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Issue No.:01/02/14

# EASWARI ENGINEERING COLLEGE

(Autonomous)

## Department of Physics

## LAB LESSON PLAN

**Subject code: 231PYB111L** **Degree/Branch: B.E/B.Tech**

**Subject Name: Physics Laboratory** **Year/Sem/Sec: I / I**

**Faculty Name:**

**Total No of Periods given in syllabus**

**Lecture: 00** **Tutorial: 00** **Practical: 15** **Project: 00** **Grand Total: 15**

**OBJECTIVES:**

- To impart knowledge on experimental skills to determine elastic, optical and thermal properties of materials.
- To demonstrate the experimental determination of compressibility of liquid and band gap of a semiconductor.

| S. No | Experiments | No. of Periods | Ref. Books | Page Nos. |
|---|---|---|---|---|
| 1. | Determination of rigidity modulus of wire and moment of inertia of disc using Torsion Pendulum | 3 | | 3 |
| 2. | Determination of Young's modulus of the material by Non Uniform Bending | 3 | | 13 |
| 3. | Determination of Wavelength of laser light and Size of particle using Semiconductor Laser | 3 | T1 | 22 |
| 4. | Determination of thermal conductivity of a bad conductor using Lee's Disc method | 3 | | 40 |
| 5. | Determination of dispersive power of the prism using Spectrometer | 3 | | 50 |
| | **Total** | **15** | | |

**BEYOND THE SYLLABUS**

**ANY ONE EXPERIMENT**

1. Ultrasonic Interferometer - Velocity of sound and Compressibility of liquid
2. Determination of the Band gap of a semiconductor

**REFERENCE BOOKS:**


**R1** Physics Laboratory Manual, Department of Physics, Easwari Engineering College.

**R2** R.K.Shukla and Anchal Srivastava, Practical Physics, 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

**R3** G.L.Souires, Practical Physics, 4th Edition, Cambridge University, UK, 2001.

**R4** D.Chattopadhyay, P.C. Rakshit and B.Saha, An Advanced Course in Practical Physics, 2nd ed., Books & Allied Ltd., Calcutta, 1990.


**Prepared by**

**Dr. R. Sivakumar**
**AP/Physics**

**Approved by**

**Dr. S.Nirmala**
**HoD/Physics**

# EASWARI ENGINEERING COLLEGE

## (Autonomous)

## Department of Physics

### LESSON PLAN

| | | | | | |
|---|---|---|---|---|---|
| **Subject code** | **:** | **231PYS203T** | **Degree/Branch** | **:** | **B.E ECE, RA** |
| **Subject Name** | **:** | **Materials Science for Electronics Engineering** | **Year/Sem/Sec** | **:** | **I/II/** |
| **Faculty Name** | **:** | | | | |

**OBJECTIVES:**

1. To impart knowledge on electrical and magnetic properties of materials.
2. To teach the principles of quantum mechanics and transport phenomena for semiconducting materials.
3. To introduce the concepts of dielectric materials and insulators.
4. To explain the functioning of optical materials for optoelectronics.
5. To enable the students to gain knowledge on smart materials and nanomaterials.

**COURSE OUTCOMES:**

Upon completion of this course, student will be able to: **Bloom's level**

| | | |
|---|---|---|
| **CO1** | analyse the classical and quantum electron theories towards the formation of energy bands and the properties of magnetic materials. | **K4** |
| **CO2** | apply the principles of quantum mechanics and transport phenomena for semiconducting materials. | **K3** |
| **CO3** | evaluate the dielectric strength of dielectric materials in static and alternating field. | **K5** |
| **CO4** | design the optical materials and devices for optoelectronics. | **K6** |
| **CO5** | select the smart materials for applications in engineering and technology. | **K4** |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT I – ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS** | | | | | |
| **Objective: To impart knowledge on electrical and magnetic properties of materials.** | | | | | |
| 1 | A brief about **Materials Science for Electronics Engineering** | 1 | - | - | Mind Mapping |
| 2 | Classical free electron theory | 1 | R2 | 149 | Chart |
| 3 | Expression for electrical conductivity and thermal conductivity of metals | 1 | R2 | 149 | Black Board |
| 4 | Electron in periodic potential – Energy bands in solids – tight binding approximation | 1 | R2 | 150 | Power Point |
| 5 | Effective mass of electron, concept of hole. Dia, Para and Ferromagnetism, exchange interaction | 1 | R2 | 1.16-1.21 | Black Board |
| 6 | Soft and Hard Magnetic material | 1 | R2 | 294 | Power Point |
| 7 | Quantum interference devices | 1 | R2 | 314 | Quiz |
| 8 | GMR devices and their applications. | 1 | R2 | 305 | Flash Card |
| 9 | Problems and Review | 1 | T3 | 160 | Black Board |
| **UNIT II - SEMICONDUCTORS AND TRANSPORT PHYSICS** | | | | | |
| **Objective: To teach the principles of quantum mechanics and transport phenomena for semiconducting materials.** | | | | | |
| 1 | Introduction about **Semi Conducting Materials** | 1 | - | - | Mind Mapping |
| 2 | Direct & indirect semiconductors, carrier concentration in Intrinsic semiconductor | 1 | R2 | 380 | Power Point |
| 3 | Carrier concentration in n- and p- type semiconductor (qualitative study), variation of carrier concentration with temperature | 1 | R2 | 388 | Black Board |
| 4 | Carrier transport in Semiconductors: Drift, mobility and diffusion | 1 | R2 | 46-49 | Peer Learning |
| 5 | Hall effect and Devices | 1 | R2 | 145-148 | Power Point |
| 6 | Ohmic contacts | 1 | R2 | 502-506 | Chart |
| 7 | Schottky Diode | 1 | R2 | 372, 271 | Flip Class Mode |
| 8 | Introduction to solid state drive | 1 | R2 | 532 | Flash Card |
| 9 | Problems and Review | 1 | T3 | 267 | Black Board |
| **UNIT III – DIELECTRIC MATERIALS** | | | | | |
| **Objective: To introduce the concepts of dielectric materials and insulators.** | | | | | |
| 1 | Brief about **Dielectric Materials and Insulators** for engineering applications | 1 | - | - | Mind Mapping |
| 2 | Dielectric polarization and relative permittivity | 1 | R2 | 692 | Power Point |
| 3 | Dipole moment and polarization vector Polarization mechanisms | 1 | T3 | 699 | Black Board |
| 4 | Electronic, ionic, orientational, interfacial and total polarization, frequency dependence | 1 | R2 | 700 | Power Point |
| 5 | local field and Clausius-Mosotti equation | 1 | R2 | 638 | Black Board |
| 6 | Dielectric constant, loss and strength | 1 | R2 | 685 | Quiz |
| 7 | Dielectric breakdown | 1 | R2 | 729 | Black Board |
| 8 | Capacitor materials – typical capacitor constructions. | 1 | R5 | 731 | Flash Card |
| 9 | Problems and Review | 1 | T3 | 541 | Black Board |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT IV – OPTICAL PROPERTIES OF MATERIALS** | | | | | |
| **Objective: To explain the functioning of optical materials for optoelectronics** | | | | | |
| 1 | Introduction to **Materials for Optoelectronic Devices** | 1 | - | - | Mind Mapping |
| 2 | Optical absorption and emission, charge injection and recombination, loss and gain | 1 | T2 | 583 | Black Board |
| 3 | Optical processes in quantum wells | 1 | T3 | 598 | Black Board |
| 4 | Optoelectronic devices: light detectors and solar cells | 1 | R1 | 593 | Power Point |
| 5 | Light emitting diode – laser diode | 1 | R2 | 603 | Black Board |
| 6 | Optical processes in organic semiconductor devices | 1 | R3 | 620 | Chart Preparation |
| 7 | Excitonic state, Electro-optics | 1 | R4 | | Black Board |
| 8 | Modulators and switching devices | 1 | R5 | 647 | Flash Card |
| 9 | Problems and Review | 1 | T3 | 460 | Black Board |
| **UNIT V – SMART MATERIALS AND NANOMATERIALS** | | | | | |
| **Objective: To enable the students to gain knowledge on smart materials and nanomaterials.** | | | | | |
| 1 | Brief about the role of **Smart and Nano Materials** in different engineering applications. | 1 | - | - | Mind Mapping |
| 2 | Metallic glasses: Preparation, properties and applications | 1 | T2 | 3.4-3.8 | Flip Class Mode |
| 3 | Shape Memory Alloys (SMA): Characteristics, properties and applications of Ni-Ti alloy | 1 | T3 | 149-154 | Black Board |
| 4 | Nanomaterials, Quantum size effect | 1 | R6 | 154-159 | Power Point |
| 5 | Quantum dot, wire and well | 1 | R2 | 4.2-4.4 | Black Board |
| 6 | Carbon nanotubes and its types | 1 | R6 | 4.5-4.7 | Power Point |
| 7 | Potential uses of nanomaterials in electronics, robotics, computers, sensors, mobile electronic devices | 1 | R6 | 4.8-4.18 | Power Point |
| 8 | Classification of biomaterials and its applications | 1 | R5 | 4.19-4.23 | Power Point |
| 9 | Review | 1 | T3&R6 | - | Quiz |
| | **Total Hours** | **45** | | | |

**CONTENT BEYOND THE SYLLABUS**

Four Probe Method

Single Electron Transistors (SET)

Phosphate glass for high energy storage application

Holography

Quantum Dot (QD) laser

**TEXT BOOKS**


**T1.** S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.

**T2.** Umesh K Mishra and Jasprit Singh, Semiconductor Device Physics and Design, Springer, 2008.

**T3.** M.A.Wahab, Solid State Physics: Structure and Properties of Materials, Narosa Publishing House, 2009.


**REFERENCES**


**R1.** S.O.Pillai, Solid State Physics, New Age International (P) Ltd., publishers, 2009.

**R2.** V.Rajendran, Materials Science, Mc Graw Hill Education (India) Private Ltd., 2017.

**R3.** Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.

**R4.** Lawrence H. Vanvlack, Elements of Material Science and Engineering, Pearson, 2002.

**R5.** David Jiles, Introduction to the Electronic Properties of Materials, CRC Press, e-book, 2017.

**R6.** Charles P. Poole Jr., Frank J. Owens, Introduction to nano technology, Wiley, 2003.

**R7.** Mark Fox, Optical Properties of Solids, Oxford Univ. Press, 2001.


**WEBSITES:**

**W1.** https://archive.nptel.ac.in/courses/113/105/113105081/

**W2.** https://nptel.ac.in/courses/115102025

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Approved by

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Associate Professor & Head/Physics

# EASWARI ENGINEERING COLLEGE
## (autonomous)
## Department of Physics

## LESSON PLAN

**Subject code: 231PYS201T** **Subject Name: Materials Technology**

**Degree/Branch: B.E., Auto/Mech** **Year/Sem /Sec: I/II/A/B**

**Faculty Name:**

**Total No of Periods given in syllabus:**

**Lecture: 45** **Tutorial: 00** **Practical: 00** **Project: 00** **Grand Total: 45**

**OBJECTIVES:** To impart basic knowledge on the properties and behavior of the material for advancement in the field of mechanical and automobile engineering.

**COURSE OUTCOMES:**

At the end of this course, the students will

CO1 : Evaluate the method of crystallization and importance of phase diagrams in the field of materials science and engineering.

CO2 : Analyse the classical and quantum electron theories towards the formation of energy bands and the properties of magnetic materials.

CO3 : Apply the principles of quantum mechanics and transport phenomena for semiconducting materials.

CO4 : Design the optical materials and devices for optoelectronics.

CO5 : Apply nanomaterials for energy storage systems.

| S. No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching aids /methods Used |
|---|---|---|---|---|---|
| **UNIT-I INTRODUCTION TO CRYSTALLINE MATERIALS** | | | | | |
| Objective: To introduce the mechanism of crystallization and importance of phase diagrams in the field of materials science and engineering | | | | | |
| 1 | Introduction to crystallography.<br>Solid solutions-Principles of solidification. | 1 | R2 | 259 | Mind mapping |
| 2 | Nucleation-Homogeneous and Heterogeneous Nucleation. | 1 | R2 | 263 | Blackboard |
| 3 | Growth of a single crystal- solution and melt growth-Czochralski technique. | 1 | T1<br>T2 | 370<br>276 | Animated PPT |
| 4 | Crystal characterization using X-ray diffraction technique. | 1 | T2 | Appendix A | PPT |
| 5 | Introduction to phase diagram, phase rule.<br>Unary system. | 1 | T1 | 148 | PPT |
| 6 | Binary phase diagram-Isomorphous system-Tie line rule-Lever rule. | 1 | R1<br>T1 | 176<br>161 | PPT |

| S. No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching aids /methods Used |
|---|---|---|---|---|---|
| | | | T1 | 159 | |
| 7 | Eutectic, Peritectic, Eutectoid, and Peritectoid reactions. | 1 | R1 | 202 | Flash cards |
| 8 | Typical phase diagram-Fe-$Fe_3C$ system. | 1 | R1 | 208 | Blackboard |
| 9 | Review and problem solving. | 1 | | | Assignment |
| | | | | | |
| **UNIT- II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS** | | | | | |
| **Objective**: To impart knowledge on electrical and magnetic properties of materials. | | | | | |
| 1 | Classical free electron theory-Expression for electrical conductivity. | 1 | T2<br>R1 | 114<br>625 | Blackboard |
| 2 | Expression for Thermal conductivity. | 1 | T2 | 149 | Blackboard |
| 3 | Quantum free electron theory.<br>Concepts of tunneling, degenerate states and Fermi Dirac statistics. | 1 | T2 | 221 | Animated PPT |
| 4 | Density of energy states. | 1 | T2 | 305 | Black board |
| 5 | Energy bands in solids, tight binding approximation, electron effective mass, concept of hole. | 1 | R1 | 626 | Chart preparation |
| 6 | Magnetic materials: Dia, para, and ferromagnetic effects.<br>Paramagnetism in the conduction electrons in metals. | 1 | R1<br>T2 | 685<br>698 | PPT |
| 7 | Exchange interaction and ferromagnetism. | 1 | T2 | 700 | Blackboard |
| 8 | Quantum interference devices and GMR devices. | 1 | T2<br>T2 | 731<br>744 | Student Seminar |
| 9 | Review and Numerical. | 1 | | | Quiz |
| | | | | | |
| **UNIT III SEMICONDUCTOR AND TRANSPORT PHYSICS** | | | | | |
| **Objective**: To teach the principles of quantum mechanics and transport phenomena for semiconducting materials | | | | | |
| 1 | Introduction to semiconductors and Energy band diagram. | 1 | T2 | 381 | Mind mapping |
| 2 | Carrier concentration in intrinsic semiconductor-electrons. | 1 | T3 | 95 | Blackboard |
| 3 | Carrier concentration in intrinsic semiconductor-holes. | 1 | T3 | 95 | Blackboard |
| 4 | Carrier concentration in n-type and p-type semiconductors (qualitative).<br>Variation of carrier concentration with temperature. | 1 | T2<br>T2 | 388<br>396 | Animated PPT |
| 5 | Carrier transport in semiconductors: mobility, drift and diffusion. | 1 | T2<br>T2<br>R3 | 401<br>424<br>98 | Flip class node |
| 6 | Hall effect and devices. | 1 | T2 | 145 | Blackboard |
| 7 | Ohmic contacts and Schottky diode. | 1 | T2<br>T3 | 443<br>316 | Animated PPT |
| 8 | Introduction to solid state drive. | 1 | https://uwaterloo.ca/arts-computing-newsletter/winter-2018/feature/everything-you-need-know-about-solid-state-drives-ssd | | Student seminar |
| 9 | Review and Numerical. | 1 | | | Peer learning |

| S. No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching aids /methods Used |
|---|---|---|---|---|---|
| | | | | | |
| **UNIT-IV Optical properties of materials** | | | | | |
| **Objective**: To explain the functioning of optical materials for optoelectronics | | | | | |
| 1 | Optical processes in semiconductor: Optical absorption and emission. | 1 | T3 | 182 | PPT |
| 2 | Charge injection and recombination.<br>Optical absorption, loss and gain. | 1 | T3 | 205 | Blackboard |
| 3 | Optical processes in quantum wells. | 1 | T3 | 189 | Blackboard |
| 4 | Optoelectronic devise: Light detectors and solar cells. | 1 | T2 | 551 | PPT |
| 5 | Light emitting diode. | 1 | T2 | 543 | PPT |
| 6 | Laser diode. | 1 | | | PPT |
| 7 | Optical processes in organic semiconductor devices. | 1 | | | PPT |
| 8 | Electro-optics modulators and switching devices. | 1 | https://en.wikipedia.org/wiki/Electro-optic_modulator#:~:text=An%20electro%2Doptic%20modulator%20(EOM,or%20polarization%20of%20the%20beam. | | Student seminar |
| 9 | Review and Numerical. | 1 | | | Quiz |
| | | | | | |
| **UNIT-V MATERIALS FOR ENERGY APPLICATIONS** | | | | | |
| **Objective:** To enable the students to gain knowledge on synthesis and fabrication of nanomaterials. | | | | | |
| 1 | Introduction to materials for energy storage. | 1 | R6 | 317 | Chart Preparation |
| 2 | Properties of nanomaterials. | 1 | R6 | 199 | Black board |
| 3 | Carbon nanotubes (CNT). | 1 | R6 | 273 | Group activity |
| 4 | carbon nanofibers (CNF). | 1 | https://www.sciencedirect.com/topics/chemical-engineering/carbon-nanofiber#:~:text=Carbon%20nanofibers%20(CNFs)%20are%20cylindrical,electronic%20structure%20similar%20to%20graphite. | | PPT |
| 5 | CNTs and CNFs for hydrogen storage. | 1 | https://www.sciencedirect.com/science/article/pii/S1369702111701626 and https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119769149.ch7 | | PPT |
| 6 | Advanced batteries and supercapacitors for electrochemical energy storage. | 1 | https://pubs.acs.org/doi/10.1021/cr020730k | | Animated PPT |
| 7 | Role of carbon nanomaterials as electrodes in batteries and supercapacitors. | 1 | https://www.mdpi.com/2313-0105/9/1/19#:~:text=4.2.-,Activated%20Carbon,in%20large%20quantities%20cost%2Deffectively | | Flip class node |
| 8 | Fuel cells and their applications. | 1 | https://energypedia.info/wiki/Fuel_cell_and_its_applications | | Student seminar |
| 9 | Review. | 1 | | | Quiz |
| | **TOTAL:** | **45** | | | |

**Content beyond the Syllabus:**

Bridgman single crystal growth
Ferroelectricity
Graphene

| **TEXT BOOKS:** | |
|---|---|
| **1.** | Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley (Indian Edition), 2007. |
| **2.** | S.O. Kasap. Principles of Electronic Materials and Devices, McGraw-Hill Education (Indian Edition), 2020. |
| **3.** | Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020. |

| **REFERENCE BOOKS:** | |
|---|---|
| **1.** | Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019. |
| **2.** | Y. B. Band and Y. Avishai, Quantum Mechanics with Applications to Nanotechnology and Information Science, Academic Press, 2013. |
| **3.** | B. Rogers, J.Adams and S.Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014. |
| **4.** | Nouredine Zettili, Quantum Mechanics Concepts and Applications, 2nd Edition, Wiley, 2009. |
| **5.** | V.Rajendran, Materials Science, McGraw Hill Education (India) Private Ltd., 2017. |
| **6.** | G. Aruldhas, Quantum Mechanics, PHI Learning, 2008. |

| **WEBSITES:** | |
|---|---|
| **1.** | https://nptel.ac.in/courses/115102025 |

**Prepared by**

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Assistant Professor

**Approved by**

**Dr.S.Nirmala**
**HoD/Physics**

# EASWARI ENGINEERING COLLEGE
## (autonomous)
## Department of Physics

## LESSON PLAN

**Subject code: 231PYS202T** **Subject Name: Physics for Information Science**

**Degree/Branch: B.E., /B.Tech./CSE/IT/AIML/CS/AI&DS** **Year/Sem /Sec: I/II/A/B/C**

**Faculty Name:**

**Total No of Periods given in syllabus:**

**Lecture: 45** **Tutorial: 00** **Practical: 00** **Project: 00** **Grand Total: 45**

**OBJECTIVES:** To introduce the essential principles of Quantum theory and related concepts for an Engineering applications.

**COURSE OUTCOMES:**

At the end of this course, the students will

CO1 : apply the principles of quantum mechanics and transport phenomena for semiconducting materials.

CO2 : design the optical materials and devices for optoelectronics.

CO3 : apply the principles of quantum mechanics to one dimensional motion of particles.

CO4 : analyse the quantum mechanical principles towards the formation of energy bands.

CO5 : recommend the nano devices and nano materials for quantum computing.

| S. No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching aids /methods Used |
|---|---|---|---|---|---|
| | **UNIT-I SEMICONDUCTOR PHYSICS** | | | | |
| **Objective:** To teach the principles of quantum mechanics and transport phenomena for semiconducting materials. | | | | | |
| 1 | Introduction to semiconductors- Energy band diagram – direct and indirect band gap semiconductors | 1 | T2 | 299, 448 | Mind Mapping |
| 2 | Intrinsic Semiconductors- Density of electrons in conduction band | 1 | R5 | 241 | Black Board |
| 3 | Density of holes in Valence band – Intrinsic Charge carrier concentration. | 1 | R5 | 244 | Black Board |
| 4 | Fermi level and its variation with temperature | 1 | R5 | 246 | PPT |
| 5 | Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors (Qualitative study) – Variation of fermi level with carrier concentration and temperature. | 1 | T2 | 388 | Flash Card |
| 6 | Carrier transport in Semiconductor: random motion, | 1 | T2 | 401, | Chart |

| S. No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching aids /methods Used |
|---|---|---|---|---|---|
| | drift, mobility and diffusion | | | 416 | Preparation |
| 7 | Hall effect and determination of Hall coefficient - Experimental Verification and its application. | 1 | T2 | 145 | Black Board |
| 8 | Ohmic contacts and Schottky diode- Construction and Working. | 1 | T2 | 435, 443 | PPT |
| 9 | Review and problem solving. | 1 | | | Quiz |
| | | | | | |
| **UNIT- II LIGHT - SEMICONDUCTOR INTERACTION** | | | | | |
| **Objective**: To explain the functioning of optical materials for optoelectronics. | | | | | |
| 1 | Introduction to optical materials - Classification of optical materials | 1 | R5 | 360 | Mind Mapping |
| 2 | Carrier generation and recombination processes | 1 | T1 | 113 | Black Board |
| 3 | Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) | 1 | R5<br>T1 | 364<br>458 | Black Board |
| 4 | Photo current in a PIN diode | 1 | T2<br>T1 | 564<br>470 | PPT |
| 5 | Solar cell | 1 | T2 | 551 | Peer Learning |
| 6 | LED – Organic LED | 1 | T2 | 543 | Animated Videos |
| 7 | Laser diodes | 1 | T1 | 482 | Black Board |
| 8 | Optical data storage techniques | 1 | https://en.wikipedia.org/wiki/Optical_storage | | Black Board |
| 9 | Review and problem solving | 1 | | | Quiz |
| | | | | | |
| **UNIT III BASIC QUANTUM MECHANICS** | | | | | |
| **Objective**: To introduce the basic principles of quantum mechanics to one dimensional motion of particles. | | | | | |
| 1 | Inadequacies of Classical Mechanics – Black body radiation | 1 | T2 | 202 | Mind Mapping |
| 2 | Planck's theory of radiation – Derivation | 1 | R6 | 4 | Black Board |
| 3 | Deducement of Wien's Displacement law and Rayliegh Jeans law | 1 | R6 | 5 | Peer Learning |
| 4 | Dual nature of electromagnetic radiation – De Broglie hypothesis for matter waves- Heisenberg's uncertainty principle | 1 | T2 | 205, 217 | Flash card |
| 5 | Schrodinger's time dependent wave equation | 1 | R6 | 34 | Black Board |
| 6 | Schrodinger's time independent wave equation | 1 | R6 | 42 | Black Board |
| 7 | Significance of wave function - Born interpretation | 1 | R6 | 37 | Chart Preparation |
| 8 | Particle confinement in 1D box | 1 | R6 | 99 | Animated videos |
| 9 | Review and solving problems | 1 | | | Quiz |
| | | | | | |
| **UNIT-IV APPLIED QUANTUM MECHANICS** | | | | | |
| **Objective**: To enable the students to gain knowledge on applied quantum mechanics to form energy bands | | | | | |
| 1 | Introduction to Applied quantum mechanics | 1 | R6 | 1 | Mind Mapping |
| 2 | The harmonic oscillator | 1 | T2 | 337 | PPT |
| 3 | Barrier penetration and quantum tunneling Scanning | 1 | T2 | 221 | Black Board |

| S. No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching aids /methods Used |
|---|---|---|---|---|---|
| | Tunneling Microscope (STM) | | | | |
| 4 | Resonant diode | 1 | https://en.wikipedia.org/wiki/Resonant-tunneling_diode | | Animated PPT |
| 5 | Finite potential wells | 1 | R6 | 101 | Black Board |
| 6 | Bloch's theorem for particles in a periodic potential | 1 | R1<br>R6 | 167<br>110 | Black Board |
| 7 | Basics of Kronig - Penney model | 1 | R5,<br>R6 | 191,<br>111 | Black Board |
| 8 | Origin of energy bands. | 1 | R5 | 186 | Animated PPT |
| 9 | Review and Problem solving | 1 | | | Flip class node |
| | | | | | |
| | **UNIT-V NANODEVICES AND QUANTUM COMPUTING** | | | | |
| **Objective:** To teach the basics of quantum structures and their applications and quantum computing | | | | | |
| 1 | Introduction - quantum confinement– quantum structures: quantum wells, wires and dots | 1 | R2<br>R3 | 752<br>205 | Mind Mapping |
| 2 | Band gap of nanomaterials | 1 | R3 | 215 | Animated Videos |
| 3 | Tunneling – Single electron phenomena - Coulomb blockade | 1 | R3 | 216<br>220 | PPT |
| 4 | Resonant tunneling diode | 1 | R3 | 218 | Animated videos |
| 5 | Single electron transistor | 1 | R3 | 225 | PPT |
| 6 | Quantum system for information processing - quantum states | 1 | R2 | 21 | Black Board |
| 7 | Classical bits – quantum bits or qubits:–CNOT gate - multiple qubits | 1 | R2 | 205 | Black Board |
| 8 | Bloch sphere – quantum gates | 1 | R2 | 213,<br>418 | Peer Learning |
| 9 | Advantage of quantum computing over classical computing. | 1 | https://archive.nptel.ac.in/courses/115/101/115101092/ | | Quiz |
| | | | | | |
| | **TOTAL:** | **45** | | | |

**Content beyond the Syllabus:**

- Density of Energy states
- TEM AND STEM
- Carbon nano tube

| **TEXT BOOKS:** | |
|---|---|
| **1.** | Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley (Indian Edition), 2007. |
| **2.** | S.O. Kasap. Principles of Electronic Materials and Devices, McGraw-Hill Education (Indian Edition), 2020. |
| **3.** | Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020. |

| REFERENCE BOOKS: | |
|---|---|
| **1.** | Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019. |
| **2.** | Y. B. Band and Y. Avishai, Quantum Mechanics with Applications to Nanotechnology and Information Science, Academic Press, 2013. |
| **3.** | B. Rogers, J.Adams and S.Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014. |
| **4.** | Nouredine Zettili, Quantum Mechanics Concepts and Applications, 2nd Edition, Wiley, 2009. |
| **5.** | V.Rajendran, Materials Science, McGraw Hill Education (India) Private Ltd., 2017. |
| **6.** | G. Aruldhas, Quantum Mechanics, PHI Learning, 2008. |

| WEBSITES: | |
|---|---|
| **1.** | https://nptel.ac.in/courses/115102025 |

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**Approved by**

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**HoD/Physics**

# EASWARI ENGINEERING COLLEGE

(Autonomous)

## Department of Physics

## LESSON PLAN

**Subject code : 231PYB101T** **Degree/Branch : B.E/B.Tech.**

**Subject Name : Engineering Physics** **Year/Sem/Sec : I/I**

**Faculty Name :**

**Total number of periods given in the syllabus**

**Lecture: 45** **Tutorial: 00** **Practical: 00** **Project: 00** **Grand Total: 45**

**OBJECTIVES:**

- To impart knowledge on the basic principle of mechanics.
- To enable the students to gain knowledge on thermal physics.
- To explain the application of ultrasonics devices in engineering and medicine.
- To teach the description of various crystal structures and crystal defects for industrial applications.
- To learn the importance of laser and optical fibers for industry, telecommunication and medical applications.

**COURSE OUTCOMES:**

At the end of this course, the students will be able to

**CO1:** apply the basic principle of dynamics in torsional pendulum.

**CO2:** evaluate the heat energy flow in thermal devices.

**CO3:** design ultrasonic devices for engineering and medical disciplines.

**CO4:** analyze the crystal structures and crystal defects for industrial applications.

**CO5:** select the appropriate laser and optical fibers for industry, telecommunication and medical applications.

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT I – MECHANICS** | | | | | |
| **Objective: To impart knowledge on the basic principle of mechanics.** | | | | | |
| 1 | Multiparticle dynamics: Basics of Center of mass and Center of mass for continuous bodies | 1 | T1 | 4.11 | Mind Mapping |
| 2 | Motion of the Center of mass and kinetic energy of system of particles | 1 | T1 | 4.11 | Black Board |
| 3 | Rotation of rigid bodies: Rotational kinematics and rotational kinetic energy | 1 | T1 | 5.1 | Black Board |
| 4 | Moment of inertia theorems, moment of inertia of uniform rod | 1 | T1 | 5.11 & 5.12 | Power Point |
| 5 | Moment of inertia of circular disc and moment | 1 | T1 | 5.15 & | Black Board |

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| | inertia of solid cylinder | | | 5.17 | |
| 6 | Moment of inertia of a diatomic molecule, torque and rotational dynamics of rigid bodies | 1 | T1 | 5.2 to 5.5 | Chart Preparation |
| 7 | Conservation of angular momentum and gyroscope | 1 | T1 | 5.3 & 5.8 | Black Board |
| 8 | Torsional pendulum | 1 | T1 | 7.16 | Power Point |
| 9 | Numerical Problems and Review of the first unit | 1 | T1 | 5.27 | Technical Quiz |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT II - THERMAL PHYSICS** | | | | | |
| **Objective: To enable the students to gain knowledge on thermal physics.** | | | | | |
| 1 | Fundamentals of thermal energy | 1 | T1 | 9.1 | Mind Mapping |
| 2 | Expansion joints and Bimetallic strips | 1 | T1 | 11.1 | Chart Preparation |
| 3 | Thermal conductivity and conductions in solids | 1 | T1 | 16.2 | Black Board |
| 4 | Determination of Thermal Conductivity of good conductor by Forbe's Methods | 1 | T1 | 16.3 | Power Point |
| 5 | Thermal Conductivity of bad conductor by Lee's Disc Method | 1 | T1 | 16.4 | Power Point |
| 6 | Conduction through compound media (Parallel and Series) | 1 | T1 | 16.9 | Power Point |
| 7 | Thermal insulation and thermal shock resistance | 1 | T1 | 16.11 & 16.12 | Chart Preparation |
| 8 | Applications: Solar water heater, tempered glass and cryogenic materials | 1 | T2 | 5.43 to 5.51 | Flash Card |
| 9 | Numerical Problems and Review of the second unit | 1 | T1 | 16.27 | Technical Quiz |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT III – SOUND WAVES AND VIBRATIONS** | | | | | |
| **Objective: To explain the application of ultrasonics devices in engineering and medicine.** | | | | | |
| 1 | Propagation of sound waves | 1 | T1 | 40.1 | Mind Mapping |
| 2 | Intensity, Loudness of sound waves | 1 | T1 | 40.4 | Chart Preparation |

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| 3 | Determination of absorption coefficient | 1 | T1 | 41.4 | Power Point |
| 4 | Sabine's formula for reverberation time | 1 | T1 | 41.3 | Power Point |
| 5 | Factors affecting acoustics of buildings and their remedies | 1 | T1 | 41.6 | Power Point |
| 6 | Ultrasonic waves and properties | 1 | T1 | 42.1 | Chart Preparation |
| 7 | Methods of Ultrasonic production | 1 | T1 | 42.2 | Power Point |
| 8 | Applications of Ultrasonic in engineering and medicine | 1 | T1 | 42.6 | Flash Card |
| 9 | Numerical Problems and Review of the third unit | 1 | T1 | 41.6 | Technical Quiz |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT IV – CRYSTAL PHYSICS** | | | | | |
| **Objective: To teach the description of various crystal structures and crystal defects for industrial applications.** | | | | | |
| 1 | Single crystalline, polycrystalline and amorphous materials | 1 | T1 | 58.1 & 58.2 | Mind Mapping |
| 2 | Single crystals: unit cell, crystal systems, Bravais lattices | 1 | T1, R5 | 58.3 to 58.5, 13.2 to 13.6 | Power Point |
| 3 | Directions and planes in a crystal, Miller indices | 1 | T1 | 58.5 | Power Point |
| 4 | Inter-planar distances - coordination number | 1 | T1 | 58.8 | Power Point |
| 5 | Packing factor for SC and BCC | 1 | T1, R5 | 58.10, 13.12 to 13.14, | Power Point |
| 6 | Packing factor for FCC and HCP | 1 | T1, R5 | 58.10, 13.15 to 13.20 | Power Point |
| 7 | Diamond structures | 1 | Web link | https://en.wikipedia.org/wiki/Diamond_cubic | Chart Preparation |
| 8 | Crystal imperfections: point defects, line defects, Burger vector and stacking faults | 1 | Web link | https://www.britannica.com/science/crystal-defect | Flash Card |
| 9 | Numerical Problems and Review of the fourth unit | 1 | T1 | 58.1 to 58.13 | Technical Quiz |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT V – APPLIED OPTICS** | | | | | |
| **Objective: To learn the importance of laser and optical fibers for industry, telecommunication and medical applications.** | | | | | |
| 1 | Theory of laser, characteristics of Spontaneous and stimulated emission | 1 | T1 | 31.1 to 31.2 | Black Board |
| 2 | Einstein's coefficients, population inversion and He-Ne laser | 1 | T1 | 31.3 | Power Point |
| 3 | $CO_2$ laser and Basic applications of lasers in industry | 1 | T1 | 31.7 | Black Board |
| 4 | Semiconductor laser | | T1 | 31.6 | Power Point |
| 5 | Basic applications of lasers in industry | | T1 | 31.8 | Chart Preparation |
| 6 | Principle and propagation of light in optical fiber, Derivation for Numerical aperture and Acceptance angle | 1 | T1 | 32.7 | Power Point |
| 7 | Types and losses of optical fiber | 1 | T1 | 32.8 | Chart Preparation |
| 8 | Fiber Optical Communication (Block diagram) – Fiber Optic Endoscope | 1 | T1 | 32.10 | Flash Card |
| 9 | Numerical Problems and Review of the fifth unit | 1 | T1 | 18.11 | Technical Quiz |
| | **Total Hours** | **45** | | | |

**CONTENT BEYOND THE SYLLABUS**

- Double Pendulum
- Heat Exchanger - Refrigerator
- Detection of Ultrasonic waves
- Crystal Defects – Surface and Volume defects
- Nd-YAG Laser

**TEXT BOOKS:**


**T1** R. K. Gaur and S. L. Gupta, Engineering Physics, Dhanpat Rai Pub., 2018.

**T2** Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

**T3** D.Kleppner and R.Kolenkow, An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.


**REFERENCE BOOKS:**


**R1** Jeff Sanny, Samuel J. Ling, and William Moebs, University Physics, Volume 1- 3, OpenStax, ISBN-13: 978-1-947172-15-9, 2023.

**R2** D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.

**R3** Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.

**R4** D.K.Bhattacharya & T.Poonam, Engineering Physics, Oxford University Press, 2015.

**R5** V. Rajendran, Engineering Physics, McGraw Hill Publication, 2017.

**WEBSITES:**

**W1** https://www.britannica.com/technology/laser/Laser-applications

**W2** https://en.wikipedia.org/wiki/Crystal_structure

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# EASWARI ENGINEERING COLLEGE

## (Autonomous)

## Department of Physics

## LESSON PLAN

**Subject code : 231PYS204T** **Degree/Branch : B.E EEE**

**Subject Name : Electrical Engineering Materials** **Year/Sem/Sec : I/II**

**Faculty Name : Dr. S. Nirmala**

**Total number of periods given in the syllabus**

**Lecture: 45** **Tutorial: 00** **Practical: 00** **Project: 00** **Grand Total: 45**

**OBJECTIVES:**

- To impart knowledge on electrical properties of materials.
- To introduce the concepts of dielectric materials and insulators.
- To explain the importance of magnetic properties and superconductivity.
- To teach the principles of quantum mechanics for semiconducting materials.
- To enable the students to gain knowledge on nanomaterials.

**COURSE OUTCOMES:** At the end of the course, the students will be able to

CO1: analyse the classical and quantum electron theories towards the formation of energy bands.

CO2: evaluate the dielectric strength of dielectric materials in static and alternating field.

CO3: compare the properties of magnetic materials and superconductors for electrical engineering.

CO4: apply the principles of quantum mechanics for semiconducting materials.

CO5: develop the nano materials and nano devices for electrical engineering.

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT I – CONDUCTIVITY OF METALS** | | | | | |
| **Objective: To impart knowledge on electrical properties of materials** | | | | | |
| 1 | A brief about electrical engineering materials and conductivity of metals | 1 | T2 | 67 | Mind Mapping |
| 2 | Classical free electron theory, ohm's law, relaxation time, collision time, mean free path, electron scattering and resistivity of metals | 1 | T2 | 68-72 | Chart Preparation |
| 3 | Expression for electrical conductivity and thermal conductivity of metals | 1 | T2,R4 | 96,149 | Technical Quiz |
| 4 | Temperature dependence of resistivity, skin | 1 | R1 | 122-123, | Power Point |

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| | effect, Fermi – Dirac statistics | | | 163-165 | |
| 5 | Density of energy states | 1 | R1 | 305-308 | Black Board |
| 6 | Electron in periodic potential | 1 | R5 | 136 | Black Board |
| 7 | Energy bands in solids, Tight bind approximation | 1 | T2 | 74-77 | Black Board |
| 8 | Effective electron mass and concept of hole | 1 | R1 | 303-305 | Flash Card |
| 9 | Numerical Problems and Review | 1 | T2,R4 | 78-79<br>160-169 | Black Board |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
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**UNIT II - DIELECTRIC PROPERTIES OF INSULATORS IN STATIC AND ALTERNATING FIELD**

**Objective: To introduce the concepts of dielectric materials and insulators**

| | | | | | |
|---|---|---|---|---|---|
| 1 | Introduction to Dielectric materials: Relative permittivity, dipole moment, polarization vector | 1 | T2 | 105-108 | Mind Mapping |
| 2 | Types of polarization mechanisms | 1 | T2 | 111-112 | Black Board |
| 3 | Frequency and temperature dependence of polarization | 1 | T2 | 132 | Chart Preparation |
| 4 | Dielectric constant of mono-atomic gases, polyatomic molecules and solids | 1 | T2 | 109-110 | Black Board |
| 5 | Internal field and Clausius–Mosotti equation (derivation) | 1 | T2 | 113-116 | Black Board |
| 6 | Ferro-Electric and Piezzo-Electric materials | 1 | T2 | 145-147 | Power Point |
| 7 | Dielectric losses and dielectric strength | 1 | T2 | 126-127 | Power Point |
| 8 | Dielectric breakdown | 1 | T2 | 133-135 | Technical Quiz |
| 9 | Numerical Problems and Review | 1 | T2,R4 | 147-148<br>460-477 | Black Board |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
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**UNIT III – MAGNETIC PROPERTIES AND SUPERCONDUCTIVITY**

**Objective: To explain the importance of magnetic properties and superconductivity**

| | | | | | |
|---|---|---|---|---|---|
| 1 | Introduction about Magnetic and superconducting materials and Magnetic materials classification. | 1 | T2 | 149-152 | Mind Mapping |
| 2 | Domain theory of Ferromagnetism, Curie – Weiss law | 1 | T2 | 159-161 | Power Point |
| 3 | Soft and Hard magnetic materials | 1 | R1 | 719-727 | Technical Quiz |
| 4 | Quantum Interference Devices, GMR devices and Applications | 1 | R4 | 730-731 | Black Board |
| 5 | Origin of Superconductivity, zero resistance, Meissner effect and critical current density | 1 | T2 | 86-87 | Technical |

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| | | | | | Quiz |
| 6 | Properties and types of superconductors | 1 | R4 | 558-562 | Chart Preparation |
| 7 | BCS Theory (qualitative) and High $T_c$ superconductors | 1 | R4 | 562-564 | Black Board |
| 8 | Applications of superconductor in SQUID, cryotron and magnetic levitation | 1 | R1,R4 | 758-759<br>565-567 | Flash Card |
| 9 | Numerical Problems and Review | 1 | R4 | 541-549<br>568-570 | Technical Quiz |

| S.No | Topics | No. of Periods | Ref. Book | Page Nos | Teaching Aids |
|---|---|---|---|---|---|
| **UNIT IV – SEMICONDUCTOR MATERIALS** | | | | | |
| **Objective: To teach the principles of quantum mechanics for semiconducting materials** | | | | | |
| 1 | Introduction about semi conducting Materials | 1 | T2 | 172-173 | Mind Mapping |
| 2 | classification and semiconductor conductivity | 1 | T2 | 178-183 | Power Point |
| 3 | carrier concentration in Intrinsic semiconductor (Quantitative) | 1 | T2 | 183-186 | Black Board |
| 4 | n- type and p- type semiconductor, carrier concentration (qualitative study) | 1 | T2 | 186 | Black Board |
| 5 | Variation of carrier concentration with temperature – n - type and p- type semiconductor – graphical representation | 1 | T2 | 187-189 | Black Board |
| 6 | Trends in materials used in electrical equipment | 1 | T2 | 196-200 | Power Point |
| 7 | Hall effect and Devices | 1 | T2 | 191-194 | Peer Learning |
| 8 | Introduction to solid state drive | 1 | https://www.geeksforgeeks.org/introduction-to-solid-state-drive-ssd/ | - | Chart Preparation |
| 9 | Numerical Problems and Review | 1 | T3,R4 | 200-202<br>267-291 | Technical Quiz |
| **UNIT V – NANO DEVICES** | | | | | |
| **Objective: To enable the students to gain knowledge on nanomaterials** | | | | | |
| 1 | Introduction to nano materials and energy values for 0D, 1D, 2D and 3D. | 1 | R5 | 3-5 | Mind Mapping |
| 2 | Quantum confinement and structures | 1 | R5 | 91-97 | Black Board |
| 3 | Density of states for quantum well, quantum wire and quantum dot structures | 1 | R5 | 122-125 | Black Board |

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| 4 | Band gap of nanomaterials | 1 | https://www.accessengineeringlibrary.com/content/book/9781259007323/back-matter/appendix11 | - | Power Point |
| 5 | Carbon nanotubes: Types, properties and applications | 1 | R5 | 172 | Black Board |
| 6 | Tunneling, Single electron phenomena and Single Electron Transistor | 1 | https://cse.poriyaan.in/topic/single-electron-phenomena-and-single-electron-transistor-50119/ | - | Chart Preparation |
| 7 | Conductivity of metallic wires, ballistic transport, quantum resistance and conductance | 1 | https://ece.poriyaan.in/topic/ballistic-transport-20187/ | - | Black Board |
| 8 | Spintronic Devices and applications | 1 | https://www.ssla.co.uk/spintronics/ | - | Flash Card |
| 9 | Numerical Problems and Review | 1 | R5 | - | Technical Quiz |

**Total Hours 45**

**CONTENT BEYOND THE SYLLABUS**

Nano Ferrites

Maxwell-Boltzmann Statistics

Dilute Magnetic Semiconductors

Ferrites

Electro Optic Effects

CNT Fabrication

**TEXT BOOKS**

T1. Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers.

T2. Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by Indulkar C, S. Chand & Company Ltd-New Delhi.

T3. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi.

**REFERENCES**

R1. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.

R2. Umesh K Mishra and Jasprit Singh, Semiconductor Device Physics and Design, Springer, 2008.

R3. M.A.Wahab, Solid State Physics: Structure and Properties of Materials, Narosa Publishing House, 2009.

R4. V.Rajendran, Materials Science, Mc Graw Hill Education (India) Private Ltd., 2017.

R5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education.

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