fock equation. | CO6 | U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Gain an in depth Uing on the central concepts and principles of quantum mechanics: the Schrödinger equation, the wave function and its physical interpretation, stationary and non-stationary states and expectation values. |
| CO2 | Improved mathematical skills necessary to solve differential equations and eigenvalue problems using the operator formalism. |
| CO3 | Quantum mechanical solution of simple systems such as the harmonic oscillator and a particle in a potential well. |
| CO4 | Grasp the concepts of spin and angular momentum, as well as their quantization- and addition rules. |
| CO5 | Student forms a mental picture on the meaning of linear combination of states within quantum mechanics. |
| CO6 | Solutions to perturbation problems and many electron systems. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **R** | **U** | **A** | **An** | **Evaluate** | **Create** | **Total** |
| CO1 | 25 |  |  |  |  |  | 25 |
| CO2 |  | 15 |  |  |  |  | 15 |
| CO3 |  |  | 40 |  |  |  | 40 |
| CO4 |  | 20 | 20 |  |  |  | 40 |
| CO5 |  |  |  | 40 |  |  | 40 |
| CO6 |  | 10 |  | 10 |  |  | 20 |
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| **Course Code** | **17PH3017** | **Duration** | **3hrs** |
| **Course Name** | **RENEWABLE ENERGY SOURCES** | **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. | Illustrate the various conventional energy sources. | CO1 | U | 10 |
|  | b. | i) Summarize the different available energy sources.  ii) List the advantages and limitations of renewable energy sources. | CO1 | U  R | 5  5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Write notes on: (a) Solar pumping (b) Solar water heating. | CO2 | R | 10 |
|  | b. | Write notes on: (a) Solar Furnace (b) Solar cooking. | CO2 | R | 10 |
|  |  |  |  |  |  |
| 3. | a. | i) Explain the basic principle of wind energy conversion.  ii) Derive the expression for power developed due to wind. | CO2 | U | 5  5 |
|  | b. | Enumerate the different main applications of solar storage. | CO2 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain with a neat sketch the basic components of WECS. | CO3 | U | 10 |
|  | b. | i) Discuss in brief the classification of WEC Systems.  ii) Discuss the advantages and disadvantages of the wind energy conversion system. | CO3 | R | 5  5 |
|  |  |  |  |  |  |
| 5. | a. | Explain the process of ‘photosynthesis’. What are the conditions, which are necessary for it? | CO4 | U | 10 |
|  | b. | Discuss in detail biofuels and types of biofuels. | CO4 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain direct combustion, thermochemical and biochemical conversion of biomass. | CO5 | U | 10 |
|  | b. | Discuss in brief wet processes in biomass conversion process. | CO5 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the construction and working of flat plate collectors with a suitable sketch | CO2 | U | 10 |
|  | b. | Demonstrate the working principle of concentrating collectors | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the methods of solar energy storage. | CO2 | R | 10 |
|  | b. | Discuss in brief dry processes in biomass conversion process | CO2 | R | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | What is the basic principle of ocean thermal energy conversion (OTEC)  Describe the ‘hybrid cycle’ variation of the standard OTEC open cycle system | CO6 | U | 10 |
|  | b. | Describe the ‘open cycle’ and ‘closed cycle’ OTEC system | CO6 | U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | List and generally explain the main sources of energy and their primary applications in the world. |
| CO2 | Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment. |
| CO3 | Discuss remedies/potential solutions to the supply and environmental issues associated with |
| CO4 | Understand fossil fuels and other energy resources. |
| CO5 | List and describe the primary renewable energy resources and technologies. |
| CO6 | Describe/illustrate basic electrical concepts and system components. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 15 | - | - | - | - | 20 |
| CO2 | 50 | 30 | - | - | - | - | 80 |
| CO3 | 10 | 10 | - | - | - | - | 20 |
| CO4 | 10 | 10 | - | - | - | - | 20 |
| CO5 | 10 | 10 | - | - | - | - | 20 |
| CO6 | - | 20 | - | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **17PH3021** | **Duration** | **3hrs** |
| **Course Name** | **MATERIAL CHARACTERIZATION** | **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. |  | Differentiate the bright and dark field microscopy with a neat sketch and recall their application in material characterization. | CO1 | U&R | 15+5 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Illustrate the powder X-ray diffraction method in detail and explain its principle behind analyzing the structure of a given material. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 3. |  | Discuss the working principle of UV-Visible spectrophotometer and explain its instrumentation with a neat sketch. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Compare alpha and beta spin states with respect to NMR. | CO4 | An | 5 |
|  | b. | Explain the working principle of Auger Electron Spectroscopy (AES) and describe the significance of differentiation with respect to AES energy spectrum. | CO4 | U | 7 |
|  | c. | Sketch the instrumentation of AES and discuss the role of each component. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 5. |  | Illustrate the process of photoluminescence with suitable examples and explain the role of each component in photoluminescence spectroscopy. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss in detail, the principle behind the measurement of composition of any compound using EDX. | CO3 | U | 10 |
|  | b. | Explain the instrumentation of scanning electron microscopy and illustrate the requirements in determination of the morphology of a conducting and a non-conducting material. | CO3 | U&A | 7+3 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the instrumentation and working of DTA with a neat sketch. | CO6 | U | 15 |
|  | b. | Cite the advantages and applications of TGA. | CO6 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Differentiate the Hall effect in n-type and p-type materials with a neat sketch. | CO5 | A | 15 |
|  | b. | Explain the concept of Schottky barrier with a suitable sketch. | CO2 | U | 5 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate the working principle of four probe method in observing the resistivity measurements of sample under study. | CO2 | A | 10 |
|  | b. | Describe the instrumentation, working principle and application of VSM. | CO5 | U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Identify suitable techniques for specific materials characterization. |
| CO2 | Use various instrumentations to scan and test materials for electrical, mechanical and thermal property analysis. |
| CO3 | Analyse the structural and compositional properties of materials using XRD, SEM, XPS, EDAX and AFM. |
| CO4 | Apply the microscopic and macroscopic property analysis for various materials. |
| CO5 | Analyse the magnetic properties of materials and functions. |
| CO6 | Practice the testing of materials for various thermal property analysis. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 05 | 55 | - | - | - | - | 60 |
| CO2 | - | 5 | 10 | - | - | - | 15 |
| CO3 | - | 17 | 23 | - | - | - | 40 |
| CO4 | - | 07 | 8 | 5 | - | - | 20 |
| CO5 | - | 25 | - | - | - | - | 25 |
| CO6 | - | 20 | - | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **17PH3021** | **Duration** | **3hrs** |
| **Course Name** | **MATERIAL CHARACTERIZATION** | **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. | Recall the different parts of an optical microscope and mention the role of each. | CO1 | R | 5 |
|  | b. | Explain the working principle of an optical microscope with a neat sketch. | CO1 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Describe the principle of AFM and differentiate the three different modes of scanning in AFM. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 3. | a. | Describe the instrumentation and working principle of XPS with a neat sketch. | CO3 | U | 15 |
|  | b. | List the advantages and disadvantages of XPS. | CO3 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Sketch the block diagram explaining the process of secondary ion mass spectroscopy and explain the working principle of SIMS. | CO4 | A | 8 |
|  | b. | Illustrate the block diagram of NMR and explain the role of each component. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 5. |  | Explain the principle and working of scanning electron microscope with adequate block diagram in analyzing the properties of a given material. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the principle, instrumentation, and application of TEM in characterization of the given material. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Explain in detail how thermos-gravimetric analysis (TGA) is being used in analyzing the mass loss of a compound under study. | CO6 | U | 15 |
|  | b. | Interpret the following DSC curve. | CO6 | An | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe hall effect in determination of n-type and p-type materials with a neat sketch. | CO2 | U | 15 |
|  | b. | Define schottky barrier and sketch the energy band diagram of a schottky diode comprising of a metal and an n-type semiconductor with a suitable sketch. | CO2 | A | 5 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the four-probe method in measurement of the sheet resistance and resistivity of a thin film sample. | CO2 | U | 10 |
|  | b. | Discuss the working principle of VSM. | CO5 | U | 5 |
|  | c. | Interpret the hysteresis curve obtained for a ferromagnetic material from VSM measurement. | CO5 | An | 5 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Identify suitable techniques for specific materials characterization. |
| CO2 | Use various instrumentations to scan and test materials for electrical, mechanical, and thermal property analysis. |
| CO3 | Analyse the structural and compositional properties of materials using XRD, SEM, XPS, EDAX and AFM. |
| CO4 | Apply the microscopic and macroscopic property analysis for various materials. |
| CO5 | Analyse the magnetic properties of materials and functions. |
| CO6 | Practice the testing of materials for various thermal property analysis. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 15 | - | - | - | - | 20 |
| CO2 | - | 25 | 5 | - | - | - | 30 |
| CO3 | 5 | 75 | - | - | - | - | 80 |
| CO4 | - | - | 20 | - | - | - | 20 |
| CO5 | - | 5 | - | 5 | - | - | 10 |
| CO6 | - | 15 | - | 5 | - | - | 20 |
|  | | | | | | | **180** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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| **Course Code** | **18PH1009** | **Duration** | **3hrs** |
| **Course Name** | **APPLIED PHYSICS AND PROPERTIES OF MATTER** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **CO** | **BL** | **Marks** |
|  | **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Phonons are \_\_\_\_\_\_\_\_\_\_. | CO1 | R | 1 |
|  |  |  |  |  |
| 2. | LASER stands for \_\_\_\_\_\_\_\_. | CO1 | U | 1 |
|  |  |  |  |  |
| 3. | In optical fiber, the outer layer is \_\_\_\_\_\_\_\_\_ and inner layer is \_\_\_\_\_\_\_\_\_\_\_\_. | CO2 | An | 1 |
|  |  |  |  |  |
| 4. | The fibers mostly not used nowadays for optical fiber communication system are \_\_\_\_\_\_\_\_\_\_\_mode fibers. | CO2 | E | 1 |
|  |  |  |  |  |
| 5. | For which of the following process, the thermal conduction is maximum? (a) Combustion (b) Radiation (c) Convection (d) Conduction | CO3 | C | 1 |
|  |  |  |  |  |
| 6. | Hooke’s law states that \_\_\_\_\_\_\_\_\_. | CO3 | R | 1 |
|  |  |  |  |  |
| 7. | **According to de Broglie’s hypothesis, the wavelength of electron is** \_\_\_\_\_\_\_\_\_ proportional to velocity of particle. | CO4 | U | 1 |
|  |  |  |  |  |
| 8. | According to wave mechanics, a material particle is associated with :  a) a single wave b) a wave packet c) progressive wave d) light wave. | CO5 | E | 1 |
|  |  |  |  |  |
| 9. | Which part of human ear converts sound vibrations into electrical signals   a) Hammer b) Stirrup  c) Tympanic membrane d) Cochlea | CO5 | U | 1 |
|  |  |  |  |  |
| 10. | Sound waves with a frequency of 20Hz to 20,000Hz termed as \_\_\_\_\_\_\_\_\_\_\_. | CO6 | R | 1 |

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|  | **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Define stimulated emission. | CO1 | An | 3 |
| 12. | Draw the diagram for explaining acceptance cone angle. | CO2 | A | 3 |
| 13. | Explain the term “Non uniform bending”. | CO3 | E | 3 |
| 14. | State DeBroglie hypothesis. | CO4 | C | 3 |
| 15. | List out Acoustic properties of biomaterials. | CO5 | R | 3 |
| 16. | Describe the classification of sound. | CO6 | U | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is Compulsory)** | | | | | | |
|  | |  | | | | |
| 17. |  | | Briefly discuss the construction and working of a helium neon laser with the energy level diagram. | CO1 | An | 12 |
| 18. |  | | Classify the optical fibers on the basis of materials, mode of propagation and refractive index difference. | CO2 | An | 12 |
| 19. |  | | Explain the theory of uniform bending and method of finding the Young’s modulus by uniform bending. | CO2 | U | 12 |
| 20. |  | | Describe Davisson and Germer’s experiment to demonstrate the wave nature of electron. | CO3 | A | 12 |
| 21. |  | | Derive an expression for Sabine’s formula. | CO4 | E | 12 |
| 22. |  | | Discuss the principle of operation of semi-conductor laser. Draw the energy level diagram and indicate the wavelength of the radiation. | CO5 | C | 12 |
| 23. |  | | Derive an expression of Depression of a cantilever. | CO6 | R | 12 |
|  |  | | **COMPULSORY QUESTION** | | | |
| 24. |  | | Draw the circuit diagram of magnetostriction oscillator and explain the production of ultrasonic waves using it | CO6 | E | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | To impart knowledge on the fundamentals of various lasers and its application in Fibre optics. |
| CO2 | To understand the principle of fibre optics and lasers. |
| CO3 | Apply the relationship between properties of matter and the thermal physics. |
| CO4 | To impart knowledge on the basic concepts of quantum mechanics and its application. |
| CO5 | To impart knowledge on principles of acoustics and application of ultrasonic waves. |
| CO6 | Design devices based on ultrasonic generators . |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 |  | 15 |  |  | 17 |
| CO2 |  | 12 | 3 | 13 | 1 |  | 29 |
| CO3 | 1 |  | 12 |  | 3 | 1 | 17 |
| CO4 |  | 1 |  |  | 12 | 3 | 16 |
| CO5 | 3 | 1 |  |  | 1 | 12 | 17 |
| CO6 | 13 | 3 |  |  | 12 |  | 28 |
|  | | | | | | | **124** |



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| **Course Code** | **19PH1003** | **Duration** | **3hrs** |
| **Course Name** | **ENGINEERING PHYSICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Recall any two applications of LED. | | | CO1 | U | 1 |
| 2. | Semiconducting material that are free from impurities is known as \_\_\_\_\_\_ . | | | CO1 | An | 1 |
| 3. | Voltage regulations can be done by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | | CO2 | A | 1 |
| 4. | In the P-channel JFET, the gate terminal is made up of \_\_\_\_\_\_\_\_\_\_\_.   1. N-type material 2. P-type material 3. Metal grid 4. Insulating material | | | CO2 | U | 1 |
| 5. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the principle behind the optical fiber communication. | | | CO3 | U | 1 |
| 6. | The diameter of single mode fibre is \_\_\_\_\_\_\_\_\_   1. Very big 2. Two times larger than the multimode 3. Very small 4. Equal to the diameter of cladding | | | CO3 | R | 1 |
| 7. | The high frequency sound wave that is not perceptible by humans is \_\_\_\_\_\_\_\_\_\_\_. | | | CO4 | R | 1 |
| 8. | Mention any one application of ultrasonic wave. | | | CO5 | U | 1 |
| 9. | A solar cell is a device that converts sunlight directly into \_\_\_\_\_\_\_\_\_\_\_\_ . | | | CO6 | An | 1 |
| 10. | The conversion of mechanical power of wind turbine into the electrical power can be accomplished by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.   1. Transformer 2. Gearbox 3. Generator 4. Pitch system | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Describe semiconducting materials. | | | CO1 | An | 3 |
| 12. | Give details about MOSFET. | | | CO2 | U | 3 |
| 13. | Draw the structure of optical fibre. | | | CO3 | U | 3 |
| 14. | Classify sounds based on frequency and explain them in brief. | | | CO4 | A | 3 |
| 15. | State piezoelectric effect. | | | CO5 | U | 3 |
| 16. | Explain any two renewable energy sources. | | | 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. | |  | Categorize semiconductors and explain each in detail. | CO1 | U | 12 |
|  | |  |  |  |  |  |
| 18. | |  | Discuss the working of zener diode with I-V characteristics. | CO1 | A | 12 |
|  | |  |  |  |  |  |
| 19. | |  | Illustrate the construction and working of depletion MOSFET. | CO2 | U | 12 |
|  | |  |  |  |  |  |
| 20. | |  | Sketch the basic construction of JFET and explain the working of JFET. | CO2 | U | 12 |
|  | |  |  |  |  |  |
| 21. | |  | Derive the formula for numerical aperture. | CO3 | A | 12 |
|  | |  |  |  |  |  |
| 22. | |  | Categorize the optical fibres based on refractive index profile and explain them in detail. | CO3 | U | 12 |
|  | |  |  |  |  |  |
| 23. | |  | Illustrate the magnetostriction method to produce ultrasonic waves. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | |  | Demonstrate the construction and working of solar cells. | CO6 | A | 12 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Remember the fundamentals of semiconducting materials. |
| CO2 | Understand the principle and operation of semiconductor devices. |
| CO3 | Demonstrate the application of fibre optics in communications. |
| CO4 | Analyze the application of acoustics in construction and acoustic design. |
| CO5 | Ability to explore the application of ultrasonic in various fields. |
| CO6 | Understand about the renewable energy sources and devices. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 13 | 12 | 4 |  |  | 29 |
| CO2 |  | 28 | 1 |  |  |  | 29 |
| CO3 | 1 | 16 | 12 |  |  |  | 29 |
| CO4 | 1 |  | 15 |  |  |  | 16 |
| CO5 |  | 4 |  |  |  |  | 4 |
| CO6 |  | 1 | 15 | 1 |  |  | 17 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

|  |  |  |  |
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| **Course Code** | **19PH1009** | **Duration :** | **3hrs** |
| **Course Name** | **ENGINEERING PHYSICS - ELECTROMAGNETICS, OPTICS AND PROPERTIES OF MATTER** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome / Pattern** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Which laser has continuous output?  a) Ruby laser b) [Helium-Neon](https://winnerscience.com/construction-of-helium-neon-laser/) laser c) Both d) None of the above | CO1 / R | 1 |
|  |  |  |  |
| 2. | A laser source that emits radiation only in one direction is called \_\_\_\_\_\_\_\_\_ | CO1 / U | 1 |
|  |  |  |  |
| 3. | Fiber optic cable operate at frequencies near  a) 2 GHz b) 20 MHz c) 200 MHz d) 800 THz | CO2 / An | 1 |
|  |  |  |  |
| 4. | Light \_\_\_\_\_\_\_\_ is described by the concept of numerical aperture in an optical fibre. | CO2 / E | 1 |
|  |  |  |  |
| 5. | In damped oscillation the directions of the restoring force and the resistive force (a) are the same (b) are opposite (c) may be same or opposite (d) have no relation with each other | CO3 / C | 1 |
|  |  |  |  |
| 6. | In the case of forced oscillations, amplitude tends to \_\_\_\_\_\_\_\_\_ at resonance. | CO3 / R | 1 |
|  |  |  |  |
| 7. | Loudness of a note of sound is \_\_\_\_\_\_\_\_\_\_ proportional to square of amplitude of wave. | CO4 / U | 1 |
|  |  |  |  |
| 8. | Energy is not carried by \_\_\_\_\_\_\_\_\_\_\_waves. | CO5 / E | 1 |
|  |  |  |  |
| 9. | When does a dielectric become a conductor? a) At avalanche breakdown b) At high temperature c) At dielectric breakdown d) In the presence of magnetic field | CO5 / U | 1 |
|  |  |  |  |
| 10. | Piezoelectric effect involves generation of mechanical stress. True or false? | CO6 / R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Discuss various pumping methods used in the Lasers for obtaining population inversion. | CO1 / An | 3 |
| 12. | An optical fiber has a numerical aperture of 20 0 ⋅ and cladding refractive index of 59 1⋅Determine the acceptance angle for the fiber in water, which has a refractive index of 1.33. | CO2 / E | 3 |
| 13. | Write down the time period of simple pendulum. | CO3 / E | 3 |
| 14. | What are transverse waves? Give one example. | CO4 / C | 3 |
| 15. | Define Polarizability. | CO5 / R | 3 |
| 16. | State Ampere’s Circuital Law. | CO6 / U | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is Compulsory)** | | | | |
| 17. | a. | Draw the energy level diagram of Helium Neon laser. Explain the operation principle of He-Ne laser. | CO1 / An | 6 |
| b. | Can we obtain light amplification in the absence of stimulated emission? Explain. | CO1 / C | 3 |
| c. | What is population inversion? How is it achieved? | CO1 / R | 3 |
|  |  |  |  |  |
| 18. | a. | Define and derive expression for numerical aperture. Explain why numerical aperture is small for a graded index fiber in comparison to an identical step index fiber. | CO1 / An | 5 |
| b. | What is an optical fiber? Give the basic principle of light guidance through the optical fiber. Derive an expression for numerical aperture of an optical fiber | CO1 / C | 5 |
| c. | What is the basic principle of guiding light through an optical fiber? | CO1 / R | 2 |
|  |  |  |  |  |
| 19. | a. | What is meant by simple harmonic oscillation? Give examples and explain why every simple harmonic motion is a periodic motion whereas the converse need not be true. | CO1 / An | 5 |
| b. | A piece of wood of mass m is floating erect in a liquid whose density is ρ. If it is slightly pressed down and released, then executes simple harmonic motion.  Show that its time period of oscillation is**https://img.brainkart.com/imagebk41/ESyrGB3.jpg** | CO1 / C | 5 |
| c. | Define time period of simple harmonic motion. | CO1 / R | 2 |
|  |  |  |  |  |
| 20. | a. | Explain how overtones are produced in a  (a) Closed organ pipe  (b) Open organ pipe | CO1 / An | 5 |
| b. | Discuss about Source chases Observer. | CO1 / C | 2 |
| c. | Explain types of waves and its properties. | CO1 / R | 5 |
|  |  |  |  |  |
| 21. | a. | Obtain Clausius-Mosotti equation and explain how it can be used to determine dipole moment of a polar molecule. | CO1 / An | 6 |
| b. | Write the condition of frequency and temperature dependence of Polarization. | CO1 / C | 4 |
| c. | Define Dielectric loss. | CO1 / R | 2 |
|  |  |  |  |  |
| 22. | a. | Elaborate the working of Holography and list out its medical applications. | CO1 / An | 5 |
| b. | List out the Different Polarizations in Dielectrics | CO1 / C | 4 |
| c. | Draw the energy level diagram of Semiconductor Laser | CO1 / R | 3 |
|  |  |  |  |  |

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| 23. | a. | Explain the term of dielectric loss and dielectric break down. | CO1 / An | 4 |
| b. | Give the condition about Damped Harmonic Oscillations. | CO1 / C | 4 |
| c. | How Fiber endoscope is working in Human Body? | CO1 / R | 4 |
|  |  | **Compulsory:** | | |
| 24. | a. | Drive an expression for Gauss Divergence Theorem. | CO1 / An | 4 |
| b. | Obtain the Poynting’s theorem for the conservation of energy in electromagnetic field. | CO1 / C | 5 |
| c. | Define Stoke’s Theorem. | CO1 / R | 3 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the basics of Lasers |
| CO2 | Explain and interpret the concepts of Optical Fiber Cables |
| CO3 | Apply the fundamentals laws concerning Oscillations |
| CO4 | Discern the laws governing Wave Motion. |
| CO5 | Evaluate and perceive the various laws governing Dielectric Materials |
| CO6 | Understand the basic principles Electromagnetic Theory |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 1 |  | 7 |  | 6 | 19 |
| CO2 | 6 |  | 3 | 4 | 4 |  | 17 |
| CO3 | 1 | 6 | 3 | 3 | 3 | 1 | 17 |
| CO4 | 6 | 1 |  | 5 |  | 10 | 22 |
| CO5 | 3 | 8 | 4 | 8 | 5 |  | 28 |
| CO6 | 6 | 3 | 4 |  | 5 | 3 | 21 |
|  | | | | | | | **124** |



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| **Course Code** | **20OP2001** | **Duration** | **3hrs** |
| **Course Name** | **PHYSICAL AND GEOMETRICAL OPTICS I** | **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. | Write a note on Huygen’s wave theory of light. | CO1 | U | 4 |
|  | b. | Explain the properties of light with the help of neat diagrams. | CO1 | U | 16 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain total internal reflection with the help of a neat diagram. | CO1 | R | 8 |
|  | b. | Compare the laws of reflection and refraction with diagrams. | CO1 | U | 6 |
|  | c. | Why do we see colours? Briefly explain the concept of visible light and the eye. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 3. | a. | Briefly explain the two types of lenses, their anatomy and language. | CO2 | U | 12 |
|  | b. | Distinguish between spherical, cylindrical and contact lens. | CO2 | An | 8 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write a note on constructive and destructive interference. | CO3 | R | 4 |
|  | b. | Explain the interference in thin films and wedge shaped thin films with conditions. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 5. | a. | Distinguish between Fresnel and Fraunhofer diffraction with the help of neat diagrams. | CO3 | An | 10 |
|  | b. | Give a brief note on the practical applications of diffraction. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Light of wavelength 5890 Ao has wavetrains of 16λ. Calculate coherence length and coherence time. | CO5 | A | 4 |
|  | b. | Write a note on the polarization of light, its types and methods. Mention few applications of polarization. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 7. | a. | Briefly explain emission and absorption spectra. | CO4 | R | 4 |
|  | b. | Illustrate and explain electromagnetic spectrum.  Mention the names of electromagnetic radiation and its uses. | CO1 | U | 16 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Briefly explain:  (i) Photoelectric effect  (ii) Raman effect | CO4 | U | 6 |
|  | b. | What is glare? Give 3 examples for direct and indirect glares. Explain different types of glare in detail. | CO4 | U | 14 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Elaborate the working of Michelson interferometer and Fabry-Perot interferometer. | CO6 | U | 20 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Describe the usage of various theories and components of light. |
| CO2 | Report the effect of interference of light on lenses. |
| CO3 | Apply the knowledge of combination of optical principles such as interference, diffraction, polarization in optical elements. |
| CO4 | Design an optical system, component to meet desired needs of optometry. |
| CO5 | Solve problems in optical physics and lens assembly. |
| CO6 | Demonstrate the techniques , skills, and modern tools necessary for optical physics in analytical instruments. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 8 | 42 | - | - | - | - | 50 |
| CO2 | - | 12 | - | 8 | - | - | 20 |
| CO3 | 14 | 32 | - | 10 | - | - | 56 |
| CO4 | 4 | 26 | - | - | - | - | 30 |
| CO5 | - | - | 4 | - | - | - | 4 |
| CO6 | - | 20 | - | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2002** | **Duration** | **3hrs** |
| **Course Name** | **GENERAL ANATOMY AND GENERAL PHYSIOLOGY** | **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. | Define anatomy and physiology. | CO3 | R | 3 |
|  | b. | Classify different types of anatomy. | CO3 | U | 7 |
|  | c. | Illustrate on the types of bones in Axial system with suitable diagrams. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Recall the types of blood vessels. | CO2 | R | 3 |
|  | b. | Classify the pulmonary artery and pulmonary vein based on the functions. | CO2 | U | 7 |
|  | c. | Interpret the working of pulmonary and systemic circulation with a neat diagram of the heart. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Recall the location of meibobian glands in the eyes. | CO6 | R | 3 |
|  | b. | Contrast the different layers of retina with a schematic diagram and label the parts. | CO6 | U | 7 |
|  | c. | Differentiate outer, middle and inner layers of the eye structure with a neat diagram and mention their functions. | CO6 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Name the soft muscle that is present in the middle layer of eyes which helps in lens accommodation. | CO6 | R | 3 |
|  | b. | Explain the role of different layers of cornea with a neat diagram. | CO6 | U | 7 |
|  | c. | Analyze the role of different layers in a tear film in the eyes with a neat diagram. | CO6 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Define homeostasis. | CO2 | R | 3 |
|  | b. | Interpret the role of homeostasis in functioning of human body with examples. | CO2 | U | 7 |
|  | c. | Construct the vector diagram of blood flow through heart. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discover the method of supply of nutrients to cornea. | CO2 | R | 3 |
|  | b. | Summarize the composition and function of blood with a neat diagram. | CO2 | U | 7 |
|  | c. | With a neat diagram, show the blood circulation to the eyes from heart through ophthalmic arteries. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Recall the difference between breathing and respiration. | CO3 | R | 3 |
|  | b. | Explain the Tidal volume and total lung volume using a graph. | CO3 | U | 7 |
|  | c. | Analyze the structure of Nephron and its role in kidney functioning. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Recall the enzyme secreted by salivary glands. | CO4 | R | 3 |
|  | b. | Interpret the role of lymphatic vessel in the microvilli structures with a neat diagram. | CO1 | U | 7 |
|  | c. | Compare the role of small and large intestine in the digestion of food with a neat diagram. | CO4 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Give the expansion for CNS and PNS. | CO5 | R | 3 |
|  | b. | Classify Neurons, Nerves and Nervous system. | CO5 | U | 7 |
|  | c. | Draw the structure of Neuron and explain the parts. | CO5 | An | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Recall outline on cells, their functions and membrane transportation of cells. |
| CO2 | Understand the composition of blood and its function on maintaining homeostasis. |
| CO3 | Elaborate the components of respiratory and cardiovascular systems. |
| CO4 | Describe about the anatomical locations, structures and their physiological functions. |
| CO5 | Analyse the structure and functions of nervous system and parts of brain. |
| CO6 | Evaluate the functions of eye, ear and kidney. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 7 |  |  |  |  | 7 |
| CO2 | 9 | 21 | 20 |  |  |  | 50 |
| CO3 | 6 | 14 | 10 |  |  |  | 30 |
| CO4 | 3 | 10 | 10 |  |  |  | 23 |
| CO5 | 3 | 7 | 20 |  |  |  | 30 |
| CO6 | 6 | 14 | 20 |  |  |  | 40 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2006** | **Duration** | **3hrs** |
| **Course Name** | **PHYSICAL AND GEOMETRICAL OPTICS II** | **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 concept of refraction through a convex and concave spherical surface. | CO1 | A | 14 |
|  | b. | Explain the different types of lenses with a schematic diagram and depict their ray propagations. | CO1 | R | 6 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the concept of convergence and divergence by convex and concave lenses using ray diagrams. | CO1 | An | 14 |
|  | b. | Imagine the optical fibre cable and briefly write about total internal reflection. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 3. | a. | Enumerate the relations expressing the lateral magnification and angular magnification. | CO2 | E | 5 |
|  | b. | Draw the schematic diagram of two thin lenses separated by a small distance. Represent the ray propagation between them and obtain the focal length of the combination of the two thin lenses. | CO2 | An | 15 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | With a neat diagram, explain the cardinal points with special reference to their ray propagations through the points. | CO3 | C | 10 |
|  | b. | Discuss the two co-axial thin lens assembly and express their focal length. | CO3 | C | 10 |
|  |  |  |  |  |  |
| 5. | a. | Obtain an expression for focal length of a thick lens. | CO3 | A | 16 |
|  | b. | Determine the position of the focal points, principal points and nodal points in the case of a sphere of radius 10 cm and µ=1.5. Indicate their positions in a diagram. | CO3 | E | 4 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the concept of translation, reflection and refraction in ray propagation and with the help of matrix theory obtain their matrices. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 7. |  | Write short notes on   1. sphero cylindrical lenses 2. Chromatic aberration 3. Cylindrical lens 4. circle of least confusion | CO4 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the location of focal points of image and object for a cylindrical type of lens with diagram. | CO5 | An | 10 |
|  | b. | Elaborate the mechanism of refraction through a sphero cylindrical lens. | CO5 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Write short notes on (i) achromatic prism (ii) magnification in mirrors. | CO6 | R | 6 |
|  | b. | Derive the equation for dispersive power of the prism. | CO6 | A | 14 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the stimulus vision, spherical vision and focal points. |
| CO2 | Interpret the laws of prism diopter, power, and magnification principles. |
| CO3 | Demonstrate the power manipulation in thick lenses with matrix theory. |
| CO4 | Apply the cylindrical and sphero-cylindrical lenses, techniques to calculate the different meridians power. |
| CO5 | Evaluate the motion of physical systems. |
| CO6 | Apply the concept stops, pupils and ports on the optical systems to overcome the distortions. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 |  | 20 | 14 |  |  | 40 |
| CO2 |  |  |  | 15 | 5 |  | 20 |
| CO3 |  |  | 16 |  | 4 | 20 | 40 |
| CO4 |  | 20 | 20 |  |  |  | 40 |
| CO5 |  |  | 10 | 10 |  |  | 20 |
| CO6 | 6 |  | 14 |  |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2007** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTING AND COMPUTER APPLICATIONS** | **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. | Give an outline about input devices. Discuss the different types of keyboards commonly used. | CO1 | R | 15 |
| b. | Differentiate primary and secondary memory. | CO1 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Memory is an essential component of any digital computer. Validate and classify them in detail. | CO1 | U | 15 |
| b. | List the characteristics of impact printers. | CO1 | R | 5 |
|  |  |  |  |  |  |
| 3. | a. | Define software. Give an account on the application software. | CO2 | A | 15 |
| b. | Expand SMPS and recall some of its features. | CO2 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Distinguish in detail between LAN, WAN and MAN. | CO2 | A | 15 |
| b. | Summarize on the basic services of internet. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 5. |  | Define an operating system. Explain in detail the basic features, components and architecture of Linux operating system with necessary diagram. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Recognize the five different generations of a computer programming language and discuss them in detail. | CO3 | An | 15 |
| b. | Write short notes on compilers. | CO3 | U | 5 |
|  |  |  |  |  |  |
| 7. | a. | Give an account on the control statement. Classify and explain them with neat syntax. | CO4 | A | 15 |
| b. | List the rules for using identifiers in a C program. | CO4 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Operators are symbol used to perform operations on variables, operands or with the constant in C program. Validate and explain their types in detail. | CO5 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain the following in detail,   1. Encapsulation 2. Inheritance 3. Polymorphism | CO6 | U | 20 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Recall the history of computers and its characteristics. |
| CO2 | Understand the functions of different ports in hardware and software tools. |
| CO3 | Apply the knowledge on office applicate suite for programming specific cases. |
| CO4 | Interpret the functions, arrays, union, structures and pointers in C language. |
| CO5 | Analyze specific clinical data required for the history of individuals. |
| CO6 | Evaluate the data for any specific conditions to process for further references and data processing. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 | 20 |  |  |  |  | 40 |
| CO2 | 5 | 5 | 30 |  |  |  | 40 |
| CO3 |  | 5 |  | 35 |  |  | 40 |
| CO4 |  | 5 | 15 |  |  |  | 20 |
| CO5 |  |  | 20 |  |  |  | 20 |
| CO6 |  | 20 |  |  |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2008** | **Duration** | **3hrs** |
| **Course Name** | **NUTRITION** | **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 food pyramid and balanced diet in brief. | CO1 | U | 6 |
|  | b. | Explain food groups in detail with necessary examples. Also discuss the limitations of food guide and RDA. | CO1 | A | 14 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss the term ‘nutritional science’ and its requirement in daily life. | CO1 | U | 6 |
|  | b. | Differentiate macro and micro nutrient in detail. Explain the role of food nutrients in general health and mention its importance. | CO1 | A | 14 |
|  |  |  |  |  |  |
| 3. | a. | Describe various classification of Carbohydrate in detail. | CO2 | R | 6 |
|  | b. | Illustrate the sources of carbohydrate with adequate examples and state some of the important functions of carbohydrates in detail. | CO2 | A | 14 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Compare and contrast functional fibre and dietary fibre and discuss its availability through various food sources. | CO5 | An | 6 |
|  | b. | Discuss resistant starch in brief and differentiate it with regular starch. Also explain the benefits of high-fibre diet and the health conditions linked to low dietary fibre. | CO6 | A | 14 |
|  |  |  |  |  |  |
| 5. | a. | Compare and contrast complete and incomplete proteins with necessary examples. | CO2 | U | 6 |
|  | b. | Illustrate any six attributes of Protein in nutrition and explain various function and food sources of proteins in detail. | CO2 | A | 14 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Define ‘Nitrogen Balance’ in nutrition and discuss its effects in general well-being. | CO6 | An | 6 |
|  | b. | Explain the main classification of fats in detail and elaborate its sources and functions with examples. | CO6 | A | 14 |
|  |  |  |  |  |  |
| 7. | a. | Categorize seven important functions of dietary fat in human body in detail. | CO5 | R | 6 |
|  | b. | Explain saturated, unsaturated and trans fats in detail. Discuss the sources of Omega 3 fatty acids and its health benefits in brief. | CO5 | A | 14 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Appraise energy expenditure and its various components in brief. | CO4 | An | 6 |
|  | b. | Explain different types of vitamins, food sources and general functions in detail. Mention the importance of Vitamin A in vision. | CO4 | A | 14 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Compare and contrast fat and water soluble vitamins in detail. | CO3 | An | 6 |
|  | b. | Illustrate the macro and micro minerals with examples. Describe the functions, food sources of Calcium and its disorders in human body in detail. | CO3 | A | 14 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the importance of balanced food and food groups. |
| CO2 | Classify the carbohydrates, Fats and proteins and its presence in different sources. |
| CO3 | Demonstrate the role of Macro and micro minerals associated with the eye defects. |
| CO4 | Measure the energy value of food, Energy expenditure. |
| CO5 | Calculate the total energy/calorie requirement for different age groups and diseases. |
| CO6 | Recommend suitable diet plan for a specific case related to different conditions of eye. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | 6 | 14 | 14 |  |  | 40 |
| CO2 | 6 | 6 | 14 | 14 |  |  | 40 |
| CO3 |  | 6 |  | 14 |  |  | 20 |
| CO4 | 6 | 6 |  | 14 |  |  | 26 |
| CO5 | 14 | 6 | 14 |  |  |  | 34 |
| CO6 | 6 |  | 14 |  |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2018** | **Duration** | **3hrs** |
| **Course Name** | **OPTOMETRIC OPTICS II** | **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. | Categorize tinted lenses and discuss their characteristics in detail. | CO1 | U | 14 |
|  | b. | Describe the following   1. Need of absorptive lens 2. Effect of Ionizing Radiation 3. Effect of non-Ionizing Radiation | CO1 | A | 6 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Clarify various methods of tinting in detail with neat sketches. | CO1 | A | 14 |
|  | b. | List the options for protecting the eye from solar UV radiation. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 3. | a. | Discuss photochromic lenses and their manufacturing process in detail. | CO2 | U | 14 |
|  | b. | Illustrate the manufacturing of polarized lens. | CO2 | U | 6 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Paraphrase the anatomy, types, characteristics and disadvantages of bifocal lenses with neat sketches. | CO2 | A | 14 |
|  | b. | Distinguish bifocal, trifocal and progressive lenses. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 5. | a. | Summarize the characteristics of progressive addition lens. | CO2 | U | 14 |
|  | b. | Explain any two designs of PAL and distinguish the same. | CO5 | U | 6 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Give detailed information about the ghost images by reflection and recommend the methods to solve them. | CO3 | A | 14 |
|  | b. | List out the benefits of glasses with anti-reflective coating. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 7. | a. | Write a report on the application of Anti-fog coating in spectacle lenses. | CO4 | U | 14 |
|  | b. | (i)Tabulate the difference between hydrophilic and hydrophobic anti-fog coating.  (ii) Propose the ideal way to clean an anti-fog coating. | CO4 | An | 6 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Outline the edge coating of lenses. | CO5 | U | 14 |
|  | b. | Identify the need of hard multi-coating and illustrate the advantages of the same. | CO5 | A | 6 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Sketch the manufacturing methods of Aspherical lenses in detail. | CO6 | A | 20 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Define the properties and characteristics of the tinted and protective lenses. |
| CO2 | Describe the different types of filters used in lenses with their merits. |
| CO3 | Examine the reflected images and ghost images from the spectacle lenses. |
| CO4 | Analyse the effect of anti-reflective, anti-fog and anti-scratch coatings on the lenses. |
| CO5 | Appraise on the size, shape and mounting of the lenses. |
| CO6 | Design and develop flawless, purpose solving spectacle lenses suitable for the patients. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 14 | 20 | 6 |  |  | 40 |
| CO2 |  | 34 | 14 | 6 |  |  | 54 |
| CO3 |  |  | 20 |  |  |  | 20 |
| CO4 |  | 14 | 6 |  |  |  | 20 |
| CO5 |  | 20 | 6 |  |  |  | 26 |
| CO6 |  |  | 20 |  |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2020** | **Duration** | **3hrs** |
| **Course Name** | **VISUAL OPTICS II** | **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 Presbyopia in detail with relevant diagrams. | CO1 | R | 6 |
|  | b. | Illustrate Anisometropia in brief. Discuss Aphakia and Pseudo Aphakia with necessary examples and diagrams. | CO1 | A | 14 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define the refractive error amblyopia and discuss its various classifications. | CO1 | R | 6 |
|  | b. | Appraise the refractive error aniseikonia, symptoms and its treatment in detail. Also discuss the clinical classification of aniseikonia with appropriate diagram. | CO1 | An | 14 |
|  |  |  |  |  |  |
| 3. | a. | Classify various types of ‘accommodation’ in detail. | CO2 | U | 6 |
|  | b. | Illustrate near point and far point of accommodation in detail and associate this concept for the emmetropic, and myopic eyes with diagrams. | CO2 | A | 14 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Calculate the AC/A ratio for the value of inter-pupillary distance (IPD) value of 56mm, the patient is 4.5 Δ exphoric at distance and 9Δ esophoric at near (60cm). | CO2 | U | 6 |
|  | b. | Illustrate AC/A ratio and explain the two different methods used to calculate this ratio in detail with any one numerical example. | CO2 | An | 14 |
|  |  |  |  |  |  |
| 5. | a. | Appraise the concept of retinoscope and its classification of methods in detail. | CO3 | An | 6 |
|  | b. | Illustrate the projection and observation system of a streak retinoscope in detail with adequate diagram mentioning the parts and its functions. | CO3 | A | 14 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Compare and contrast the methods of static and dynamic retinoscope. | CO3 | U | 6 |
|  | b. | Illustrate the ‘Neutralization’ method in retinoscope and discuss the various prerequisites involved to perform retinoscopy in laboratory. | CO3 | A | 14 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the procedures and steps involved in the duo-chrome test. | CO4 | A | 6 |
|  | b. | Demonstrate the Jackson cross cylinder technique in detail for determination of Astigmatism in a patient and to observe the correct cylinder axis and power. | CO4 | An | 14 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Differentiate ocular and spectacle accommodation in detail with examples. | CO5 | U | 6 |
|  | b. | Illustrate how the monocular viewing under binocular conditions can be achieved using concept septum and fogging. Also, explain Binocular refraction and its advantages over monocular refraction in detail. | CO5 | A | 14 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe depth of field and depth of focus while carrying out the procedure of spectacle correction. | CO6 | R | 6 |
|  | b. | Analyze the concepts of the terms vertex distance and its effects, vertex compensation power and effective power in detail with adequate examples. | CO6 | An | 14 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the different types of defects associated with vision. |
| CO2 | Recognize various refractive conditions and relate both accommodation and convergence. |
| CO3 | Review on the methods and optimum conditions such as static and dynamic of retinoscopy. |
| CO4 | Compare the objective and subjective refractive methods along with other methods for  Astigmatism. |
| CO5 | Interpret on the astigmatic test and difficulties in objective tests. |
| CO6 | Analyze and correct the defects that are connected to the spectacles. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 12 |  | 14 | 14 |  |  | 40 |
| CO2 |  | 12 | 14 | 14 |  |  | 40 |
| CO3 |  | 6 | 28 | 6 |  |  | 40 |
| CO4 |  |  | 6 | 14 |  |  | 20 |
| CO5 |  | 6 | 14 |  |  |  | 20 |
| CO6 | 6 |  |  | 14 |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2021** | **Duration** | **3hrs** |
| **Course Name** | **OPTOMETRIC INSTRUMENTATIONS** | **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. | List the different compartments of a trial frame. | CO1 | R | 5 |
|  | b. | Describe the different types of autorefractor and mention its uses. | CO1 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Demonstrate the different types of charts used in testing of near and far vision. | CO1 | A | 20 |
|  |  |  |  |  |  |
| 3. | a. | Define lensometer and mention its purpose. | CO2 | U+R | 2+3 |
|  | b. | Explain the instrumentation and optics in direct ophthalmoscope with a neat sketch. | CO2 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Demonstrate the use of ophthalmoscope in special cases. | CO2 | A | 5 |
|  | b. | Discuss the various methods of illumination used in slit lamp test. | CO2 | U | 15 |
|  |  |  |  |  |  |
| 5. |  | Define tonometry and briefly explain the working of each type of tonometry. | CO3 | R+U | 2+18 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Discuss the principle and purpose of fundus camera with a suitable sketch. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Explain the working principle of an ocular ultrasound. | CO5 | U | 5 |
|  | b. | Differentiate ‘A’ scan and ‘B’ scan in ophthalmic ultrasonography. | CO5 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Demonstrate the basic ERG waveform and components with respect to various layers of the retina with a neat sketch. | CO5 | A | 10 |
|  | b. | Define EOG and discuss the origins and measurement of EOG. | CO5 | R+U | 2+8 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the assessment method and working principle of Humphrey field analyser (HFA) as a tool for measuring the human visual field. | CO6 | U | 15 |
|  | b. | Explain the Traquair’s hill of vision. | CO6 | U | 5 |

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

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| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the various topics related to refractive instruments. |
| CO2 | Discuss about the design, features and advantages of ophthalmoscope and related devices. |
| CO3 | Illustrate on the principles, types and uses of tonometer. |
| CO4 | Interpret the techniques involved in fundus camera. |
| CO5 | Utilize the orthoptic and ophthalmic instruments for ultrasonography and electro diagnostics. |
| CO6 | Appraise on the results of various vision testing and screening devices. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 15 | 20 |  |  |  | 40 |
| CO2 | 3 | 32 | 5 |  |  |  | 40 |
| CO3 | 2 | 18 | - |  |  |  | 20 |
| CO4 | - | 20 | - |  |  |  | 20 |
| CO5 | 2 | 28 | 10 |  |  |  | 40 |
| CO6 | - | 20 | - |  |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2032** | **Duration** | **3hrs** |
| **Course Name** | **GLAUCOMA** | **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 in detail aqueous humor production with a neat sketch. | CO1 | U | 10 |
|  | b. | Explain in detail aqueous humor drainage with a neat diagram. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe primary open angle glaucoma and explain its types, clinical features, and management. | CO1 | U | 15 |
|  | b. | Explain in detail optic nerve head imaging diagnosis and its signs with a diagram. | CO1 | U | 5 |
|  |  |  |  |  |  |
| 3. | a. | Write about secondary open angle glaucoma and explain its types, clinical features, and management. | CO2 | A | 15 |
|  | b. | Explain ISNT RULE of optic rim with diagram. | CO2 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Discuss angle closure glaucoma and explain its types, clinical features and management. | CO2 | U | 15 |
|  | b. | Define Van Herrick grading. | CO2 | R | 5 |
|  |  |  |  |  |  |
| 5. | a. | Differentiate between direct and indirect gonioscopy and explain commonly used gonioscopy lens. | CO3 | An | 10 |
|  | b. | Briefly describe Goldman applanation tonometer procedure and interpretation. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain in detail about various grading system of anterior chamber angle. | CO3 | U | 15 |
|  | b. | Illustrate cup to disc ratio with diagram   1. Normal CD ratio. 2. Large cup disc ratio. | CO3 | A | 5 |
|  |  |  |  |  |  |
| 7. | a. | Explain optical coherence tomography and glaucoma relation with diagram. | CO4 | U | 15 |
|  | b. | Name the tonometer’s for IOP Measurement. | CO4 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain trabeculectomy surgery for POAG. | CO4 | U | 10 |
|  | b. | Explain medical management drugs for glaucoma. | CO4 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate Humphrey field analyzer test and explain the zones in interpretation. | CO5 | A | 15 |
|  | b. | Draw the different types of scotomas and explain it. | CO6 | A | 5 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the basics of glaucoma. |
| CO2 | Attain clear knowledge on the clinical examination of glaucoma. |
| CO3 | Interpret and diagnosis the different types of glaucoma. |
| CO4 | Articulate the medical characterisation of angle closure glaucoma. |
| CO5 | Detect developmental abnormality of angle of anterior chamber leading to high intraocular pressure. |
| CO6 | Adapt the proper medical treatment to normalize and control the intraocular pressure and to prevent loss of visual acuity. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 40 |  |  |  |  | 40 |
| CO2 | 5 | 20 | 15 |  |  |  | 40 |
| CO3 |  | 25 | 5 | 10 |  |  | 40 |
| CO4 | 5 | 35 |  |  |  |  | 40 |
| CO5 |  |  | 15 |  |  |  | 15 |
| CO6 |  |  | 5 |  |  |  | 5 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2033** | **Duration** | **3hrs** |
| **Course Name** | **PEDIATRIC OPTOMETRY AND GERIATRIC OPTOMETRY** | **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 a baby's visual development milestones. | CO1 | U | | 10 |
|  | b. | Illustrate the details on post-natal factors of neonates. | CO1 | R | | 10 |
|  |  | **(OR)** |  |  | |  |
| 2. | a. | Discuss about the ocular embryology in detail. | CO2 | U | | 15 |
|  | b. | Describe APGAR Score and its significance in optometry. | CO2 | U | | 5 |
|  |  |  |  |  | |  |
| 3. | a. | Explain the concepts on EOM in detail. | CO3 | R | | 10 |
|  | b. | Summarize the Congenital cataract and treatment. | CO4 | R | | 10 |
|  |  | **(OR)** |  |  | |  |
| 4. | a. | Discuss the orbital anomalies in detail with examples. | CO2 | R | | 10 |
|  | b. | Describe Bruckner's test and its interpretation. | CO4 | U | | 10 |
|  |  |  |  |  | |  |
| 5. |  | Explain in detail amblyopia, pathophysiology, types, diagnostic procedures and treatment options. | CO4 | U | | 20 |
|  |  | **(OR)** |  |  | |  |
| 6. |  | Describe nystagmus and its concepts in brief. Illustrate various types of nystagmus pathophysiology conditions, diagnostic procedures and treatment options in detail. | CO4 | U | | 20 |
|  |  |  |  |  | |  |
| 7. | a. | Explain in detail the structural changes of eye in geriatrics. | CO5 | U | | 15 |
|  | b. | Describe the instrument telescope and its applications in optometry in detail. | CO3 | R | | 5 |
|  |  | **(OR)** |  |  | |  |
| 8. |  | Illustrate with detailed notes on POAG, pathophysiology, clinical features and treatment options. | CO5 | R | | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | | |
| 9. |  | Explain low vision evaluation of geriatric people in detail. | CO6 | R | | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the principal theories of childhood and visual development. |
| CO2 | Analyse a thorough pediatric history which encompasses the relevant developmental, visual, medical and educational issues. |
| CO3 | Attain clear knowledge on the accommodative-vergence system to assess the pediatric eye disorders. |
| CO4 | Analyse the techniques for examining visual function of children of all ages and an understanding varied management concepts of pediatric vision disorders. |
| CO5 | Identify and investigate the age related changes in the eyes. |
| CO6 | Demonstrate dispensing contact lens, low vision aids and referral to the surgeon. |

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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 | 20 | - | - | - | - | 30 |
| CO3 | 15 | - | - | - | - | - | 15 |
| CO4 | 10 | 50 | - | - | - | - | 60 |
| CO5 | 20 | 15 | - | - | - | - | 35 |
| CO6 | 20 | - | - | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2034** | **Duration** | **3hrs** |
| **Course Name** | **CONTACT LENS** | **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. | Briefly explain corneal anatomy and physiology with diagram. | CO1 | An | 15 |
|  | b. | Give a note on sagittal depth. | CO1 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe slit lamp biomicroscopy illumination techniques. | CO6 | R | 10 |
|  | b. | Discuss the optics of contact lenses with neat diagram. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Enlist the indications of contact lenses. | CO2 | R | 10 |
|  | b. | Explain the procedure of BC measurement in keratometry. | CO6 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe the contra-indications of contact lenses. | CO2 | U | 10 |
|  | b. | Explain the FDA classification of CL based on DK. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. |  | Write down the philosophy of SCL fitting and assessment. | CO4 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Elaborate the fitting assessment of rigid gas permeable contact lens. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the soft toric contact lens fitting and assessment in detail. | CO4 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the various considerations for fitting contact lens in children. | CO4 | U | 15 |
|  | b. | Explain bandage contact lens. | CO5 | U | 5 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain the risk and complications involved in soft contact lens. | CO5 | U | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the history and basics of contact lenses. |
| CO2 | List the important properties of contact lenses. |
| CO3 | Predict the contact lens design for various kinds of patients. |
| CO4 | Recognize various type of contact lens fitting. |
| CO5 | Hypothesize the contact lens care procedures for the awareness of the patients. |
| CO6 | Demonstrate the instrumentation in contact lens practices. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 15 | - | 15 | - | - | 30 |
| CO2 | 10 | 10 | - | - | - | - | 20 |
| CO3 | - | 10 | - | - | - | - | 10 |
| CO4 | 20 | 55 | - | - | - | - | 75 |
| CO5 | - | 25 | - | - | - | - | 25 |
| CO6 | 10 | 10 | - | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20OP2035** | **Duration** | **3hrs** |
| **Course Name** | **OCCUPATIONAL OPTOMETRY** | **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 in detail any five aims of Labour law. | CO1 | U | 10 |
|  | b. | Discuss the importance of Occupational safety. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain any five objectives of ILO on occupational health. | CO1 | U | 10 |
|  | b. | Discuss any five aims of WHO on occupational health. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. |  | Elaborate occupational diseases caused by Biological agents. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain occupational diseases caused by chemical agents. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Illustrate the Light measurements and standards in detail. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Briefly explain Colour Vision and test types in detail. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain Ultra Violet wave types and its effects on eye in depth. | CO4 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Summarize the ways of protection of laser hazards. | CO5 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain in detail about visual standards for various occupations. | CO6 | U | 20 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the occupational health. |
| CO2 | Identify the visual requirements in various jobs. |
| CO3 | Illustrate the effects of Physical, chemical and biological hazards on eye and vision. |
| CO4 | Analyze occupational causes of visual and eye problems. |
| CO5 | Prescribe suitable corrective lenses and eye protective wear to the patients. |
| CO6 | Formulate visual requirements and standards for different jobs. |

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



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| **Course Code** | **20OP2036** | **Duration** | **3hrs** |
| **Course Name** | **SYSTEMATIC DISEASES** | **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 in detail about hypertension, clinical features, and its management. | CO1 | U | 10 |
|  | b. | Identify the different stages of hypertensive retinopathy. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the different forms of arthritis. | CO1 | R | 10 |
|  | b. | Explain episcleritis and scleritis. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Summarize diabetes mellitus, clinical features, and management. | CO2 | U | 10 |
|  | b. | Evaluate the stages of diabetic retinopathy. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain in detail hyper and hypo thyroidism. | CO2 | U | 15 |
|  | b. | What is thyroid orbitopathy? | CO2 | R | 5 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the various types and stages of cancer and its management. | CO4 | U | 10 |
|  | b. | Explain in detail the tumors in eye. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | What is the mode of transmission of tuberculosis? Explain in detail about clinical features and management of tuberculosis. | CO4 | A | 10 |
|  | b. | Recall about uveitis caused by tuberculosis. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain in detail acquired heart disease. | CO3 | R | 10 |
|  | b. | Demonstrate the retinal vein occlusion clinical features and its management. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain Nutritional Deficiency. | CO6 | An | 10 |
|  | b. | Assess the Vitamin A deficiency disorder of eye. | CO5 | E | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss Cerebral vascular accident. | CO5 | A | 10 |
|  | b. | Summarize vitamin and nutritional disorders of eye. | CO5 | U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the common systematic conditions. |
| CO2 | Classify the various systematic diseases and the respective clinical examinations. |
| CO3 | Perform the clinical diagnosis of diverse systematic diseases. |
| CO4 | Acquaint with the first aid knowledge and management options |
| CO5 | Analyse the Ocular findings of the systematic conditions. |
| CO6 | Design the report on malnutrition and immunology. |

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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 | 5 | 35 |  |  |  |  | 40 |
| CO3 | 20 | 10 |  |  |  |  | 30 |
| CO4 |  | 10 | 20 |  |  |  | 30 |
| CO5 |  | 10 | 10 |  | 10 |  | 30 |
| CO6 |  |  |  | 10 |  |  | 10 |
|  | | | | | | | **180** |



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| **Course Code** | **20PH1001** | **Duration** | **3hrs** |
| **Course Name** | **ELEMENTS OF PHYSICS IN AVIATION** | **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. | Light rays passing through \_\_\_\_\_\_\_\_ lens converges. | | CO1 | R | 1 |
| 2. | Images formed by convex mirrors are \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | The \_\_\_\_\_\_\_\_\_\_\_\_\_\_is the foundation of electrical and electronics power engineering | | CO2 | R | 1 |
| 4. | The \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is defined as the force per unit charge at that point. | | CO2 | R | 1 |
| 5. | Define induced Emf. | | CO3 | R | 1 |
| 6. | Explain magnetic flux line. | | CO3 | R | 1 |
| 7. | Explain types of mechanical waves. | | CO4 | R | 1 |
| 8. | Write the expression for a Wave function y (x,t). | | CO4 | U | 1 |
| 9. | \_\_\_\_\_\_\_\_\_\_\_\_\_is the study of interaction between radiation and matter. | | CO5 | R | 1 |
| 10. | The viscosity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_when temperature increases. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Recall reflection, refraction and diffraction. | | CO1 | R | 3 |
| 12. | List the sources of magnetic field. | | CO2 | R | 3 |
| 13. | List out some electrical safety devices. | | CO3 | R | 3 |
| 14. | Write the working principle of sonar. | | CO4 | R | 3 |
| 15. | Mention the limitations of AFM. | | CO5 | R | 3 |
| 16. | Derive the height of center of pressure for triangle. | | 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. | Compare spontaneous absorption and emission of lasers. | CO1 | U | 4 |
|  | b. | Explain construction and working of He:Ne Laser with applications. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 18. | a. | Discuss about capacitors and its working. | CO2 | U | 9 |
|  | b. | List the factors affecting capacitance. | CO2 | R | 3 |
|  |  |  |  |  |  |
| 19. |  | Explain the construction and working of electrical generators with neat sketches. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Discuss about the electromagnetic waves and its characteristics present in the electromagnetic spectrum. | CO4 | R | 9 |
|  | b. | Define wave interference with neat sketch. | CO4 | R | 3 |
|  |  |  |  |  |  |
| 21. |  | Explain the working, construction and application of AFM with neat sketches. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain differential thermal analysis with neat diagram. | CO5 | R | 8 |
|  | b. | List the advantages and disadvantages of SEM. | CO5 | R | 4 |
|  |  |  |  |  |  |
| 23. |  | Distinguish between capillary rise and capillary depression with neat sketch and example. | CO6 | R | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss Bernoulli’s equation and its applications. | CO6 | R | 8 |
|  | b. | Explain Archimedes principle. | CO6 | R | 4 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Compare the laws of optics with regards to reflection, refraction, interference, diffraction and polarization. |
| CO2 | Explain various laws governing oscillations and waves. |
| CO3 | Appraise the characterization ability of analytical instruments. |
| CO4 | Describe the interplanetary travel in solar system. |
| CO5 | Describe the characteristics of acoustic waves. |
| CO6 | Demonstrate the process of obtaining nanomaterial and its applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 12 | - | - | - | - | 17 |
| CO2 | 8 | 9 | - | - | - | - | 17 |
| CO3 | 5 | 12 | - | - | - | - | 17 |
| CO4 | 16 | 1 | - | - | - | - | 17 |
| CO5 | 28 | - | - | - |  | - | 28 |
| CO6 | 28 | - | - | - | - | - | 28 |
|  | | | | | | | **124** |



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| **Course Code** | **20PH1011** | **Duration** | **3hrs** |
| **Course Name** | **PHYSICAL 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. | Define an electron. | | CO1 | R | 1 |
| 2. | State the formula to represent the mobility of an electron. | | CO1 | R | 1 |
| 3. | Define PN junction. | | CO2 | R | 1 |
| 4. | Give an example of pentavalent impurity. | | CO2 | U | 1 |
| 5. | List any two field effect transistors. | | CO3 | R | 1 |
| 6. | Identify the controlling terminal in the MOS structure. | | CO3 | U | 1 |
| 7. | Pitch is directly propotional to ----------. | | CO4 | R | 1 |
| 8. | Define Loudness. | | CO4 | R | 1 |
| 9. | Indicate the principle behind the ultrasonic flaw detector. | | CO5 | U | 1 |
| 10. | Write any two non-conventional sources of energy. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Illustrate the energy band diagram of semiconductor. | | CO1 | U | 3 |
| 12. | Write any three applications of PN junction diode. | | CO2 | A | 3 |
| 13. | Compare depletion mode and enhancement mode of a MOS device. | | CO3 | U | 3 |
| 14. | Interpret the characteristics of musical sound. | | CO4 | U | 3 |
| 15. | Describe the basic principle of acoustic grating. | | CO5 | R | 3 |
| 16. | Classify the types of tides based on tidal range. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the Boltzmann transport equation and solution in the presence of low electric and magnetic fields. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe the formation of PN junction and illustrate the movement of charges in forward bias and reverse bias conditions. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Classify the types of MOSFET and discuss the operation of P-channel Depletion MOSFET. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Write the factors that should be considered while judging the quality of the acoustics of a room, a hall, or an auditorium. Suggest remedies to improve the same. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe magnetostriction method and explain in detail the method of producing ultrasonics using the same. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Piezoelectric effect was discovered initially during the early 1900s and it has been successfully employed in various important applications. Explain in detail the method of producing ultrasonic waves by inverse piezoelectric method. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the photovoltaic effect which uses the sun’s energy to produce renewable forms of electricity and hence define the construction, principle, and working of a photovoltaic cell. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the process of generating electricity through wind energy conversion system. | CO6 | U | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Remember the fundamentals of semiconducting physics. |
| CO2 | Understand the principle and operation of semiconductor junctions. |
| CO3 | Demonstrate the MOS structures. |
| CO4 | Analyse the application of acoustics in construction and acoustic design. |
| CO5 | Ability to explore the application of ultrasonics in various fields. |
| CO6 | Understand about the renewable energy sources and devices. |

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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 | 13 | 3 | - | - | - | 17 |
| CO3 | 1 | 16 | - | - | - | - | 17 |
| CO4 | 2 | 3 | 12 | - | - | - | 17 |
| CO5 | 3 | 25 | - | - | - | - | 28 |
| CO6 | - | 27 | 1 | - | - | - | 28 |
|  | | | | | | | **124** |



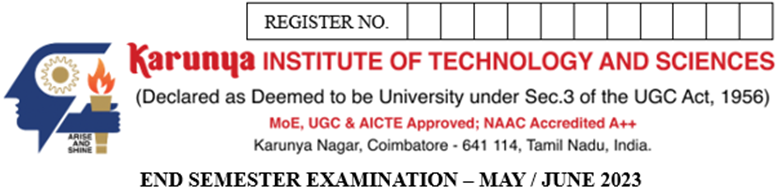
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| **Course Code** | **20PH1015** | **Duration** | **3hrs** |
| **Course Name** | **PHYSICS FOR ROBOTICS ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Give the equation for force. | | | CO1 | R | 1 |
| 2. | The inertia of a body is inversely proportional to its mass. True/False | | | CO1 | An | 1 |
| 3. | Longitudinal stress produced due to the decrease in length of the object is known as \_\_\_\_\_\_\_\_\_\_\_\_ stress. | | | CO2 | R | 1 |
| 4. | Young’s modulus is defined only for solid and not for liquids and gases. True/False | | | CO2 | A | 1 |
| 5. | What is rigid body? | | | CO3 | U | 1 |
| 6. | A ceiling fan is an example for \_\_\_\_\_\_\_\_\_\_\_ motion. | | | CO3 | A | 1 |
| 7. | Physical pendulum will not execute simple harmonic motion. True/False | | | CO4 | An | 1 |
| 8. | The smallest time interval after which the oscillation repeats is called as \_\_\_\_\_\_\_\_.   1. Phase 2. Frequency 3. Time period 4. Amplitude | | | CO4 | R | 1 |
| 9. | Mention any two applications of laser. | | | CO5 | A | 1 |
| 10. | Why do the core and cladding has different refractive indices? | | | CO6 | E | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Discuss on work done by the constant force. | | | CO1 | A | 3 |
| 12. | Classify strain and explain them. | | | CO2 | U | 3 |
| 13. | Clarify the translatory motion of a rigid body. | | | CO3 | A | 3 |
| 14. | Define periodic and oscillatory motion. | | | CO4 | R | 3 |
| 15. | List and explain the properties of laser. | | | CO5 | U | 3 |
| 16. | Sketch the structure of optical fiber and explain the same. | | | 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 force and momentum. | CO1 | U | 4 |
|  | | b. | State Newton’s laws of motion. Demonstrate each of them with example and applications | CO1 | A | 8 |
|  | |  |  |  |  |  |
| 18. | |  | Elucidate the following.   1. Rigidity Modulus 2. Bulk Modulus | CO2 | U | 12 |
|  | |  |  |  |  |  |
| 19. | | a. | State and explain Euler’s two laws of motion of a rigid body. | CO3 | U | 4 |
|  | | b. | Write a detailed report on rigid body and its motion with examples. | CO3 | A | 8 |
|  | |  |  |  |  |  |
| 20. | |  | Illustrate and derive the equation of motion of a simple harmonic motion. | CO4 | A | 12 |
|  | |  |  |  |  |  |
| 21. | |  | Demonstrate the principle, recording and reconstruction of hologram with appropriate diagrams. | CO5 | A | 12 |
|  | |  |  |  |  |  |
| 22. | |  | Derive an expression for position vector of center of mass for a three particle system. | CO1 | A | 12 |
|  | |  |  |  |  |  |
| 23. | |  | Illustrate the following   1. Methods of achieving population inversion. 2. Principle of laser. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | |  | Paraphrase the different types of optical fibers in detail. | CO6 | U | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Apply Newtonian Mechanics to solve problems. |
| CO2 | Demonstrate the ability to solve the problems based on modulus of elasticity. |
| CO3 | Analyze rigid body mechanics using transformations. |
| CO4 | Apply the fundamentals laws concerning Oscillations. |
| CO5 | Discuss about the concepts of lasers and its applications. |
| CO6 | Relate the application of fibre optics in optic devices. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 4 | 23 | 1 |  |  | 29 |
| CO2 | 1 | 15 | 1 |  |  |  | 17 |
| CO3 |  | 5 | 12 |  |  |  | 17 |
| CO4 | 4 |  | 12 | 1 |  |  | 17 |
| CO5 |  | 15 | 13 |  |  |  | 28 |
| CO6 |  | 15 |  |  | 1 |  | 16 |
|  | | | | | | | **124** |

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| **Course Code** | **20PH1017** | **Duration** | **3hrs** |
| **Course Name** | **APPLIED PHYSICS FOR BIOTECHNOLOGY ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | | | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | Mention few characteristics of laser. | | | | | CO1 | U | 1 |
| 2. | In laser, combination of 100% reflecting mirror and less than 100% partially reflecting mirror is called …………cavity. | | | | | CO1 | R | 1 |
| 3. | Propagation in optical fiber is classified as ……… ray and …… ray. | | | | | CO2 | R | 1 |
| 4. | The principle of optical fiber is …………… reflection. | | | | | CO2 | U | 1 |
| 5. | …………….is the medium in which the ultrasound travels with less velocity. | | | | | CO3 | U | 1 |
| 6. | In magnetostriction oscillator ……….. material is used to produce ultrasound. | | | | | CO3 | R | 1 |
| 7. | State any two characteristics of musical sound. | | | | | CO4 | U | 1 |
| 8. | In acoustics the prolongation of a sound wave even after the source is cut off is called as …………….. | | | | | CO4 | R | 1 |
| 9. | Mention any two examples of ferro magnetic material. | | | | | CO5 | U | 1 |
| 10. | In superconductivity, ……………… is the effect which is used to levitate train. | | | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | Describe ‘spontaneous absorption’ and ‘stimulated emission’ in lasers. | | | | | CO1 | An | 3 |
| 12. | Calculate the numerical aperture of a fiber with refractive indices used as n1 = 1.72 and n2 = 1.63. | | | | | CO2 | U | 3 |
| 13. | Define Magnetostriction effect in ultrasonics with an example. | | | | | CO3 | An | 3 |
| 14. | Define reverberation time in acoustics. | | | | | CO4 | U | 3 |
| 15. | Differentiate the characteristics of hard and soft magnetic materials. | | | | | CO5 | An | 3 |
| 16. | Describe the principle of ‘superconductivity’ and mention its various types. | | | | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | | | |
| 17 | |  | | Appraise the concept and deduce an equation to prove the existence of stimulated emission in lasers using Einstein’s quantum theory of radiation. | CO1 | | E | 12 |
| 18. | | a. | | Describe the structure of optical fiber in brief. | CO2 | | U | 4 |
|  | | b. | | Illustrate the types of optical fiber based on material, mode and refractive index with mention to its advantages and applications. | CO2 | | A | 8 |
| 19 | |  | | Explain the construction and working of a magnetostriction oscillator in the production of ultrasonic waves with necessary circuit diagram. | CO3 | | An | 12 |
| 20. | | a. | | Compare and contrast the terms ‘intensity’ and ‘loudness’ in acoustics. | CO4 | | U | 4 |
|  | | b. | | Assess the various factors affecting the architectural acoustics of a building in detail and discuss its remedies to overcome. | CO4 | | E | 8 |
| 21. | |  | | Explain the hysteresis curve in detail by plotting a model graph between magnetic flux density and the magnetizing field strength. | CO5 | | An | 12 |
| 22. | |  | | Detail the principle, construction and working of a He:Ne laser, with its energy level diagram. | CO3 | | A | 12 |
| 23. | |  | | Explain the construction and working of a piezoelectric oscillator in the production of ultrasonic waves with circuit diagram. | CO3 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | | | |
| 24. | | a. | Report the electrical resistance and magnetic field property in superconductors. | | | CO6 | U | 4 |
|  | | b. | Explain different types of superconductors in detail with its graphical diagram. | | | CO6 | An | 8 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the concept of lasers and apply laser action in biotechnology related industries. |
| CO2 | Explain and interpret the principle of fiber optics for biochemical processes monitoring drug design. |
| CO3 | Apply non-destructive testing techniques in activation of enzymes and various other processes in  biotechnology industry. |
| CO4 | Discern the laws governing acoustics and implement the same in synthetic biology and understand bioacoustics and plant acoustics. |
| CO5 | Evaluate and perceive various laws governing magnetism with special reference to magnetic  separation of heavy minerals and magnetic drug delivery. |
| CO6 | Create novel industrial and medical imaging applications by applying the principles of  superconducting materials. |

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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 | 1 | 8 | 8 |  |  |  | 17 |
| CO3 | 1 | 1 | 24 | 15 |  |  | 41 |
| CO4 | 1 | 8 |  |  | 8 |  | 17 |
| CO5 |  | 1 |  | 15 |  |  | 16 |
| CO6 |  | 8 |  | 8 |  |  | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **20PH1018** | **Duration** | **3hrs** |
| **Course Name** | **APPLIED PHYSICS FOR FOOD PROCESS OPERATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the right statement about the nature of laser light emission.   1. The laser beam is an intense, focused and monochromatic light source in nature. 2. The laser beam is an intense, focused and polychromatic light source in nature. 3. The laser beam is an intense, non-focused and monochromatic light source in nature. 4. The laser beam is a weak, focused and monochromatic light source in nature. | | CO1 | R | 1 |
| 2. | In a spontaneous emission, the emitted photons have directions and phase as follows:   1. They are highly coherent in nature 2. They are in a particular direction. 3. They are monochromatic in nature. 4. They are random in nature. | | CO1 | U | 1 |
| 3. | The fundamental principle of operation of an optical fiber cable is \_.   1. Total Internal Refraction 2. Total Internal Diffraction 3. Total Internal Interference 4. Total Internal Reflection | | CO2 | R | 1 |
| 4. | This light ray would never cross and intersect the axis of the optical fiber cable. This light ray is known as \_\_\_\_\_.   1. Meridional Bound Rays 2. Skew Ray 3. Meridional Unbound Rays 4. Exponential Ray | | CO2 | U | 1 |
| 5. | Based on frequency, sound waves are classified into three types:-   1. Infra sound, Audible sound, Ultrasound 2. Infrared, Audible sound, Ultraviolet 3. Infra sound, Audible sound, Ultraviolet 4. Infrared, Audible sound, Ultrasound | | CO3 | R | 1 |
| 6. | Magnetostriction effect was observed first by this great scientist who was one of the founding fathers of thermodynamics.   1. Lord Kelvin. 2. James Clerk Maxwell. 3. Michael Faraday. 4. James Joule. | | CO3 | U | 1 |
| 7. | Find out the correct statement about the nature of sound waves from the given statements.   1. Sound is a longitudinal and mechanical wave. 2. Sound is a transverse and mechanical wave. 3. Sound is a longitudinal and electromagnetic wave. 4. Sound is a transverse and electromagnetic wave. | | CO4 | R | 1 |
| 8. | For good acoustics, an acoustics engineer should design an auditorium with optimum reverberation time. If an auditorium has zero seconds (0 sec) as reverberation time, the sound will \_\_\_\_\_.   1. Become dead sound. 2. Become muddy and there will be severe loss of articulation at the back. 3. Behave in a pure inverse square law fashion. 4. Be dramatic for pipe organ. | | CO4 | U | 1 |
| 9. | This magnetic material, when placed in a magnetic field, acquires magnetism in a direction opposite to that of the applied magnetic field.   1. Paramagnetic Material. 2. Diamagnetic Material. 3. Ferromagnetic Material. 4. Ferrimagnetic Material. | | CO5 | R | 1 |
| 10. | Materials with narrow hysteresis loops are classified as \_\_\_\_\_\_\_\_.   1. Hard Magnetic materials. 2. Swift Magnetic materials. 3. Soft Magnetic materials. 4. Slow Magnetic materials. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Infer the wavelength of emission from a semiconductor laser if the band gap energy is 3 eV. | | CO1 | U | 3 |
| 12. | Calculate the numerical aperture of a step index single mode optical fiber cable in which the refractive index of the core is 1.456 and the refractive index of cladding is 1.439. | | CO2 | A | 3 |
| 13. | Estimate the first excited frequency of a pure iron rod of 40 mm length. The density of pure iron is 7250 kg/m3 and its Young’s modulus value is 11.5 x 1010 N/m2. | | CO3 | U | 3 |
| 14. | Calculate the intensity level of a heavy traffic which has an intensity of 1 W/m2. [The standard intensity = 10-12 W/m2.] | | CO4 | A | 3 |
| 15. | A magnetic field of 3600 ampere/meter produces a magnetic flux density of 3 Wb/m2. Calculate permeability. | | CO5 | U | 3 |
| 16. | Superconducting Niobium titanate (NbTi) has a critical temperature of 10 K. It’s critical field at 0 K is 15 Tesla. Find the critical field at 5 K. | | 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. |  | Establish the existence of stimulated emission of radiation with the help of Einstein’s quantum theory of radiation. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Classify the optical fiber cables based on the materials used for manufacture and the modes of transmission of light and explain each type in detail. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the method of producing ultrasonic waves with the help of inverse piezoelectric effect with a circuit diagram. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Analyze any four factors that affect the acoustics of a good auditorium and suggest remedial measures for the same. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Compare and contrast between diamagnetic, paramagnetic and ferromagnetic materials. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | List the methods of achieving population inversion and explain any one of them in detail. | CO1 | R | 6 |
|  | b. | Define the terms numerical aperture and acceptance angle with a proper equation and a diagram respectively. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 23. | a. | Define the following effects briefly:-  Magnetostriction effect and piezoelectric effect. | CO3 | U | 6 |
|  | b. | Name the characteristics of a musical sound and describe in brief, any one of them. | CO4 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Superconductors are a unique class of materials that are divided into two categories. Describe the classification of superconductors in detail. | CO6 | R | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the concept of lasers and apply laser action in food processing industries. |
| CO2 | Explain and interpret the principle of fiber optics for food quality and safety assessment. |
| CO3 | Apply non-destructive testing techniques in agro-food products. |
| CO4 | Discern the laws governing acoustics and implement the same in creating better environment for workers in food industries. |
| CO5 | Evaluate and perceive various laws governing magnetism with special reference to magnetic separation of contaminants in food industries. |
| CO6 | Create efficient industrial applications by applying the principles of superconducting materials. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 7 | 4 | 12 | --- | --- | --- | **23** |
| CO2 | 7 | 1 | 3 | 12 | --- | --- | **23** |
| CO3 | 1 | 10 | 12 | --- | --- | --- | **23** |
| CO4 | 1 | 7 | 3 | 12 | --- | --- | **23** |
| CO5 | 1 | 4 | --- | 12 | --- | --- | **17** |
| CO6 | 12 | --- | 3 | --- | --- | --- | **15** |
|  | | | | | | | **124** |



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| **Course Code** | **20PH1020** | **Duration** | **3hrs** |
| **Course Name** | **APPLICATION OF ENGINEERING MATERIALS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Define unit cell. | | | CO1 | R | 1 |
| 2. | Coordination number for F.C.C is……………….. | | | CO1 | R | 1 |
| 3. | Interpret toughness. | | | CO2 | U | 1 |
| 4. | Infer ductility and mention its significance. | | | CO2 | U | 1 |
| 5. | List few properties of glass fiber. | | | CO3 | R | 1 |
| 6. | The high ………….. of technical ceramics results in favourable wear resistance. | | | CO3 | R | 1 |
| 7. | The …………….. phase is harder and stiffer than the matrix. | | | CO4 | R | 1 |
| 8. | …………………….. fills voids between gravel particles. | | | CO4 | R | 1 |
| 9. | **…………….** improves the strength and hardness of steel. | | | CO5 | R | 1 |
| 10. | ……………………….. is the degeneration of materials by reaction with environment. | | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Differentiate ‘amorphous structures’ from ‘crystalline structures’. | | | CO1 | U | 3 |
| 12. | Define burgers vector. | | | CO2 | R | 3 |
| 13. | List the properties of ceramics. | | | CO3 | R | 3 |
| 14. | Interpret the three distinct phases of composites. | | | CO4 | U | 3 |
| 15. | Indicate few properties of cutting tool materials. | | | CO5 | U | 3 |
| 16. | Illustrate the electrochemical reaction in corrosion. | | | 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. | Classify the materials with a neat flowchart diagram. | CO1 | An | 8 |
|  | | b. | Compare F.C.C and B.C.C crystal structure with examples. | CO1 | An | 4 |
|  | |  |  |  |  |  |
| 18. | | a. | Explain IZOD and Charpy tests with neat sketches. | CO2 | U | 6 |
|  | | b | Discuss the construction of phase diagrams with neat sketches. | CO2 | U | 6 |
|  | |  |  |  |  |  |
| 19. | | a. | Categorize the various ceramics and their engineering applications. | CO3 | An | 6 |
|  | | b. | Discuss the distinct thermal properties of ceramics. | CO3 | U | 6 |
|  | |  |  |  |  |  |
| 20. | | a. | Explain in detail the general characteristics of composite materials and state some of their application. | CO4 | U | 6 |
|  | | b. | Illustrate processing of polymer matrix composites with neat sketches. | CO4 | A | 6 |
|  | |  |  |  |  |  |
| 21. | |  | Discuss the various properties of materials required for bearing applications with suitable examples. | CO5 | U | 12 |
|  | |  |  |  |  |  |
| 22. | | a. | Demonstrate the 3 stages of annealing process with neat sketches. | CO2 | A | 6 |
|  | | b. | Illustrate any two hardness testing procedures. | CO2 | A | 6 |
|  | |  |  |  |  |  |
| 23. | | a. | Appraise the plastic deformation by slip and twinning. | CO 2 | An | 6 |
|  | | b. | Interpret point and surface defects in crystals. | CO 2 | A | 6 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | | a. | Evaluate ‘Corrosion mechanism’ in metals with suitable examples. | CO6 | E | 6 |
|  | | b. | Summarize the various factors influencing corrosion. | CO6 | E | 6 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Apply the concepts of materials science for material selections towards new product development. |
| CO2 | Evaluate behavior of metal/alloys for engineering applications. |
| CO3 | Suggest the modern ceramic materials for engineering applications. |
| CO4 | Synthesize and develop the unique customized composites for aerospace applications. |
| CO5 | Knowledge on bearing, cutting and refractory metals for special engineering applications |
| CO6 | Develop the corrosion resistance materials for marine applications |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 3 | 12 | 12 |  |  | 32 |
| CO2 | 3 | 14 | 18 | 6 |  |  | 41 |
| CO3 |  | 11 |  | 6 |  |  | 6 |
| CO4 | 2 | 9 | 6 |  |  |  | 17 |
| CO5 | 1 | 15 |  |  |  |  | 16 |
| CO6 |  |  |  |  | 12 |  | 12 |
|  | | | | | | | **124** |



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| **Course Code** | **20PH3005** | **Duration** | **3hrs** |
| **Course Name** | **QUANTUM MECHANICS I** | **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. | Two eigen functions of Hermitian operators, belonging to two different eigen values, are orthogonal. Prove the statement. | CO1 | R | 10 |
| b. | In the Schrodinger picture the state vectors are always time dependent. Validate. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | State and explain the postulates of quantum mechanics. | CO1 | U | 10 |
| b. | Arrive at the equations which clearly prove that for the Hamiltonian with interaction term both state vectors and operators are time dependent. | CO2 | R | 10 |
|  |  |  |  |  |  |
| 3. | a. | Solve the Schrodinger equation for a particle in a one dimensional potential well and obtain the eigen function and eigen values. | CO3 | A | 15 |
| b. | Calculate the energy required for an electron in a one dimensional box of 0.1nm to jump from its first excited state to fourth excited state. | CO3 | An | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Obtain the Schrodinger wave equation for a one dimensional linear harmonic oscillator. | CO3 | A | 15 |
| b. | Write the equation that represents the rotational energy eigen values of the rigid rotator. | CO3 | U | 5 |
|  |  |  |  |  |  |
| 5. |  | Derive the eigen value of operator J2 and Jz wherein both represent the square and Z component of the angular momentum operator respectively. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Show (i) [J2, Jy] = 0 (ii) [ Jz, J+] = hJ+/2π | CO4 | An | 15 |
| b. | Give an account on the angular momentum operator in terms of position representation. | CO4 | U | 5 |
|  |  |  |  |  |  |
| 7. |  | Obtain the expression for first order perturbation energy correction for a non-degenerate system. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Use variation method to obtain an upper limit for the energy of the ground state of the helium atom. | CO5 | A | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain in detail the Thomas-Fermi model of the atom. | CO6 | U | 20 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Gain an in depth understanding on the central concepts and principles of quantum mechanics. |
| CO2 | Improve their mathematical skills necessary to solve the differential equations and eigenvalue problems using the operator formalism. |
| CO3 | Apply the Schrodinger wave equation and obtain the solution for various quantum mechanical systems such as particle in a box, harmonic oscillator, rigid rotator and hydrogen atom. |
| CO4 | Develop the concepts of angular momentum, such as their addition and commutation relation with components. |
| CO5 | Analyze different time independent perturbed systems and solve them with the aid of approximation methods. |
| CO6 | Appraise quantum mechanical systems involving many electron atoms and use the available models to solve them. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 10 | 10 |  |  |  |  | 20 |
| CO2 | 10 | 10 |  |  |  |  | 20 |
| CO3 |  | 5 | 30 | 5 |  |  | 40 |
| CO4 |  | 5 |  | 35 |  |  | 40 |
| CO5 |  |  | 40 |  |  |  | 40 |
| CO6 |  | 20 |  |  |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20PH3006** | **Duration** | **3hrs** |
| **Course Name** | **MATHEMATICAL PHYSICS II** | **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. | Show that the real part u and the imaginary part v of ln z satisfy the Cauchy-Riemann equations and find through the partial derivatives of u and v. Use rectangular coordinates. | CO1 | A | 15 |
|  | b. | State whether complex numbers are necessary for solving a general algebraic equation and whether there is a need for any more number system after the complex number system. | CO1 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Evaluate the integral  around (a) the circle and (b) the circle . | CO1 | U | 15 |
|  | b. | State the “Fundamental Theorem of Algebra” and give the significance of the same. | CO1 | An | 5 |
|  |  |  |  |  |  |
| 3. | a. | Find the Fourier integral of  and hence show that  . | CO2 | An | 15 |
|  | b. | Write down Dirichlet conditions. | CO2 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | The function f(t) is defined only over the range 0 < t < 1 to be . Find the half range cosine Fourier expansion of f(t). | CO2 | U | 15 |
|  | b. | List the properties of Fourier series and its applications.. | CO2 | R | 5 |
|  |  |  |  |  |  |
| 5. | a. | Given the Differential Equation with the following conditions.  Boundary Conditions:- u(0,t) = 0, u(L,t) = 0  Initial Condition:- u(x,0) = f(x), ut(x,0) = 0.  Using the method of separation of variables, find the equation governing the vibration of a string fixed at both ends. | CO3 | U | 15 |
|  | b. | Describe the phenomenon of travelling waves. | CO3 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Derive an expression for one dimensional, linear, homogenous and second order wave equation. | CO6 | R | 15 |
|  | b. | Explain the phenomenon of standing waves. | CO6 | An | 5 |
|  |  |  |  |  |  |
| 7. | a. | Given the Differential Equation with the following conditions.  Boundary Conditions:- u(0,t) = 0, u(L,t) = K  Initial Condition:- u(x,0) = f(x).  Solve the equation for heat conduction when both the ends of a long rod subjected to an initial temperature distribution along its axis are at different temperature. | CO4 | An | 15 |
|  | b. | Laplace equation may be obtained by setting in the heat conduction equation . Explain the significance of the same. | CO4 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Prove that the set of positive integers under addition modulo 6 (Z6, +6) forms an Abelian group. | CO4 | R | 15 |
|  | b. | State and prove Lagrange’s theorem. | CO4 | A | 5 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Evaluate correct to three decimal places using both the trapezoidal and Simpson’s rules. | CO5 | A | 15 |
|  | b. | State and explain Newton’s forward and backward formula. | CO5 | An | 5 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Expand a function in terms of a fourier series, with knowledge of the conditions for the validity of the series expansion. |
| CO2 | Apply Fourier and Laplace transforms to solve mathematical problems and analyzing experimental data. |
| CO3 | Solve partial differential equations of second order by use of standard methods like separation of variables, series expansion (Fourier series) and integral transforms. |
| CO4 | Understand the fundamental concepts of group. |
| CO5 | Appraise numerical interpolation and approximation of functions, numerical integration and differentiation. |
| CO6 | Apply the mathematical concepts to solve the problems in physics. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 15 | 15 | 5 | -- | -- | 40 |
| CO2 | 5 | 15 | 5 | 15 | -- | -- | 40 |
| CO3 | -- | 15 | 5 | -- | -- | -- | 20 |
| CO4 | 20 | -- | 5 | 15 | -- | -- | 40 |
| CO5 | -- | -- | 15 | 5 | -- | -- | 20 |
| CO6 | 15 | -- | -- | 5 | -- | -- | 20 |
| Sub-Total | 45 | 45 | 45 | 45 | -- | -- |  |
|  | | | | | | | **180** |



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| **Course Code** | **20PH3007** | **Duration** | **3hrs** |
| **Course Name** | **SPECTROSCOPY - I** | **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. | Define emission. | CO1 | R | 3 |
|  | b. | Discuss the applications of electromagnetic radiation in different types of spectroscopy methods based on the frequency range. | CO1 | U | 7 |
|  | c. | Explain the concept of Fourier transforms and its importance. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Give the physical significance of the total momentum quantum number “J”. | CO1 | R | 3 |
|  | b. | Discuss on the reason behind the natural line width of the spectral lines. | CO1 | U | 7 |
|  | c. | Illustrate the coarse spectra of a hydrogen atoms with a neat energy level diagram and prove the value of ionization energy to be **13.6 eV**. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Give the meaning of moment of inertia. | CO2 | R | 3 |
|  | b. | Classify the types of molecules based on the moment of inertia. | CO2 | U | 7 |
|  | c. | Explain the Schroedinger Equation associated with a rigid rotating diatomic molecule and discuss its energy level diagram. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Define a rigid rotator. | CO2 | R | 3 |
|  | b. | Discuss the role of isotopic substitution in the “B” value of the rigid diatomic molecule. | CO2 | U | 7 |
|  | c. | Differentiate the intensity of spectral lines in case of rotating diatomic molecule based on Boltzmann distribution and degeneracy. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | State the role of Fourier Transform in FTIR. | CO3 | R | 3 |
|  | b. | Discuss the selection rule for the HCl molecule as a simple harmonic oscillator with a neat sketch on energy level diagram. | CO3 | U | 7 |
|  | c. | Sketch the vibrations of CO2 molecule and give a brief discussion on the types of vibration. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Recall the meaning of “Vibrating-Rotator”. | CO3 | R | 3 |
|  | b. | Discuss the energy equation and selection rule for HCl as a diatomic vibrating-rotator. | CO3 | U | 7 |
|  | c. | Explain the working of FTIR instrument and give its advantages and disadvantages. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Define Scattering. | CO4 | R | 3 |
|  | b. | Classify Raman and Rayleigh scattering with examples. | CO6 | U | 7 |
|  | c. | Infer the Stokes and anti-Stokes Raman Spectra based on quantum principles. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Mention the role of molecular polarizability in Raman scattering. | CO4 | R | 3 |
|  | b. | Explain the rule of mutual exclusion with CO2 molecule as an example. | CO6 | U | 7 |
|  | c. | Illustrate the Raman Spectroscopy instrumentation and give its applications in industries. | CO4 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | List the applications of UV-VIS Spectroscopy. | CO5 | R | 5 |
|  | b. | Discuss the Electronic Spectra of Diatomic Molecules and the vibrational coarse structure. | CO5 | U | 15 |

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

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| CO1 | Understand the fundamentals of spectroscopy and the atomic spectra of hydrogen atom. |
| CO2 | Appreciate the role of microwaves in rotational spectroscopy and its working principle. |
| CO3 | Experiment the use of infrared rays in finding the structure of molecules. |
| CO4 | Find the use of Raman spectroscopy in studying the matter. |
| CO5 | Analyze the structure of atoms through the electronic spectroscopy. |
| CO6 | Identify the best method to solve the spectroscopic problems. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | 14 |  | 20 |  |  | 40 |
| CO2 | 6 | 14 |  | 20 |  |  | 40 |
| CO3 | 6 | 14 | 20 |  |  |  | 40 |
| CO4 | 6 |  |  | 20 |  |  | 26 |
| CO5 | 5 | 15 |  |  |  |  | 20 |
| CO6 |  | 14 |  |  |  |  | 14 |
|  | | | | | | | **180** |



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| **Course Code** | **20PH3008** | **Duration** | **3hrs** |
| **Course Name** | **ELECTROMAGNETIC THEORY** | **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. | State and prove the differential form of Gauss law in electrostatics. Extend its importance in deriving point charge, line charge, surface charge and volume charges. | CO1 | R | 15 |
|  | b. | **A point charge of**−2μC**is located at the center of a cube with sides**L=5cm**. What is the net electric flux through the surface?** | CO1 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss boundary behaviour of light as it passes from empty space into a transparent medium in an electric field at a boundary of an interface. | CO1 | U | 15 |
|  | b. | Write down the important vector notations in electromagnetism. | CO3 | R | 5 |
|  |  |  |  |  |  |
| 3. | a. | Deduce an expression for Biot-Savart law. Prove that Biot-Savart law can be used to calculate the magnetic field B current distribution in conductors. | CO2 | A | 15 |
|  | b. | Give an account of the physical significance of divergence. | CO2 | An | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Classify the magnetic materials dia, para and ferromagnetism with suitable diagrams. | CO2 | An | 10 |
|  | b. | Give a note on magnetic vector and scalar potential. | CO2 | C | 10 |
|  |  |  |  |  |  |
| 5. |  | Explain how wave propagate in a conducting medium. Explain the theory of propagation of plane electromagnetic waves in a non-conducting medium. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain the boundary behavior between two dielectrics and derive the relations connecting transmission and reflection coefficients. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Obtain Poynting’s vector for the conservation of energy and discuss the physical meaning of each term in the resulting equation. | CO6 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe the Maxwell’s equations of electromagnetic field and discuss their empirical basis. | CO4 | E | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe and derive an expression for the electric and magnetic field of a radiating oscillating electric dipole and hence obtain the radiation power and radiation resistance. | CO6 | An | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Explain the concept of different laws of electro-magnetic fields. |
| CO2 | Solve static electric and magnetic field problems using coordinate systems. |
| CO3 | Relate the applications of EM Waves in different domains and to find the time average power density. |
| CO4 | Explain Maxwell’s equation for time varying electric and magnetic fields. |
| CO5 | Illustrate the wave equation and its parameters for a conductor, dielectric and magnetic medium. |
| CO6 | Analyse moving charges and radiation from an oscillating dipole antennae. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 20 | 15 |  |  |  |  | 35 |
| CO2 |  |  | 15 | 15 |  | 10 | 40 |
| CO3 | 5 | 20 |  |  |  |  | 25 |
| CO4 |  |  |  |  | 20 |  | 20 |
| CO5 |  | 10 |  | 10 |  |  | 20 |
| CO6 |  |  | 20 | 20 |  |  | 40 |
|  | | | | | | | **180** |



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| **Course Code** | **20PH3009** | **Duration** | **3hrs** |
| **Course Name** | **QUANTUM MECHANICS II** | **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. | Obtain the exact solution of the Schrodinger equation using time dependent perturbation theory when the Hamiltonian depends upon time period. | CO1 | Apply | 15 |
|  | b. | Briefly explain Fermi-Golden rule. | CO1 | Remember | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Give a detailed account on the adiabatic approximation. | CO1 | Analyze | 15 |
|  | b. | Discuss how sudden approximation occurs when the Hamiltonian changes substantially for a short but finite interval of time. | CO1 | Analyze | 5 |
|  |  |  |  |  |  |
| 3. | a. | Prove that Born approximation is likely to be valid for weak potential. | CO2 | Apply | 15 |
|  | b. | Green’s function is a solution of the scattering problem for a source of unit strength at a particular point. Discuss. | CO2 | Apply | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Using Born approximation arrive at the scattering cross-section for a screened Coulomb potential. | CO2 | Apply | 15 |
|  | b. | Describe the scattering by a Yukawa potential and calculate the scattering cross-section. | CO2 | Apply | 5 |
|  |  |  |  |  |  |
| 5. | a. | Explain the semi-classical theory on the basis of time dependent perturbation theory. | CO3 | Apply | 10 |
|  | b. | Apply semi-classical theory to obtain the spontaneous and induced emission of radiation. | CO3 | Analyze | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Elucidate the concept of radiation field as an assembly of oscillators on the basis of semi classical theory. | CO3 | Understand | 20 |
|  |  |  |  |  |  |
| 7. | a. | Find the solution of Klein-Gordan relativistic wave equation and interpret the charge and current densities associated with it. | CO4 | Apply | 15 |
|  | b. | Obtain the Klein-Gordan equation for a charged particle moving in an electromagnetic field. Show that this equation reduces to Schrodinger wave equation of motion for the particle in the electromagnetic field in the non-relativistic limit. | CO5 | Analyze | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Derive the expression for the magnetic moment of an electron subjected to electromagnetic potential using Dirac equation. | CO5 | Apply | 15 |
|  | b. | Give an account on the negative energy state of electron. | CO4 | Understand | 5 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe the quantization of wave field on the basis of classical Lagrangian and Hamiltonian formulation. | CO6 | Understand | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Recognize the systems that are subjected to different time dependent perturbations such as harmonic, sudden and adiabatic. |
| CO2 | Classify the quantum problems involving scattering and interpret them using approximations such as Born, Partial wave analysis etc. |
| CO3 | Solve the quantum mechanical systems related to radiation by using the semiclassical theory. |
| CO4 | Apply relativistic wave equation to study hydrogen like atom, free particle and other relativistic problems. |
| CO5 | Appraise on the quantization of wave field, non-relativistic equation, electromagnetic field energy and momentum. |
| CO6 | Develop appropriate skill in analytical, theoretical and/or practical techniques to further their understanding in the chosen topic. |

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



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| **Course Code** | **20PH3013** | **Duration** | **3hrs** |
| **Course Name** | **PHYSICS OF NANOMATERIALS** | **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. | Define the term aspect ratio with a suitable worked out example. | CO1 | U | 6.  14 |
| b. | Classify the quantum states of 1D, 2D,3D size reduction of bulk materials. | CO1 | AP |
| (OR) | | | | |  |
| 2. | a. | List out the physical parameters that can’t be measured simultaneously. | CO1 | U | 5  15 |
| b. | Justify that the electron wavelength is 1.226 eV with equations. | CO1 | AP |
| 3. | a. | Demonstrate the working of Laser Lithography technique of nano structure fabrication. | CO2 | U | 15 |
|  | b. | Illustrate the mechanism of Spin coating using Sol-Gel. | CO2 | U | 5 |
| (OR) | | | | |  |
| 4. | a. | Derive the Schrödinger time dependent wave equation. | CO2 | U | 14 |
|  | b. | Describe the Properties of matter waves. | CO2 | U | 6 |
| 5. | a. | Demonstrate the Splitting of Band gap of nano materials with size reduction. | CO3 | AP | 6 |
|  | b. | Analyse the electrical characteristics of metal nano particles arranged as a single chin of atoms. | CO3 | AP | 14 |
| (OR) | | | | |  |
| 6. | a. | Demonstrate the mechanism of quantum mechanical tunnelling exhibited in the nano stuctures. | CO3 | AP | 14 |
|  | b. | Draw the zig zag, arm chair and chiral carbon nanotubes. | CO3 | AP | 6 |
| 7. | a. | List out the physical properties that change due to size reduction. | CO4s | R | 5 |
|  | b. | Analyze the optical properties of nano materials using optical absorption spectrograph. | CO4 | U | 15 |
| (OR) | | | | |  |
| 8. | a. | Describe the super paramagnetism exhibited in nano magnetic materials. | CO4 | R | 10 |
|  | b. | Classify the hard and soft magnetic materials with suitable hysteresis curves explain the various regions. | CO4 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 9. | a. | Apply the nanomagentic property to justify the giant magneto resistance and the colossal magnetic field. | CO5 | U | 10 |
|  | b. | Appraise the MEMS and NEMS technology in reducing the size of electronic gadgets. | CO6 | CR | 10 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Define Quantum confinement effect in nanomaterials. |
| CO2 | Describe the different fabrication techniques of nanomaterials. |
| CO3 | Examine the characteristics of nanomaterials. |
| CO4 | Analyse the nanodevices with different characterization tools. |
| CO5 | Evaluate the nanodevices for different applications. |
| CO6 | Design and create advanced nanodevices. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 11 | 29 |  |  |  | 40 |
| CO2 |  | 40 |  |  |  |  | 40 |
| CO3 |  |  | 40 |  |  |  | 40 |
| CO4 | 15 | 25 |  |  |  |  | 40 |
| CO5 |  | 10 |  |  |  |  | 10 |
| CO6 |  |  |  |  |  | 10 | 10 |
|  | | | | | | | **180** |



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| **Course Code** | **20PH3014** | **Duration** | **3hrs** |
| **Course Name** | **FABRICATION AND TESTING OF THIN FILM DEVICES** | **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 purpose of creating vacuum during thin film depositions. | CO1 | U | 2 |
|  | b. | Analyze the difference between rotary pump, diffusion pump and turbo-molecular pump with the help of neat diagrams | CO1 | A | 18 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Give a note on the principle behind pirani gauge with the help of a diagram. | CO1 | U | 8 |
|  | b. | Explain the working of penning gauge with the help of a neat diagram. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 3. | a. | Recall the principle of sputtering with diagram. | CO2 | R | 5 |
|  | b. | Summarize the three different sputtering methods with necessary diagrams. | CO2 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe the working principle of MBE. | CO2 | U | 5 |
|  | b. | Evaluate the growth kinetics and construction of MBE with the help of diagrams. | CO2 | U | 15 |
|  |  |  |  |  |  |
| 5. | a. | Explain briefly the three basic growth processes in thin film deposition technology. | CO3 | A | 15 |
|  | b. | Elaborate the electroplating method for thin film deposition. | CO3 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Create short notes on the substrate materials, substrate cleaning and the role of temperature on thin films. | CO3 | A | 12 |
|  | b. | Summarize in detail about sol-gel process with neat diagram. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 7. |  | Demonstrate the X-ray diffraction technique with the help of Bragg’s law and how will you interpret XRD graph with the help of JCPDS standards. | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain in detail about the working of UV-Visible spectrophotometer. | CO4 | U | 10 |
|  | b. | Describe Photoluminescence spectra with neat diagrams. | CO4 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain in detail CNT based transistors. | CO5 | A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the vacuum pumps and measure the vacuum level. |
| CO2 | Illustrate the mechanism of thin film deposition. |
| CO3 | Apply the knowledge on the influence of substrates on the growth of thin films. |
| CO4 | Analyse the thin film characteristics through different tools. |
| CO5 | Appraise the latest thin film device fabrication and testing. |
| CO6 | Create fabrication methods for thin film based devices like solar cells and gas sensors. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 22 | 18 |  |  |  | 40 |
| CO2 | 5 | 35 |  |  |  |  | 40 |
| CO3 | 5 | 8 | 27 |  |  |  | 40 |
| CO4 |  | 20 | 20 |  |  |  | 40 |
| CO5 |  |  | 20 |  |  |  | 20 |
| CO6 |  |  |  |  |  |  |  |
|  | | | | | | | **180** |



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| **Course Code** | **20PH3015** | **Duration** | **3hrs** |
| **Course Name** | **SOLID STATE BATTERIES** | **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. | Give examples for rechargeable batteries. | CO1 | R | 3 |
|  | b. | Explain the progress made in primary and rechargeable batteries in the history of battery development. | CO1 | U | 7 |
|  | c. | Analyze the Global battery market and give the trend in lithium batteries with emphasis on ABC triangle. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define C-rate. | CO1 | R | 3 |
|  | b. | Discuss the various battery parameters with the appropriate units. | CO1 | U | 7 |
|  | c. | Categorize the primary and secondary batteries with lechlanche cell and Ni-Cd cells as an example, respectively. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Mention the properties of a battery separator. | CO2 | R | 3 |
|  | b. | Write a short note on applications of lithium ion batteries. | CO2 | U | 7 |
|  | c. | Outline the role of cathode in lithium ion battery and compare the lithium ion batteries based on the types of cathodes used. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | State the function of a separator in battery. | CO2 | R | 3 |
|  | b. | Describe the reasons behind replacing liquid electrolyte with polymer electrolytes for lithium ion batteries. | CO2 | U | 7 |
|  | c. | Appraise the working of lithium ion polymer batteries with a neat schematic diagram. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Relate the role of thin and thick film in performance of microbatteries. | CO3 | R | 3 |
|  | b. | Explain the working of crimping machine and the components of a coin cell and its types based on diameter and depth. | CO3 | U | 7 |
|  | c. | With a neat diagram, illustrate the working of RF sputtering equipment for the making of thin films for microbatteries with high power density. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Give an example for materials used as electrolytes for lithium ion microbatteries. | CO3 | R | 3 |
|  | b. | Describe the working of Glove box and its uses. | CO3 | U | 7 |
|  | c. | With a neat schematic diagram illustrate the working principle, advantages and disadvantages of making thin films for high power density microbatteries by pulsed laser deposition method. | CO5 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Write the recent progress with respect to manufacturing of lithium ion batteries in our country. | CO4 | R | 3 |
|  | b. | Discuss the usefulness of cyclic voltammetry in determining the oxidation / reduction peaks with any solid state microbattery as an example. | CO4 | U | 7 |
|  | c. | Examine the working principle and the role of XRD in enhancing the performance of battery materials with nanostructures. | CO6 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Define nanomaterial and give its advantage in improving a battery performance. | CO4 | R | 3 |
|  | b. | Draw the schematic diagram of a scanning electron microscopy instrument and interpret its role in battery performance. | CO4 | U | 7 |
|  | c. | Examine the role of XPS in exploring the surface properties of nanostructured materials for batteries with its working mechanism. | CO6 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Mention any one advantage and disadvantage of a lithium metal. | CO5 | R | 3 |
|  | b. | Discuss the advantages and disadvantages of lithium ion battery. | CO5 | U | 5 |
|  | c. | Outline the alternative battery technologies available to replace lithium batteries and give the advantages, challenges, current market, and working principle of any one of the alternative batteries that you consider as the best. | CO5 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the terminologies (thin and bulk) used in lithium ion batteries. |
| CO2 | Illustrate the working of lithium ion batteries. |
| CO3 | Apply the knowledge on lithium ion batteries to construct lithium ion Coin –Power Micro-batteries. |
| CO4 | Analyze the output of the fabricated coin cell. |
| CO5 | Appraise the power of lithium of ion battery. |
| CO6 | Design lithium ion battery with smart materials. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | 14 |  | 20 |  |  | 40 |
| CO2 | 6 | 14 |  | 20 |  |  | 40 |
| CO3 | 6 | 14 |  |  |  |  | 20 |
| CO4 | 6 | 14 |  |  |  |  | 20 |
| CO5 | 3 | 5 | 20 | 12 |  |  | 40 |
| CO6 |  |  |  | 20 |  |  | 20 |
|  | | | | | | | **180** |



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| --- | --- | --- | --- |
| **Course Code** | **20PH3017** | **Duration** | **3hrs** |
| **Course Name** | **ASTRONOMY AND ASTROPHYSICS** | **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. | Discuss in detail the planetary laws of motion propounded by Johannes Kepler, who worked under Tycho Brahe and used planetary observations made by Brahe to perfect his theory. | CO1 | A | 15 |
|  | b. | Analyze the reason for the following dilemma. Venus, which is the second planet from the sun, is hotter than Mercury which is the nearest planet to the sun. | CO1 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Develop a modern theory of solar system formation from the latest astronomical findings. | CO1 | U | 15 |
|  | b. | Saturn is 9 times farther than the Earth from the sun on an average. Calculate the time-period of revolution of Saturn in earth years. | CO1 | An | 5 |
|  |  |  |  |  |  |
| 3. | a. | Assume that there are two pro-stars A and B with masses less than 2 solar mass and greater than 10 solar mass respectively. Discuss the life cycle of these two stars. | CO2 | An | 15 |
|  | b. | Apply the method of trigonometric parallax and find the distance to the nearest star, alpha-centauri whose parallax is 0.76 arc seconds (in light years). | CO2 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Classify the different types of supernova explosion and explain them in detail. | CO2 | U | 15 |
|  | b. | Differentiate absolute magnitude and apparent magnitude of a star. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 5. | a. | Discuss in detail about the important parameters such as light gathering power, resolving power and magnifying power of a telescope. | CO3 | U | 15 |
|  | b. | Calculate the energies of a radio wave having a frequency of 2 MHz and a light ray of frequency of 7 x 1014 Hz. | CO3 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | List out the places that are suitable for life to exist in the Milky Way Galaxy based on the knowledge of the cosmic surroundings and list out the reasons for the same. | CO6 | R | 15 |
|  | b. | Deduce the plausible solutions for Fermi’s paradox after explaining about the same in brief. | CO6 | An | 5 |
|  |  |  |  |  |  |
| 7. | a. | Compare and distinguish different types of galaxies based on the analysis of the structure of galaxies. | CO4 | An | 15 |
|  | b. | A certain galaxy A is at a distance of 0.674 Mpc from a certain galaxy B. Find out the recession velocity of the galaxy A from galaxy B. Ascertain whether they belong to the same group of galaxies. | CO4 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Name the different types of active galactic nuclei and list out their characteristics in detail. | CO4 | R | 15 |
|  | b. | By applying the fundamental theorem about the interstellar medium, define about emission and reflection nebulae. | CO4 | A | 5 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss the Big Freeze Theory in detail which predicts that the universe will expand forever and will become very cold in the distant future. | CO5 | A | 15 |
|  | b. | Estimate the distance to a galaxy which is receding from the Milky Way galaxy at 61,000 km/s. Analyze whether this galaxy belongs to the Local Supercluster of galaxies. | CO5 | An | 5 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Remember the various solar system models, our own solar system and earth’s immediate cosmic neighborhood. |
| CO2 | Understand intricate details about the life cycle of a star and different types of stars. |
| CO3 | Apply the modern-day telescopes to explore the cosmos. |
| CO4 | Analyze the various types of galaxies, their formation, and cosmic distant scales. |
| CO5 | Evaluate the formation of the universe through the big bang theory and understand about how the universe is likely to end. |
| CO6 | Formulate novel techniques and theorems to explore the space to solve problems yet to be solved. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 15 | 15 | 5 | -- | -- | 40 |
| CO2 |  | 20 | 5 | 15 | -- | -- | 40 |
| CO3 | -- | 15 | 5 | -- | -- | -- | 20 |
| CO4 | 20 | -- | 5 | 15 | -- | -- | 40 |
| CO5 | -- | -- | 15 | 5 | -- | -- | 20 |
| CO6 | 15 | -- | -- | 5 | -- | -- | 20 |
| Sub-Total | 45 | 45 | 45 | 45 | -- | -- |  |
|  | | | | | | | **180** |



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| **Course Code** | **20PH3025** | **Duration** | **3hrs** |
| **Course Name** | **RADIATION TREATMENT AND PLANNING** | **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. | Compare and contrast between X-Rays and Gamma Rays. | CO1 | A | 4 |
|  | b. | Illustrate the functioning of a modern day linear accelerator (LINAC) system. | CO1 | U | 16 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Analyze the fundamental differences between a cobalt-60 source and an X-ray machine. | CO1 | An | 4 |
|  | b. | Label the parts of an electron generating machine and explain in detail, the acceleration of such particles by a modern day LINAC. Discuss the advantages of particle radiation treatment over electromagnetic radiation treatment. | CO1 | R | 16 |
|  |  |  |  |  |  |
| 3. | a. | Analyze the importance of inverse square law in radiation treatment and planning. | CO2 | An | 4 |
|  | b. | Define the concept of Percentage Depth Dose (PDD) and Tissue Maximum Ratio (TMR) and hence, derive the relationship between the two concepts. | CO2 | R | 16 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Apply Clarkson’s method for dose calculation and explain the procedure in brief. | CO2 | A | 4 |
|  | b. | Based on the understanding of isodose distribution, explain in detail about factors affecting isodose distribution. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 5. | a. | Outline the significance of ICRU (International Commission on Radiation Units and Measurements) 50 report. | CO3 | U | 4 |
|  | b. | Analyze the differences between Gross Tumor Volume (GTV), Clinical Target Volume (CTV), and Internal Target Volume (ITV), and determine how these elements are a part of a global Planning Target Volume (PTV) construction. | CO3 | An | 16 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Examine the importance of Technical Report Series 430 (TRS 430) released by International Atomic Energy Agency (IAEA) towards commissioning and quality assurance of computerized planning systems for radiation treatment of cancer. | CO6 | An | 4 |
|  | b. | By applying the principles of radiation safety, explain how Quality Assurance (QA) is maintained on a day-to-day basis in radiation treatment of cancer patients. | CO6 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Demonstrate the method of shielding of electron beams. | CO4 | U | 4 |
|  | b. | Discover the characteristics of an electron and list the same. Analyze how electrons interact with matter surrounding them. | CO4 | A | 16 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the occurrence of field inhomogeneity in electron beam therapy. | CO4 | U | 4 |
|  | b. | Describe the phenomenon of a virtual source in a clinical electron beam and the two methods for determining the virtual Source to Surface Distance (virtual SSD). Infer the better method that is clinically more useful. | CO4 | R | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Identify the importance of Dose Volume Histogram (DVH) in radiation treatment and planning. | CO5 | A | 4 |
|  | b. | Demonstrate the significance of 3-Dimensional Conformal Radiotherapy (3-D CRT) for the effective treatment of cancer tissues. | CO5 | An | 16 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic information about radiotherapy machines. |
| CO2 | Understand the interaction of photon beam on matter. |
| CO3 | Apply various calibration methods to ensure better quality treatment using machines. |
| CO4 | Analyze the various clinical treatment planning. |
| CO5 | Evaluate the various radiation treatment modalities. |
| CO6 | Create better treatment modalities using electron beam therapy and advanced radiotherapy treatment methods like Cyberknife. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 | 16 | 4 | 4 | -- | -- | 40 |
| CO2 | 16 | 16 | 4 | 4 | -- | -- | 40 |
| CO3 | -- | 4 | -- | 16 | -- | -- | 20 |
| CO4 | 16 | 8 | 16 | -- | -- | -- | 40 |
| CO5 | -- | -- | 4 | 16 | -- | -- | 20 |
| CO6 | -- | -- | 16 | 4 | -- | -- | 20 |
| Sub-Total | 48 | 44 | 44 | 44 | -- | -- |  |
|  | | | | | | | **180** |



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| **Course Code** | **20PH3026** | **Duration** | **3hrs** |
| **Course Name** | **MEDICAL RADIATION DOSIMETRY** | **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. | Discuss in detail classification of radiations based on their ionizing powers and describe them in detail. | CO1 | A | 15 |
|  | b. | Explain the terms mass defect and binding energy of a nucleus. | CO1 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | There is a radiation source containing alpha particle, beta particle and gamma ray emitting radionuclides outside the body. Infer which radiation is more harmful. For that particular radiation, describe the decay scheme in detail with an equation. | CO1 | U | 15 |
|  | b. | After analyzing each type of decay, fill in the blanks. | CO1 | An | 5 |
|  |  |  |  |  |  |
| 3. | a. | Assume a certain radionuclide is undergoing beta minus decay. Discuss in detail, the ways in which a beta particle interacts with matter surrounding the parent radionuclide. | CO2 | An | 15 |
|  | b. | Apply the theory of photon interaction to gamma decay and list out the ways in which gamma ray interacts with matter. | CO2 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | As per quantum electrodynamics, Compton Scattering is an incoherent process in which energy is transferred a recoil electron from an incoming gamma photon. Derive an expression for the same. | CO2 | U | 15 |
|  | b. | The photon is not conserved in the pair production process in the nuclear Coulomb field. Explain the predicament briefly. | CO2 | R | 5 |
|  |  |  |  |  |  |
| 5. | a. | Discuss in detail Linear Energy Transfer hypothesis in which the energy is deposited at the point of interest per unit length of the charged particle track. | CO3 | U | 15 |
|  | b. | Describe energy fluence and the means to calculate the same. | CO3 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the theory of deriving the absorbed dose to the medium within the cavity and relating it to the absorbed dose that would be at that point in the surrounding medium in the absence of the cavity. | CO6 | R | 15 |
|  | b. | Deduce the phenomenon in which electron, being a charged particle, radiate electromagnetic energy when they are in motion. This radiation happens only as electrons decelerate and get scattered. | CO6 | An | 5 |
|  |  |  |  |  |  |
| 7. | a. | Examine the functioning of a Geiger-Muller counter and describe its working with a neat sketch. | CO4 | An | 15 |
|  | b. | List out the important properties necessary for a dosimeter. | CO4 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Point out the ideal requirements for a thermo-luminescent dosimetric material and explain in detail a few TLD phosphors and their characteristics. | CO4 | R | 15 |
|  | b. | Identify the important characteristics for chemical dosimetric materials. | CO4 | A | 5 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss in detail, the role played by phantoms in medical radiation dosimetry. | CO5 | A | 15 |
|  | b. | Compare and contrast the calibration standards required for mega voltage photon beams and electron beams based on standard national and international protocols. | CO5 | An | 5 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Remember the basic concepts of atoms and nucleus. |
| CO2 | Understand the different types of radiation emitted from nuclear sources. |
| CO3 | Apply the interaction of radiation with matter in novel peaceful applications. |
| CO4 | Analyze and understand the various units of radiation measurements. |
| CO5 | Evaluate the different types of radiation detection and measurement. |
| CO6 | Create novel dosimetry systems for measuring different types of nuclear radiation. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 15 | 15 | 5 | -- | -- | 40 |
| CO2 | 5 | 15 | 5 | 15 | -- | -- | 40 |
| CO3 | -- | 15 | 5 | -- | -- | -- | 20 |
| CO4 | 20 | -- | 5 | 15 | -- | -- | 40 |
| CO5 | -- | -- | 15 | 5 | -- | -- | 20 |
| CO6 | 15 | -- | -- | 5 | -- | -- | 20 |
| Sub-Total | 45 | 45 | 45 | 45 | -- | -- |  |
|  | | | | | | | **180** |



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| --- | --- | --- | --- |
| **Course Code** | **22PH3001** | **Duration** | **3hrs** |
| **Course Name** | **SOLID STATE IONICS AND ENERGY DEVICES** | **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. | Classify graphite and graphene structures. | CO1 | U | 10 |
|  | b. | Discuss on the major types of solids based on bonding, interaction and other properties. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Classify the terms synthetic, natural, biodegradable and non-biodegradable polymers with suitable examples. | CO1 | U | 15 |
|  | b. | Write a note on adverse effect of polymers on environment with few toxic polymers as examples. | CO1 | U | 5 |
|  |  |  |  |  |  |
| 3. | a. | Define ionic conductors and make a detailed note of the lithium ion and sodium ion conducting materials. | CO2 | R | 15 |
|  | b. | Define solid electrolyte with Beta alumina as an example. | CO2 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe solid, gel, composites and plasticized polymer membranes with differences in their glass transition temperature, mechanical, thermal and ionic conduction properties. | CO2 | R | 20 |
|  |  |  |  |  |  |
| 5. |  | Determine the importance of non-destructive method called AC impedance spectroscopy in analyzing the energy materials. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Illustrate the use of Wagner Polarization method in determining the percentage of ionic and electronic conduction in materials. | CO3 | A | 15 |
|  | b. | Explain any one method that could be used to find the electrical properties of thin film materials with high electronic conduction. | CO3 | A | 5 |
|  |  |  |  |  |  |
| 7. | a. | Compare the properties of nano and bulk structures for energy applications. | CO4 | E | 5 |
|  | b. | Analyze the differences between the ionic and mixed conducting materials with examples and their roles in applications of energy devices. | CO5 | An | 15 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate the role of supercapacitors in replacing batteries. | CO4 | E | 5 |
|  | b. | Categorize the different types of solid state devices, and explain the working principle of any one type | CO5 | An | 15 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Summarize the use of three electrode system with a neat diagram. | CO6 | E | 10 |
|  | b. | Compare the use of cyclic voltammetry and charge-discharge process in analyzing the solid state devices. | CO6 | An | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Identify the types of materials based on structure. |
| CO2 | Understand the electrical properties of mixed and ionically conducting materials. |
| CO3 | Analyse the electrical and electrochemical properties of materials. |
| CO4 | Apply the knowledge of materials for making energy devices. |
| CO5 | Evaluate the energy storage devices. |
| CO6 | Create alternative energy storage devices to existing once. |

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