M. Sc. (Physics)
Semester - III

Course Code	PS03EPHY22	Title of the Course	Magnetic and Optical Properties of Condensed Matter (CMP)
Total Credits of the Course	4	Hours per Week	4

Main Focus of Course outcomes	Employability	Skill Development	Entrepreneurship
	✓	√	√
Course Objectives:	The course introduces the students to the; 1) Principles of luminescence, its mechanism and applications. 2) Theory of Mossbauer Effect, its understanding and consequence of different parameters. 3) Different types of magnetisms in condensed matter, its parameters and thorough understanding. 4) The different dielectric materials, theory and various parameters. 5) Nuclear magnetic resonance theory and its parameters for different magnetism.		

Course Content		
Unit	Description	Weightage* (%)
1.	Luminescence :Introduction, Excitation and emission, The Franck-Condon principle, Radiation-less transitions, Temperature dependence of luminescence, Decay mechanisms-Temperature independent exponential decay, Temperature dependent exponential decay, power-law decay, Thermo luminescence and glow curves, Thallium activated alkali halides, emission spectra, concentration dependence of the luminescence efficiency, The sulphide phosphors, electroluminescence, The Gudden-Pohl effect, The Destriau effect, carrier injection luminescence, Applications.	25%
2.	Mossbauer effect : Introduction, Resonant absorption, recoil energy, natural broadening, Doppler broadening, cross-section of resonance processes, attempts to observe resonance fluorescence, mechanism of Mossbauer effect, the experiment of Mossbauer effect, Debye-Waller factor and its temperature dependence, General importance of Mossbauer effect, Mossbauer effect and lattice dynamics, quadruple interactions, magnetic hyperfine interactions, isomer shift.	25%
3.	Optical properties: Propagation of light in conducting media, Anomalous skin effect, Drude model, absorption processes, exciton absorption, free carrier absorption, absorption processes involving	25%

	impurities, photoconductivity, response time and gain factor, p-n junction photovoltaic cells, characteristics and applications, photovoltaic detectors. Dielectrics: Polarizability and its dependence on frequency, dielectric constant and dielectric loss, effect of alternating fields, complex dielectric constants of non-polar solids, dipolar relaxation, energy absorption and losses, some important insulating materials.	
4.	Magnetism:Ferromagnetic order, Curie point, temperature dependence of saturation magnetization, magnons, thermal excitation of magnon, neutron magnetic scattering, ferrimagnetic order, Curie temperature and susceptibility of ferrimagnets, anti-ferromagnetic order, susceptibility below Neel temperature, anti-ferromagnetic magnons, Magneto-Acoustic effect. Resonances: Magnetic resonance, paramagnetic resonance, resonance with relaxation, nuclear magnetic resonance, line width, hyperfine splitting, Knight Shift, nuclear quadruple resonance, ferromagnetic resonance, anti-ferromagnetic resonance, spin wave resonance, electron paramagnetic resonance, cyclotron resonance and size effect, the de Haas-Van Alphen effect.	25%

Teaching-Learning Methodology	- Use traditional black board and chalk. - Overhead projector, power point presentation, smart board is used for better understanding of scientific ideas. - Reference books, lecture notes, supporting materials are provided. The students can use departmental library and University library as and when needed.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination / Projects (As per CBCS R.6.8.3)	15%
2.	Internal MCQ based Quizzes, Seminar Presentation / Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	The optical properties of the matter in general and luminescent properties of the phosphors in particular.
2.	The different magnetism in matter and its theory.
3.	Two important techniques, Mossbauer Effect and Nuclear Magnetic Resonance.
4.	Applications of the Mossbauer effect and the luminescent materials.

Suggested References:

Sr. No.	References
1.	Solid State Physics by A.J.Dekker, Macmillan India Ltd., New Delhi (2002).
2.	Fundamentals of Solid State Physics by B.S.Saxena, R.C.Gupta, P.N.Saxena, Pragati Prakashan, Meerut (2008).
3.	Molecular Structure and Spectroscopy by G. Aruldhas, PHI Learning Private Limited, New Delhi, Second Edition (2009).
4.	Principles of the theory of Solids by J.M.Ziman, Cambridge University Press, UK (2011).
5.	Introduction to Semiconductor theory by A. I. Anselm, MIR Publisher, Moscow (1981).
6.	Solid State Electronic Devices by B. G. Streetman, Prentice-Hall Inc, NJ (1994).
7.	Principles of Solid State Physics by R. A. Levy, Academic Press (1972).
8.	Solid State Physics by S. O. Pillai, New Age International Publisher (2016).
9.	Solid State Physics by N. W. Aschroft and N.D. Mermein, Harcourt Asia Pte Ltd. (2001).
10.	Solid State Physical Electronic by Aldert Van der Ziel, Prentice-Hall, (1957).

On-line resources to be used if available as reference material
On-line Resources
https://youtu.be/yhms0h5nfzY (Photoluminescence, electroluminescence) https://youtu.be/FJB7LJt6hGk (Introduction, types of luminescence, advantages, disadvantage, applications) https://youtu.be/Ukq2yvmKwoc (Radiationless transition, https://youtu.be/as6ExuBSgXY (Luminescence and types of luminescence) https://youtu.be/s7zsL9yFOsg (Mossbauer spectroscopy, recoil energy, isomer shift) https://youtu.be/H5UDMjwoRxI (recoil effect, recoil energy) https://youtu.be/v0oO4DE2mxI (natural broadening or natural line width) https://youtu.be/DvkOJ0jx-Uk (line broadening or Doppler broadening) https://youtu.be/9zimhww51WI (Mossbauer spectroscopy, recoil energy, chemical shift, isomer shift) https://youtu.be/2WGlKtW3yDU (Application of Mossbauer spectroscopy: isomer shift, quadrupole interaction, magnetic interaction splitting https://youtu.be/vIScSZEqj10 (Experimental arrangement for Mossbauer spectroscopy) https://www.youtube.com/watch?v=mN0zyefCKfY (propagation of light in conducting media) https://www.youtube.com/watch?v=p5SxML5T1kI (photoconductivity) https://www.youtube.com/watch?v=ewPhEKAs7_8 (dielectric and polarization) https://nptel.ac.in/courses/115/105/115105099/ (ferromagnetism, ferromagnetism, anti-ferromagnetism) https://www.youtube.com/watch?v=it6uaY8lB3A (Nuclear magnetic resonance) https://www.youtube.com/watch?v=Qgrp36u-aNs (nuclear quadruple resonance) https://www.youtube.com/watch?v=lUii0svCOPM (magnetic resonance)

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