MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE
(UGC-AUTONOMOUS)
Estd 1998

Affiliated to JNTUA, Anantapur & Approved by AICTE, New Delhi
Recognised Research Center
Accredited by NBA for CSE, ECE, EEE & ME
World Bank funded Institute
Recognised by UGC under the sections 2(f) and 12(B) of the UGC act 1956
Recognised as Scientific & Industrial Research Organization by DSIR of DST

## Department of Physics

Date: 07-05-2018

### Members of the Board of Studies for the Academic Year 2018-19

| S.No. | Name of the member | Composition as per the UGC-Autonomous guidelines | Designation & Address |
|---|---|---|---|
| 1. | Dr. Virendra Kumar Verma | Head of the Department concerned (Chairman) | Sr. Assistant Professor & Head, Department of Physics, MITS |
| 2. | Dr. N.Nanda Kumar Reddy | Subject Expert – Engineering Physics | Assistant Professor, Department of Physics MITS |
| | Dr. V. Mahendran | Subject Expert – Modern Physics | Assistant Professor, Department of Physics MITS |
| | Dr. K. Hari Krishna | Subject Expert – Physics: Electromagnetic Theory | Assistant Professor, Department of Physics MITS |
| | Dr. S. Victor Vedanayakam | Subject Expert – Optical Physics & its Applications | Assistant Professor, Department of Physics MITS |
| | Dr. Sunku Sreedhar | Subject Expert – Laser Physics & Advanced Laser Technology | Assistant Professor, Department of Physics MITS |
| | Dr. B. Jagadeesh Babu | Subject Expert – Thin Film Technology & its Application | Assistant Professor, Department of Physics MITS |
| 3. | Dr. R. Padma Suvarna | Expert in subject nominated by Academic Council | Professor & Head, Department of Physics, JNTUA College of Engineering, Anantapur 9441079332 |
| | Dr. Ariful Rahaman | Expert in subject nominated by Academic Council | Associate Professor, VIT University, Vellore 632014, Tamil Nadu 9698439988 |
| 4. | Dr. Y. Nazeer Ahammed | One expert to be nominated by the Vice-Chancellor from a panel of six recommended by the college Principal | Associate Professor, Department of Physics, Yogi Vemana University Kadapa. 9491944454 |
| 5. | Mr. M. Ravi Sankar | Representation from Industry/Corporation Sector | DIO/Scientist D National Informatics Center, Ministry of Electronics &Information Technology, Govt. of India Chickballapur, Karnataka 9538802663 |

Dr. Virendra Kumar Verma
Sr. Assistant Professor & Head
Department of Physics
MITS, Madanapalle

Head of the Department
PHYSICS
Madanapalle Institute of Technology & Science
MADANAPALLE - 517 325

Dr. C. Yuvaraj
Professor & Principal
MITS, Madanapalle

PRINCIPAL
Madanapalle Institute of Technology & Science
PO Box NO 14, Kadiri Road, Angallu
MADANAPALLE 517 325 A P

# MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

**( UGC - AUTONOMOUS )**

Approved by AICTE, New Delhi and Affiliated to JNTUA, Anantapuramu

**www.mits.ac.in www.mits.edu**


4 May 2018

To

Dr. R. Padma Suvarna
Head, Professor of Physics
JNTUA College of Engineering
Anantapuramu

Dear Madam,

Sub: Madanapalle Institute of Technology & Science, Madanapalle –Department of Physics – Member, Board of Studies – Nomination – Reg.

* * * *

Madanapalle Institute of Technology & Science (MITS), is a rapidly growing autonomous institute offering UG, PG and Ph. D. programmes in various disciplines of Engineering, Management, Sciences and Humanities. MITS is accredited by NBA & NAAC, and is receiving grants from Govt. funding agencies towards research projects. We further invite you to visit www.mits.ac.in for more details.

In our journey of academic pursuit, we need experienced and knowledgeable people like you to collaborate with us and take the institution to further heights. In this context, we are pleased to nominate you as Subject Expert on the Board of Studies in the Department of Physics and thus invite your contributions to our academic excellence.

Regards,

Dr. C. Yuvaraj
PRINCIPAL

PRINCIPAL
Madanapalle Institute of Technology & Science
P.O. No: 14, Kadiri Road, Angallu
MADANAPALLE - 517 325, A.P.

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4 May 2018

To

Mr. M. Ravi Sankar
DIO/Scientist D
National Informatics Center
Ministry of Electronics & Information Technology
Govt. of India
Chickballapur, Karnataka

Dear Sir,

Sub: Madanapalle Institute of Technology & Science, Madanapalle – Department of Physics – Member, Board of Studies – Nomination – Reg.

* * * *

Madanapalle Institute of Technology & Science (MITS), is a rapidly growing autonomous institute offering UG, PG and Ph. D. programmes in various disciplines of Engineering, Management, Sciences and Humanities. MITS is accredited by NBA & NAAC, and is receiving grants from Govt. funding agencies towards research projects. We further invite you to visit www.mits.ac.in for more details.

In our journey of academic pursuit, we need experienced and knowledgeable people like you to collaborate with us and take the institution to further heights. In this context, we are pleased to nominate you as Representative from Industry on the Board of Studies in the Department of Physics and thus invite your contributions to our academic excellence.

Regards,

Dr. C. Yuvaraj

PRINCIPAL

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# MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

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**www.mits.ac.in www.mits.edu**


4 May 2018

To

Dr. Ariful Rahaman
Associate Professor
VIT University
Vellore, Tamilnadu

Dear Sir,

Sub: Madanapalle Institute of Technology & Science, Madanapalle – Department of Physics – Member, Board of Studies – Nomination – Reg.

****

Madanapalle Institute of Technology & Science (MITS), is a rapidly growing autonomous institute offering UG, PG and Ph. D. programmes in various disciplines of Engineering, Management, Sciences and Humanities. MITS is accredited by NBA & NAAC, and is receiving grants from Govt. funding agencies towards research projects. We further invite you to visit www.mits.ac.in for more details.

In our journey of academic pursuit, we need experienced and knowledgeable people like you to collaborate with us and take the institution to further heights. In this context, we are pleased to nominate you as Subject Expert on the Board of Studies in the Department of Physics and thus invite your contributions to our academic excellence.

Regards,

Dr. C. Yuvaraj
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**DEPARTMENT OF PHYSICS**
**Board of Studies Meeting**
**Minutes of Meeting**

**Date: 30.06.2018**

The third meeting of Board of Studies is held today on 30.06.2018 from 10:30 AM - 03:30 PM for the approval of the syllabi of Physics courses offered by Department of Physics, MITS.

The following members attended the meeting.

**Members Present:**

| Sl. No. | Name | Position on BoS |
|---|---|---|
| 1. | Dr. Virendra Kumar Verma | Chairman |
| 2. | Dr. Y. Nazeer Ahammed | University Nominee |
| 3. | Dr. R. Padma Suvarna | Subject Expert |
| 4. | Dr. Ariful Rahaman | Subject Expert |
| 5. | Mr. M. Ravi Sankar | Industry Expert |
| 6. | Dr. S. Victor Vedanayakam | Member |
| 7. | Dr. Hari Krishna Koduru | Member |
| 8. | Dr. B. Jagadeesh Babu | Member |
| 9. | Dr. N. Nanda Kumar Reddy | Member |
| 10. | Dr. Sunku Sreedhar | Member |
| 11. | Dr. V. Mahendran | Member |

HoD of Physics, Dr. Virendra Kumar Verma explained in detail regarding the syllabus of Physics and Open electives for B. Tech. Programme to be offered in new regulation R18 from the academic year 2018-2019.

Board members reviewed the following syllabi

1. 18PHY101 Engineering Physics
2. 18PHY102 Modern Physics
3. 18PHY103 Physics: Electromagnetic Theory
4. 18PHY201 Physics Laboratory
5. 18PHY301 Optical Physics and its Applications
6. 18PHY302 Laser Physics & Advanced Laser Technology
7. 18PHY303 Thin Film Technology and Its Applications

**Resolutions:**

1. BOS committee suggested to prepare separate syllabus for all Engineering branches and recommended to conduct compulsory practical relevant to their opted branch.

2. The board suggested to exclude the topics conservative and non-conservative principles in Unit –I, impulse in Unit – II, Resolving power in Units – IV and Dye laser in Unit – V, of Engineering Physics course

3. The board suggested including colours in thin films to stress the application of interference in Unit – IV, of Engineering Physics course.

4. BOS committee suggested to restrict postulates of Quantum mechanics and excluded the topic linear harmonic oscillator in Unit – III of Modern Physics course.

5. BOS committee suggested to explain Kronig-Penny model in qualitatively and agreed to exclude the topics on carrier concentration, carrier transport, diffusion and drift in Unit – IV of Modern Physics. In addition, they recommended to include a text book on Quantum Mechanics written by Arul Das.

6. BOS suggested registering in National Knowledge Network – which facilitates to attend for virtual classes delivered by senior academicians from premier Institutions.

7. The board suggested excluding "Ferromagnetism", in Unit –IV of Electromagnetic Theory course.

8. According to the suggestions of the BOS members, we included experiments Planck's constant, B-H curve, Helmholtz coil, e/m determination, Wheatstone bridge experiment, determination of particle size using laser and torsional pendulum in Physics Laboratory Course.

9. The board suggested changing the title as Fibre Optics instead of Optical Fibres in Unit –V, Optical Physics and Applications.

10. The board recommended excluding the topics in following mentioned units of Laser Physics and Advanced Laser Technology.

Unit-I: Two level systems and multi-level systems, Gaussian beam and its properties.

Unit –II: Copper vapour laser, Nitrogen laser, Excimer laser.

Unit –III: Ruby laser.

Unit–IV: Liquid dye saturable absorbers, dispersion and compensation and characterization of Femtosecond pulses.

11. Board suggested to restrict to introduction for the topics Ti-Sapphire and quantum dot lasers. Pulsed operation topics shifted from unit III to unit IV.

12. The board recommended the following changes in Thin Film Technology course.

Unit –I: Crystal structure is modified as crystal defects.

Unit-II: Thermal, microwave, ion beam, polymerization deposition techniques are excluded.

Unit –III: Thermal properties of thin films are included in Unit – III.

Unit –IV: Porous measurements are excluded.

Unit –V: Ferro electric effect is replaced by thin film transistor.

It is resolved that the present syllabi brought before the BoS is thoroughly discussed and can be adopted with the suggested modifications.

**Members Present:**

| Sl. No. | Name | Position on BoS | Signature |
|---|---|---|---|
| 1. | Dr. Virendra Kumar Verma | Chairman | |
| 2. | Dr. Y. Nazeer Ahammed | University Nominee | |
| 3. | Dr. R. Padma Suvarna | Subject Expert | |
| 4. | Dr. Ariful Rahaman | Subject Expert | |
| 5. | Mr. M. Ravi Sankar | Industry Expert | |
| 6. | Dr. S. Victor Vedanayakam | Member | |
| 7. | Dr. Hari Krishna Koduru | Member | |
| 8. | Dr. B. Jagadeesh Babu | Member | |
| 9. | Dr. N. Nanda Kumar Reddy | Member | |
| 10. | Dr. Sunku Sreedhar | Member | |
| 11. | Dr. V. Mahendran | Member | |

**Head**
**Department of Physics**
Head of the Department
PHYSICS
Madanapalle Institute of Technology & Science
MADANAPALLE - 517 325

## 18PHY101 ENGINEERING PHYSICS

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**Course Prerequisite:** Plus two level physics course

**Course Description**: Engineering Physics for Civil and Mechanical Engineers is a physics course which provides fundamental knowledge to understand the concepts of mechanics, waves and oscillations, interference, diffraction, and lasers.

**Course Objectives:**

1. Expose students to the fundamental principles and laws of mechanics in Physics to understand the types of motion.
2. Demonstrate the ability to identify and apply the appropriate analytic, numerical, and mathematical reasoning, to situations of the physical world.
3. Analyze the concepts of mechanics, oscillations, waves and optics to prepare the students for advanced level courses.
4. Expose students to theoretical and mathematical aspects of interference and diffraction of light for testing of materials.
5. Adaptability to new developments in science and technology.

### UNIT I: MECHANICS OF PARTICLES

Velocity and Acceleration, Motion in one dimension, several dimensions, formal solution of kinematical equations. Polar Co-ordinates, velocity and acceleration in polar coordinates. Newton's Laws, applications of Newton's laws (Constraint equations, Block on string, Conical Pendulum, Block and Wedge). **(10)**

### UNIT II: MOMENTUM & WORK ENERGY

Momentum, law of conservation of linear momentum, flow of mass, Rocket Equation, Rocket in free space and in a gravitational field. Integrating equation of motion in one-dimension-work energy theorem, orbital velocity and escape velocity, Potential energy, Potential energy of a uniform force field, potential energy of an inverse square force, stability, conservation laws and particle collisions. **(10)**

### UNIT III: WAVES AND OSCILLATIONS

Simple Harmonic Motion, damped harmonic oscillations, forced harmonic oscillations, resonance, and quality factor. Superposition of vibrations along same direction (equal frequency) and in perpendicular directions, Lissajous figures. Transverse waves, solution of wave equation, velocity of a transverse wave along a stretched string, modes of vibration of stretched string, standing waves, standing wave ratio. **(10)**

### UNIT IV: INTERFERENCE & DIFFRACTION

Interference of light by division of wavefront- Young's double slit experiment, expression for fringe width, intensity distribution graph, interference of light by division of amplitude-

interference in thin film by reflection, Newton's rings experiment, Michelson interferometer, applications of Interference (colours of thin films). Diffraction, Farunhofer diffraction due to single slit, double slit and, Diffraction grating (N-slit), applications of Diffraction (List only)

**(10)**

**UNIT V: LASERS**

Introduction to Lasers, characteristics of Laser, interaction of radiation with matter-spontaneous and stimulated emission, Einstein's coefficients; amplification of light by population inversion, excitation mechanism, types of lasers: solid-state lasers – ruby laser, gas lasers - He-Ne Laser, semiconductor p-n junction diode laser; applications of lasers.

**(08)**

**Course Outcomes:**

Upon successful completion of this course, the students should be able to:

1. Describe and explain the fundamental physical principles and laws of Mechanics in Physics.
2. Explain the concepts conservation of momentum, energy, and predict the future state of a system based on its present state.
3. Apply the physical principles of waves together with logical and mathematical reasoning, to situations of the physical world of vibrations.
4. Define and evaluate the fundamentals of materials testing using Interference and Diffraction techniques.
5. Identify the working elements of different lasers and estimate laser operation parameters.

**Text Books**:


1. An Introduction to Mechanics, by D. Kleppner and R. Kolenkow, Tata McGraw-Hill Edition, 2007.
2. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006.
3. A. Ghatak, "Optics", McGraw Hill Education, 2012.
4. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.


**Reference Books:**


1. Physics Vol I & II, Halliday/Resnick/Krane 5th Edition, John Wiley, 2003.
2. Berkeley Physics Course Volume I, Tata-McGraw Hill.
3. Engineering Mechanics, 2nd ed. — MK Harbola
4. Introduction to Mechanics — MK Verma
5. Theory of Vibrations with Applications — WT Thomson


**Mode of Evaluation**: Assignment, Class room participation, Mid term examinations, Mini project / Term paper and External End Examination.

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## 18PHY102 MODERN PHYSICS

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**Course Prerequisite:** Plus two level physics course

**Course Description:** Modern Physics for Electrical and Computer Engineers is a basic physics course which provides fundamental knowledge to understand the concepts of Waves, Optics, Quantum Mechanics, Semiconductors and Lasers.

**Course Objectives:**

1. Expose students in understanding the basic laws of nature through wave equation using the principles of oscillations and waves.
2. Analyze and understand the concepts of waves and optics to prepare the students for advanced level courses.
3. Expose students to theoretical and mathematical aspects of Interference, Diffraction techniques and Lasers for testing of materials.
4. Develop knowledge and understanding the fundamental concepts of Quantum mechanics.
5. Adaptability to new developments in science and technology.

### UNIT I: WAVES

Simple harmonic motion, damped harmonic oscillations, forced harmonic oscillations, resonance, and quality factor. Superposition of vibrations along same direction (equal frequency) and in perpendicular directions, Lissajous figures. Transverse waves, one dimensional wave equation, solution for wave equation, velocity of a transverse wave along a stretched string, modes of vibration of stretched string, standing waves, standing wave ratio. **(10)**

### UNIT II: OPTICS

Light as an electromagnetic wave, Huygens' Principle, superposition of waves, interference of light by division of wavefront - Young's double slit experiment, expression for fringe width, intensity distribution graph, interference of light by division of amplitude- interference in thin film by reflection, Newton's rings experiment, Diffraction, Farunhofer diffraction due to single slit, double slit and Diffraction grating (N-slit). **(10)**

### UNIT III: QUANTUM MECHANICS

Introduction to Quantum Mechanics-Postulates of quantum mechanics, de Broglie's hypothesis, Uncertainty principle (Qualitative only), Time-dependent and time-independent Schrodinger equations for wave function, Free-particle wave function and wave-packets, Solution of wave equation: Solution of stationary-state, Schrodinger equation for one dimensional problems – particle in a box, Scattering from a potential barrier and principle of tunnelling- operation of scanning tunnelling microscope. **(10)**

### UNIT IV: SEMICONDUCTORS

Introduction to solids and semiconductors. Free electron theory of metals (drift velocity and electrical conductivity), Fermi energy level, density of states, Kronig-Penney model (Qualitative only) and origin of energy bands, band structure of metals, semiconductors, and

insulators. Direct and indirect bandgap semiconductors, Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), p-n junction-IV characteristics. **(10)**

**UNIT V: LASERS**

Introduction to lasers, characteristics of laser, spontaneous and stimulated emission, Einstein's coefficients; population inversion, excitation mechanisms, types of lasers: solid-state lasers – ruby laser, gas lasers - He-Ne Laser, semiconductor p-n junction diode laser; applications of lasers. **(08)**

**Course Outcomes:**

Upon successful completion of this course, the students should be able to:

1. Describe a mathematical wave equation using the principles of waves and oscillations
2. Apply the knowledge for materials testing using Interference and Diffraction techniques.
3. Understand the idea of wave function and to solve Schrodinger equation for simple potentials.
4. Explain the role of semiconductors in different realms of physics and their applications in both science and technology.
5. Identify the working elements of different lasers and estimate laser operation parameters.

**Text Books**:


1. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006.
2. A. Ghatak, "Optics", McGraw Hill Education, 2012.
3. D. J. Griffiths, "Quantum mechanics", Pearson Education, 2014.
4. B.G. Streetman, "Solid State Electronic Devices", Prentice Hall of India, 1995.
5. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010


**Reference Books:**


1. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006.
2. Physics Vol I & II, Halliday/Resnick/Krane 5th Edition, John Wiley, 2003.
3. D. A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
4. G. Aruldhas, "Quantum Mechanics", Prentice Hall India Pvt., Limited 2002.


**Mode of Evaluation**: Assignment, Class room participation, Mid term Examinations, Mini project / Term paper and External End Examination.

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## 18PHY103 PHYSICS: ELECTROMAGNETIC THEORY

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**Course Prerequisite**: Mathematics course with vector calculus and Basic Electromagnetism

**Course Description:** This course intends to provide the students to have a fair knowledge with an understanding about the theory and problems of static and dynamic electric and magnetic fields and their interaction and to enable them to use these concepts in applications. The course covers topics on vector algebra, Coulomb's law, Laplace's equation for electrostatic potential, conductors and capacitors, magnetic field due to a magnet, magnetic fields in matter, Maxwell's equations.

**Course Objectives:**

1. To understand the concepts of Vector calculus.
2. To understand the concepts of Electrostatics, Magnetostatics and their applications.
3. To estimate the Electric field intensity, potential and capacitance for different configurations and for different charge distributions.
4. To calculate the dipole moment, torque on dipole in the electric field and behaviour of conductors, insulators in electric field.
5. To analyse the Maxwell's equations, Neumann's formula.

### UNIT I: MATHEMATICAL TECHNIQUES

Vector algebra, Gradient, divergence and curl, Line, surface and volume integrals, Curvilinear co-ordinates, Dirac Delta Function, Theory of Vector Fields. **(10)**

### UNIT II: ELECTROSTATICS AND ELECTRIC POTENTIAL

Introduction, Coulomb's law, Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic fields; Laplace's and Poisson's equations for electrostatic potential; boundary conditions of electric field and electrostatic potential; Method of images; energy of a charge distribution and its expression in terms of electric field, multipole expansion. **(12)**

### UNIT III: ELECTRIC FIELDS IN MATTER

Polarization; Electrostatic field and potential of a dipole; Bound charges due to electric polarization; electric displacement; boundary conditions on displacement; Linear dielectrics and dielectric constants. **(8)**

### UNIT IV: MAGNETO STATICS AND MAGNETIC FIELDS IN MATTER

Lorentz force law; Biot-Savart law; Divergence and curl of static magnetic field; Ampere's law, Magnetic vector potential, Magnetization, the field of a magnetized object, Ampere's law in magnetized materials, Magnetic susceptibility and permeability.

**(10)**

**UNIT V: ELECTRODYNAMICS**

Electromotive force; Ohm's law; Electromagnetic induction; Faraday's law; Energy in magnetic fields; Maxwell's equations, Boundary conditions, Wave equation. **(8)**

**Course Outcomes**:

Upon successful completion of the course, students will be able to

1. Understand Gradient, Divergence and Curl along with fundamental Theorems.
2. Compute electric field intensity, displacement and potential for various charge distributions.
3. Apply Laplace equations to find potential distribution.
4. Solve magnetic field intensity for various current distributions.
5. Analyse time varying electromagnetic phenomena by using Maxwell's equations.

**Text Books**:

1. David J. Griffiths, "*Introduction to Electrodynamics*", Pearson Education Inc., Fourth Edition, 2012.
2. N.O. Sadiku, "*Elements of Electromagnetics*," Oxford Univ. Press, 4th ed., 2008.

**References:**

1. David Halliday, Robert Resnick and Kenneth S. Krane, Physics, Vol. 2, John Wiley & Sons, Inc., Fifth edition, 2002
2. W. Saslow, Electricity, magnetism and light, 2002.
3. John D. Krauss, "*Electromagnetics*", McGraw- Hill publications, 3rd ed., 1988.
4. Matthew William H. Hayt Jr. and John A. Buck, "*Engineering Electromagnetics*," TMH, 7th ed., 2006.

**Mode of Evaluation**: Assignments, Class participation, Internal Mid Examinations, Miniproject/ Term paper and External End Examination.

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## 18PHY201 PHYSICS LABORATORY

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**Course Description:**

Physics Practical course is meant for making the students to gain practical knowledge to co relate with the theoretical studies. It covers experiments on Principles of Mechanics and Optics, Measurement of Magnetic field and studying Resonance using LCR Circuit.

**Course Objectives:**

1. Elucidate the concepts of Physics through involvement in the experiment by applying theoretical knowledge.
2. Illustrate the basics of mechanics, waves and optics to analyze the behavior and characteristics of various materials for its optimum utilization.
3. Develop an ability to apply the knowledge of physics experiments in the later studies.

**LIST OF EXPERIMENTS: (Any 10 Out of 16)**

1. Spring constant - Coupled Pendulums.
2. Study of resonance effect in series and parallel LCR circuit.
3. Determination of radius of curvature of a curved surface - Newton's Rings.
4. Wavelength of a laser - Diffraction Grating
5. Wavelength of the spectral lines - Diffraction Grating.
6. Magnetic field along the axis of a current carrying coil - Stewart Gees' Apparatus
7. Ferroelectric hysteresis (B-H Curve). *(ECE)*
8. Thickness of a given wire - Wedge Method.
9. Determination of Planck's constant. *(EEE, CSE, CSIT, CST)*
10. Dispersive power of prism – Spectrometer.
11. Frequency of the tuning fork - Melde's apparatus.
12. Energy gap of a material of p-n junction. *(EEE, CSE, CSIT, CST)*
13. Width of single slit - Diffraction due to Single Slit.
14. Measurement of e/m of electron (Helical Coil method) *(ECE)*
15. Biot -Savart Law with Helmholtz Coil. *(ECE)*
16. The Wheatstone Bridge. *(ECE)*
17. Determination of particle size using Laser.
18. Torsional Pendulum. *(ME & Civil)*

**Course Outcomes:**

Upon successful completion of this course, the students should be able to:

1. Apply the scientific process in the conduct and reporting of experimental investigations.
2. Understand measurement technology, usage of new instruments and real time applications in engineering studies.

3. Verify the theoretical ideas and concepts covered in lecture by doing hands on in the experiments.
4. Know about the characteristics of various materials in a practical manner and gain knowledge about various optical technique methods.
5. Acquire and interpret experimental data to examine the physical laws.

**Reference Books:**


1. Physics Laboratory Manual
2. Optics, A. Ghatak, 4th Edition, Tata McGraw-Hill, New Delhi 2011.
3. Fundamentals of Optics, F. A. Jenkins and H. E. White, 4th edition, McGraw-Hill Inc., 1981.
4. Engineering Mechanics, 2nd ed. — MK Harbola
5. Introduction to Electrodynamics- David J Griffiths


**Mode of Evaluation**: Continuous Internal Evaluation, Practical End Examination.

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**Open Elective II**

## 18PHY301 OPTICAL PHYSICS AND ITS APPLICATIONS

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**Course Prerequisite:** None

**Course Description:**
The course will cover Geometrical optics, Aberrations, Physical Optics, Diffraction and Optical fibers.

**Course Objectives:**
1. Knowledge of basic principles and concepts in optics and the techniques used to deal with them.
2. Explain the limitations associated with spherical and chromatic aberration
3. Describe optical systems such as microscopes and telescopes with reference to parameters such as angular magnification and depth of field
4. Provide students with a working knowledge of optical physics, including interference, diffraction and physical optics.
5. Introduce construction and concepts of basic fiber optic communication system and to make the students learn about its important applications for societal needs.

### UNIT I: INTRODUCTION
Corpuscular and wave theory, Fermat's principle, Matrices for translation, refraction and reflection, Unit and nodal planes, Eigenvalues and Eigenvectors. **(9)**

### UNIT II: ABERRATIONS AND OPTICAL INSTRUMENTS
Types of aberrations, Chromatic and monochromatic aberrations. Different types of monochromatic aberrations. Simple and Compound microscopes, Astronomical and Terrestrial telescopes. Ramsden's and Huygens' eye pieces. **(9)**

### UNIT III: WAVE OPTICS & INTERFERENCE
Huygens's principle, Superposition of waves, Fourier transforms, representation of slits and apertures, Two beam interference by Division of wave front. Applications of Interference, Nonlinear interaction of light with matter (self-study). **(9)**

### UNIT IV: DIFFRACTION & POLARISATION
Fraunhoffer diffraction, Diffraction from single slit, double slit & multiple slits, Fresnel half-period zones, Zone plate, Applications of diffraction, Polarization, Malus' law, double refraction. Applications of polarization. **(9)**

### UNIT V: FIBER OPTICS
Construction and working principle of optical fibers, Numerical aperture and acceptance angle, Types of optical fibers. Attenuation and losses in optical fibers, Analog and Digital optical fiber communication system. Applications of optical fibers in communications, sensors and medicine. **(9)**

**Course Outcomes:**

Upon completion of this course the students shall be able to:

1. Recollect the fundamental characteristics of light and their mathematical principles.
2. Learn the principles of superposition, Interference and Diffraction
3. Understand nonlinear optics and photonics phenomena.
4. Be exposed to the application of optical techniques in cutting edge research areas.
5. Describe the basic laser physics, working of lasers and principle of propagation of light in optical fibers.

**Text Book:**

1. Optics by Ghatak, 4th Edition, Tata McGraw Hill (2011).

**Reference Books:**

1. Optics by Lipson, Lipson & Lipson, 4th Edition, Cambridge Univ Press (2010).
2. Optics by Hecht, 4th Edition, Addison-Wesley (2002).

**Mode of evaluation:** Assignment, Seminar, Written Examination.

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Open Elective - III

## 18PHY302 LASER PHYSICS & ADVANCED LASER TECHNOLOGY

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**Course Prerequisite:** Basic knowledge of atomic structure at intermediate (10+2) level is sufficient

**Course Description:**

Laser usage is rampant in various technological applications. Several fields gaining attention in the usage of lasers. This course covers the introduction to the theory and mechanism of laser action, various types of lasers and their applications and future use.

**Course Objectives:**

1. Make the student to understand the detailed principles of various lasers.
2. Profound understanding of different variety of lasers will provide them to think of superior selection and usage of lasers in practical technological applications.
3. Students are aware of latest developments in certain areas of Laser technology which have important applications for societal needs.
4. Explain how material processing is accomplished with lasers. Estimate laser operation parameters for material processing.
5. Exposure about Lasers applications in engineering, communications, spectroscopy and material process etc.

### UNIT I: INTRODUCTION TO LASER TECHNOLOGY

Laser characteristics, The Einstein Coefficients, Absorption and Emission Cross Sections, Spontaneous and Stimulated emission of radiation, Population inversion, Methods of Population Inversion, Laser Rate Equations, stable two minor optical resonators, Mode selection, Gain in the regenerative laser cavity. **(9)**

### UNIT II: GASES AND LIQUIDS LASING MEDIUM

Energy levels & Radiative properties of Atoms and molecules;
*Atomic lasers*: He-Ne laser, Argon Ion laser;
*Molecular Lasers*: Carbon dioxide laser,
Liquid energy levels and their radiative properties, Organic Dye laser. **(9)**

### UNIT III: SOLID STATE LASERS

Energy Levels in solids-dielectric medium, Solid-state lasing materials, Narrow line width laser materials, broad band line width laser materials, solid state lasers: Nd:YAG, Nd:YLF; Ti:Sapphire (introduction only)
Energy Levels in solids-semiconductor medium, direct and indirect band gap semiconductors, Semiconductor diode laser, Quantum dot lasers (Introduction only);

**(9)**

**UNIT IV: PULSED OPERATION OF LASERS**

Nanosecond: Q-Switching, Techniques of Q-Switching: electro-optic, Acousto-Optic. Femtosecond: Relationship between pulse duration and Spectral Width, Passive mode-locking, Active mode locking, Kerr lens mode locking, Amplification of femtosecond pulses (9)

**UNIT V: LASER APPLICATIONS**

Laser processing of materials: laser cutting, laser drilling, welding; Lasers in metrology- Accurate measurement of length, light wave communications; Laser spectroscopy: Laser fluorescence and Raman scattering (9)

**Course Outcomes**

Upon completion of this course the students shall be able to:

1. Understand the principle of phenomenon of laser and identify the operating principle involved in various type of lasers.
2. Estimate stability requirements in producing laser light by different types of sources
3. Differentiate or list the various types of lasers and their means of excitation.
4. Assess (Identify) which laser would best meet the need for a particular industrial or research task.
5. Student can knowledge of latest technological developments in laser technology. Femtosecond laser etc.

**Text books:**

1. Laser Fundamentals: William T Silfvast. Cambridge Publication.
2. Laser Theory and Applications: A.K. Ghatak and K. Thyagarajan, Springer
3. Femtosecond Laser Pulses Principles and Experiments: Claude Rulli`ere, Springer
4. Principles of Laser: O. Svelto
5. Laser Physics: Peter W Miloni, Joseph H Eberly.

**Reference books:**

1. Solid State Laser Engineering: Walter Koechner. Springer series in optical sciences.
2. Ultrafast Optics, Andrew M. Weiner
3. Laser spectroscopy: Demtroder
4. Laser Applications: Monte Ross

**Mode of evaluation:** Assignment, Seminar, Written Examination.

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**Open Elective - IV**

## 18PHY303 THIN FILM TECHNOLOGY AND ITS APPLICATIONS

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**Course Prerequisite:** None

**Course Description:**
Nucleation, crystallization, surface energy, various thin film coating processes including both physical vapour deposition such as evaporation, sputtering, pulsed laser deposition and chemical vapour deposition, spray coating, and other methods such as spin-coating, plasma polymerization, Langmuir Blodgett, transport phenomena in thin films, various properties of thin films, techniques and method to characterize thin films, current application of thin film, introduction to fabrication of thin film devices

**Course Objectives:**
1. To provide students with a comprehensive overview on the fundamentals of thin film preparation and characterization.
2. To enable the students to develop a thorough understanding of how core physics can be used to understand thin film deposition processes.
3. To establish the correlation between processing variables and materials characteristics and performance within the framework of key modern technologies.
4. To realize thin film applications to science and technology

### UNIT I: PHYSICS OF THIN FILMS
Introduction - Role of thin films in devices - Thin film definition - Crystalline and amorphous films - Crystal defects - Nucleation and growth - film formation. **(08)**

### UNIT II: THIN FILM DEPOSITION TECHNIQUES
Physical methods of films deposition-evaporation, e-beam, sputter deposition, pulsed laser, molecular beam epitaxy. Chemical methods of film deposition -Deposition of Inorganic films from Solutions-Chemical vapour deposition - Electrolysis, Anodization, Spray pyrolysis, Other techniques: Langmuir Blodgett and Spin Coating. **(10)**

### UNIT III: PROPERTIES OF THIN FILMS
Structural-Optical-Electrical-Magnetic-Mechanical and Thermal properties of thin films. **(08)**

### UNIT IV: CHARACTERIZATION OF THIN FILMS
Imaging Techniques (SEM, AFM, TEM) - Structural Techniques (XRD, Raman)-Optical Techniques (UV-Vis-NIR, PL)-Electrical Techniques (Hall Effect, IV, CV)-Magnetic Techniques (EPR, H-V curve)-Mechanical Techniques (Hardness testing)-Thickness measurement (profilometer, ellipsometry) **(10)**

### UNIT V: APPLICATIONS OF THIN FILMS
Transparent conducting coating - Optical coating – Solar cells – Photocatalytic – Sensors - Superconductivity- Superhard coatings – Thin film transistors. **(09)**

**Course Outcomes:**

After a successfully completed course the students will be able to:

1. Discuss the differences and similarities between different vacuum based deposition techniques, evaluate and use models for nucleating and growth of thin films.
2. Asses the relation between deposition technique, film structure, and film properties.
3. Know the typical thin film applications.
4. Motivate selection of deposition techniques for various applications.

**Text books:**

1. Thin Film Deposition: Principles and Practice, *Donald L. Smith*, McGraw Hill, Singapore, 2001.
2. Maissel, L.I and Glang. R, "Handbook of thin film technology", McGraw Hill, 1970.

**References:**

1. Thin film phenomena / *Kasturi L. Chopra,* New York: McGraw-Hill, c1969.
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications" Imperial College Press, 2004.
3. An introduction to physics and technology of thin films / *Alfred Wagendristel, Yuming Wang*, Singapore: World Scientific, c1994.
4. Thin film processes, *John L Vossen, Werner Kehn* editors, Academic Press, New York, 1978.
5. Thin film physics / *O.S. Heavens*, London: Methuen, c1970.

**Mode of evaluation:** Assignment, Class room participation, Mid term examinations, Mini project / Term paper and External End Examination.

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