VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
Ibrahimbagh, Hyderabad-31

DEPARTMENT OF PHYSICS
I Semester B.E Physics Syllabus for **CSE** and **IT** Branches w.e.f 2018-19

SEMICONDUCTOR PHYSICS

Course Objectives	Course Outcomes
The student will be able to 1. aware of limits of classical free electron free theory and to apply band theory of solids 2. acquire knowledge on various properties of semiconductors. 3. grasp the intricacies in semiconductor-optical interaction	***At the end of the course, the student should at least be able:*** 1. distinguish materials based on band theory of solids 2. classify semiconductors on the basis doping and to estimate conductivity and learn transport phenomenon in semiconductors 3. appreciate use of optical absorption by semiconductors.

UNIT-I: FUNDAMENTALS OF CRYSTAL STRUCTURE (8)
Introduction-Space lattice, Basis, Unit cell, Bravais lattices and crystal systems, X-ray diffraction, Bragg's law, powder x- ray diffraction-Miller Indices-types of solids: crystalline, polycrystalline and amorphous materials, point defects: Schottky, Frankel defects, compositional and substitutional impurities- NaCl, ZnS and diamond crystal structure.

UNIT-II: BAND THEORY OF SOLIDS (8)
Classical free electron theory (Drude theory) and its limitations, Somerfield theory, Fermi-Dirac Statistics- Density of states, Schrodinger wave equation for a particle in a box, Kronig-Penny model (introduction to origin of band gap), Energy bands in solids, E-k diagram, Qualitative treatment of density of states for bulk, thin and nano materials, energy band diagrams. Types of electronic materials: metals, semiconductors, and insulators, effective mass, concept of hole, direct and indirect band gap semiconductors.

UNIT-III: INTRINSIC AND EXTRINSIC SEMICONDUCTORS (8)
Intrinsic semiconductors, extrinsic semiconductors-doping, acceptor and donor impurities, expression for intrinsic and extrinsic carrier concentration (equilibrium carrier statistics), conductivity of intrinsic and extrinsic semiconductor, dependence of Fermi level on carrier-concentration and temperature, mobility, current density, Hall effect

UNIT-IV: TRANSPORT PHENOMENON IN SEMICONDUCTORS (8)
continuity equation, diffusion and drift currents, law of mass action, diffusion coefficient, diffusion length, carrier life time, P-N junction diode formation, diode in equilibrium without bias, calculation of depletion layer width metal-semiconductor junction (Ohmic and Schottky).

UNIT-V: SEMICONDUCTOR INTERACTION WITH RADIATION (8)
Optical transitions in bulk semiconductors: induced absorption, spontaneous emission, and stimulated emission; transition probabilities and Fermi's golden rule, optical absorption, optical loss and gain; Photovoltaic effect, exciton, radiative and non-radiative recombination mechanisms in semiconductors (Shockley-Read-Hall (SRH) recombination), Semiconductor materials for optoelectronic devices.

References:

1. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text Book Engineering Physics*, S. Chand, 2014.
3. A.G. Guy, Physical Metallurgy for Engineers, Addison-Wesley Pub. Co.; International Ed edition (1962)
4. Streatman and Ben. G, Solid State Electronic Devices, PHI, 2006
5. Jasprit Singh, Semiconductor Devices Basic Principles, 2000, John Wiley & Sons

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
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DEPARTMENT OF PHYSICS
II Semester B.E Physics Syllabus for **CSE** and **IT** Branches w.e.f 2018-19

OPTOELECTRONIC DEVICES

Course Objectives	Course Outcomes
The student will be able to 1. gain insight on lasing action and lasers 2. learn working of optoelectronic devices 3. acquire knowledge on optical fiber construction and signal losses in optical fibers 4. acquaint with types of sensors and transducers.	***At the end of the course, the student should at least be able:*** 1. acquaint with various types of lasers and their applications 2. apply semiconductor physics to optoelectronic devices 3. Summarize various merits, demerits and applications of optical fibers. 4. Classify various sensors and transducers for different applications

UNIT-I: LED AND PHOTO-DETECTORS (10)
LEDs*:* Electro-luminescence, device structure, materials, homo and hetero-junctions, characteristics, figure of merit, advantages and applications of LED. Visible and infrared LEDs.

Photo-detectors: photoconductivity, photodiode, Types of semiconductor photo-detectors: p-n junction, PIN, and Avalanche and their structure, materials, working principle, and characteristics, Noise limits on performance.

UNIT-II: SEMICONDUCTOR LASERS (8)
Review of laser physics: meta-stable states, population inversion, pumping, components of laser; condition for lasing, rate equations for carrier and photon-density, and their steady state solutions, Laser dynamics, characteristics of lasers. Semiconductor laser: materials, device characteristics, tuneable semiconductor lasers, applications of lasers.

UNIT-III: OPTICAL FIBRES (8)
Introduction, optical fibre as a dielectric wave guide, total internal reflection, numerical aperture, acceptance angle, propagation of light in optical fiber, types of optical fibers based on refractive index and modes of propagation, evanescent field, light sources for optical fibres, various signal losses in optical fibres, application of optical fibres. Block diagram of optical communication system.

UNIT-IV: SOLAR CELLS (7)
Introduction, solar radiation spectra, construction and working of solar cell, V-I characteristics of solar cell, quantitative treatment of spectral response, conversion efficiency, fill factor, thin film solar cells.

UNIT-V: SENSORS AND TRANSDUCERS (7)

Definitions of sensor, actuator and transducer, Sensor/transducers specifications: range, span, error, accuracy, sensitivity, Classification of sensors, bimetallic strips, Resistance temperature detectors (RTDs), thermistors, Thermocouple, photo resistor, application of photo, electro and thermo chromic materials, Piezo electric and pyro-electric sensors and their applications.

References:

1. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, PHI, 2002
2. G. Keiser, Optical communications, Mc Graw Hill, (2010)
3. M.N. Avadhanulu and P.G. Kshirsagar, *A Text Book Engineering Physics*, S. Chand, 2014.
4. D. Patranabi, sensors and transducers, PHI, 2003

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DEPARTMENT OF PHYSICS

I Semester B.E Physics Syllabus for **ECE** and **EEE** Branches w.e.f 2018-19

WAVES AND OPTICS

Course Objectives	Course Outcomes
The student will be able to	***At the end of the course, the student should at least be able:***
1. learn mathematical formulations of oscillations 2. express the various wave phenomenon exhibited by light 3. gain insight on lasing action and lasers 4. acquire knowledge on optical fiber construction and signal losses in optical fibers. 5. grasp basic concepts of EM waves	1. solve differential equations that describe the behavior of mechanical oscillators under various conditions 2. apply the fundamental principles of wave optics in relevant fields of engineering. 3. List various types of lasers and their applications 4. Summarize various merits, demerits and applications of optical fibers. 5. Apply Maxwell's equation to derive EM wave equation for different media.

UNIT-I: OSCILLATIONS (8)

Definition of SHM, motion of mechanical simple harmonic oscillator, time period of physical pendulum, energy of simple harmonic oscillator, damped harmonic oscillator, logarithmic decrement, energy of damped oscillator, relaxation time, forced oscillator equation and its solution. Resonance, Q-factor, sharpness and electromechanical analogy and Lissajous figure

UNIT-II: WAVE OPTICS (9)

Light as an electromagnetic waves, Huygens principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting, interference due to thin film, Newton's rings, interferometers: Michelson and Mach Zehnder.

Fraunhofer diffraction from a single slit- diffraction grating-Rayleigh criterion for limit of resolution, resolving power, dispersive power.

Polarization of light, Brewster angle and Brewster law, Malus law, double refraction.

UNIT-III: LASERS (8)

Review of laser physics: induced absorption, spontaneous and stimulate emissions, Einstein's theory of matter radiation interaction- A and B coefficients; amplification of light by population inversion, meta-stable states, pumping mechanisms, components of laser, rate equations for carrier and photon-density and their steady state solutions, different types of lasers: solid state laser (ruby laser, Nd: YAG) gas lasers (He-Ne, CO_2), dye lasers; Properties of laser beams, applications of lasers.

UNIT-IV: OPTICAL FIBRES (7)

Introduction, optical fibre as a dielectric wave guide, total internal reflection, numerical aperture, acceptance angle, propagation of light in optical fiber, types of optical fibers based on refractive index and modes of propagation, light sources for optical fibres, various signal losses in optical fibres, application of optical fibres. Block diagram of optical communication system.

UNIT-V: EM THEORY (8)

Introduction to electromagnetic waves, basic laws of electricity and magnetism, conduction and displacement currents, Maxwell electromagnetic equations in integral and differential forms, transverse nature of EM waves, boundary conditions, electromagnetic wave equations in non-conducting (free space) and conducting medium, energy carried by electromagnetic waves (Poynting vector), skin depth

References:

1. A. Ghatak, “Optics”, McGraw Hill Education, 2012.
2. Senior, Optical Fiber Communications: Principles and Practice, 3e: Pearson, 2010
3. G. Keiser, Optical communications, Mc Graw Hill, (2010)
4. D. J. Griffiths, “electrodynamics”, Pearson Education, 2014.
5. A. P. French, Vibration's and Waves, CRC Press, 2003
6. M.N. Avadhanulu and P.G. Kshirsagar, *A Text Book Engineering Physics*, S. Chand, 2014.

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DEPARTMENT OF PHYSICS
II Semester B.E Physics Syllabus for **ECE** and **EEE** Branches w.e.f 2018-19

QUANTUM MECHANICS AND SEMICONDUCTOR PHYSICS

Course Objectives	Course Outcomes
The student will be able to 1. demarcate classical and quantum mechanics and gain knowledge on quantum mechanics 2. aware of limits of classical free electron free theory and to apply band theory of solids. 3. acquire knowledge on various properties of semiconductors.	***At the end of the course, the student should at least be able:*** 1. solve quantum mechanical wave equation for particles 2. distinguish materials based on band theory of solids. 3. classify semiconductors on the basis doping and to estimate conductivity and 4. Explain transport phenomenon in semiconductors

UNIT-I: INTRODUCTION TO QUANTUM MECHANICS (8)
Inadequacy of classical mechanics, photo electric effect, Compton effect, Wave - particle duality, de Broglie waves, Davisson and Germer's experiment, G.P. Thomson experiment, Gaussian wave packet, uncertainty principle, wave function and its physical significance, probability current, postulates of quantum mechanics.

UNIT-II: SOLUTION OF WAVE EQUATIONS (8)
Time-dependent and time-independent Schrodinger equation, Born interpretation, Free-particle wave function and solution of stationary-state Schrodinger equation for one dimensional problems: particle in infinite square-well potential, potential barrier and tunnelling (qualitative treatment); calculation of transmission and reflection coefficients, related examples like alpha decay.

UNIT-III: BAND THEORY OF SOLIDS (8)
Classical free electron theory (Drude theory) and its limitations, Somerfield theory, Fermi-Dirac Statistics- Density of states, Schrodinger wave equation for a particle in a box, Kronig-Penny model (introduction to origin of band gap), Energy bands in solids, E-k diagram, Qualitative treatment of density of states for bulk, thin and nano materials, energy band diagrams. Types of electronic materials: metals, semiconductors, and insulators, effective mass, concept of hole, direct and indirect band gap semiconductors.

UNIT-IV: INTRINSIC AND EXTRINSIC SEMICONDUCTORS (8)
Intrinsic semiconductors, extrinsic semiconductors-doping, acceptor and donor impurities, expression for intrinsic and extrinsic carrier concentration (equilibrium carrier statistics), conductivity of intrinsic and extrinsic semiconductor, dependence of Fermi level on carrier-concentration and temperature, mobility, current density, Hall effect

UNIT-V: **TRANSPORT PHENOMENON IN SEMICONDUCTORS (8)**

continuity equation, diffusion and drift currents, law of mass action, diffusion coefficient, diffusion length, carrier life time, P-N junction diode formation, diode in equilibrium without bias, calculation of depletion layer width metal-semiconductor junction (Ohmic and Schottky).

Text / References:

1. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
2. Elmer Anderson, Modern Physics and Quantum Mechanics 1e, Saunders College Pub
3. D. J. Griffiths, "quantum mechanics ", Pearson Education, 2012.
4. John Singleton, Band Theory and Electronic Properties of Solids, OUP, 2001
5. M.N. Avadhanulu and P.G. Kshirsagar, *A Text Book Engineering Physics*, S. Chand, 2014.

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DEPARTMENT OF PHYSICS
I Semester B.E Physics Syllabus for **Civil** and **Mechanical** Branches w.e.f 2018-19

WAVES, OSCILLATIONS AND OPTICS

Course Objectives	Course Outcomes
The student will be able to 1. learn mathematical formulations of waves and oscillations 2. gain knowledge of ultrasonics 3. express the various wave phenomenon of light 4. grasp basic concepts of EM waves	***At the end of the course, the student should at least be able:*** 1. solve differential equations that describe the behavior of mechanical oscillators under various conditions 2. narrate the production and application of ultrasonics 3. apply the fundamental principles of wave optics in relevant fields of engineering. 4. Apply Maxwell's equation to derive EM wave equation for different media

UNIT-I: OSCILLATIONS (8)
Definition of SHM, motion of mechanical simple harmonic oscillator, time period of physical pendulum, energy of simple harmonic oscillator, damped harmonic oscillator, logarithmic decrement, energy of damped oscillator, relaxation time, forced oscillator equation and its solution. Resonance, Q-factor, sharpness and electromechanical analogy and Lissajous figure

UNIT-II: NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES (9)
General wave equation of a transverse wave on a string and its solution- velocity of transverse waves- reflection and transmission of waves at a boundary - modes of vibration of stretched string clamped at both ends, characteristics impedance of a string, standing waves equations.

Longitudinal wave equation and velocity-acoustics plane wave equation and speed of sound, Newton-Laplace formula, reflection and transmission of acoustic waves. Waves with dispersion, wave groups and group velocity.

UNIT-III: ULTRASONIC WAVES (7)
Introduction- properties of ultrasonics, types of ultrasonic waves, production of ultrasonics: piezoelectric and magnetostriciton methods- detection of ultrasonics: piezoelectric, Kundt's tube, flame test, thermal detector-acoustic grating: ultrasonic velocity measurements, applications of ultrasonics: SONAR, cavitation (cleaning), drilling, sonogram

UNIT-IV: WAVE OPTICS (8)
Light as an electromagnetic waves, Huygens principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting, interference due to thin film, Newton's rings, interferometers: Michelson and Mach Zehnder.

Fraunhofer diffraction from a single slit- diffraction grating-Rayleigh criterion for limit of resolution, resolving power, dispersive power.

Polarization of light, Brewster angle and Brewster law, Malus law, double refraction.

UNIT-V: EM THEORY (7)

Introduction to electromagnetic waves, basic laws of electricity and magnetism, conduction and displacement currents, Maxwell electromagnetic equations in integral and differential forms, transverse nature of EM waves, boundary conditions, electromagnetic wave equations in non-conducting (free space) and conducting medium, energy carried by electromagnetic waves (Poynting vector), skin depth

References:

1. A. Ghatak, "Optics", McGraw Hill Education, 2012
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text Book Engineering Physics*, S. Chand, 2014.
3. D. J. Griffiths, "Electrodynamics", Pearson Education, 2014.
4. A. P. French, Vibration's and Waves, CRC Press, 2003

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DEPARTMENT OF PHYSICS
II Semester B.E Physics Syllabus for **Civil** and **Mechanical** Branches w.e.f 2018-19

APPLIED PHYSICS

Course Objectives	Course Outcomes
The student will be able to 1. gain insight on lasing action and lasers 2. acquire knowledge on optical fiber construction and signal losses in optical fibers 3. grasp the concepts of acoustics 4. learn liquefaction of gasses 5. enumerate properties of magnetic materials and superconductors	***At the end of the course, the student should at least be able:*** 1. acquaint with various types of lasers and their applications 2. summarize various merits, demerits and applications of optical fibers 3. apply the principles of acoustics to minimize the reverberation 4. appreciate liquefaction of air & He and applications of low temperature 5. identify different properties and applications of magnetic and superconducting materials

UNIT-I: LASERS (8)
Review of laser physics: induced absorption, spontaneous and stimulate emissions, Einstein's theory of matter radiation interaction- A and B coefficients; amplification of light by population inversion, meta-stable states, pumping mechanisms, components of laser, rate equations for carrier and photon-density and their steady state solutions, different types of lasers: solid state laser (ruby laser, Nd: YAG) gas lasers (He-Ne, CO_2), dye lasers; Properties of laser beams, applications of lasers.

UNIT-II: OPTICAL FIBRES (8)
Introduction, optical fibre as a dielectric wave guide, total internal reflection, numerical aperture, acceptance angle, propagation of light in optical fiber, types of optical fibers based on refractive index and modes of propagation, light sources for optical fibres, various signal losses in optical fibres, application of optical fibres. Block diagram of optical communication system.

UNIT-III: ACOUSTICS (7)
Classification and Characteristics sound-expression for intensity of sound-reverberation-reverberation time-Sabine's formula-remedies to reverberation- sound absorbent materials-absorption coefficient-conditions for good acoustics of a building-acoustic quieting: effects and remedies

UNIT-IV: LOW TEMPERATURE PHYSICS (9)
Introduction to low temperature Physics- Porous plug experiment: Joule Thomson effect, Theory of porous plug experiment- J-K effect for a Van der Waal's gas. Relation between inversion temperature, Boyle temperature and critical temperature. Gas-Liquefaction-Regenerative cooling and cascade process- Liquefaction of air: Linde Process, Liquefaction of helium. Properties of cryogenic helium. Applications of cryogenic liquids

UNIT-V: MATERIALS SCIENCE (8)

Properties of ferro, antiferro and ferri-magnetic (ferrites) materials, Weiss molecular field theory of ferromagnetism- magnetic domains- hysteresis curve-Soft and hard magnetic Materials

General properties of superconductors – Meissner effect, Type I and Type II superconductors - Josephson's Junction –SQUIDS- Applications of superconductors

References:

1. Zeemansky, Heat and thermodynamics, Mc Graw Hill, 7th Ed, 1981
2. B.K. Pandey and Chaturvedi, Engineering Physics, Cengage Learning, 2016
3. L. H. Van Vlack , Elements of Materials Science and Engineering, Addison-Wesley, 1989

SYLLABUS OF ENGINEERING PHYSICS LAB
W.E.F ACADEMIC YEAR 2018-2019 for All Branches

I Semester:

1. Determination of characteristics of given laser.
2. Study of I-V characteristics of P-N Junction diode
3. Calculation of numerical aperture, acceptance angle and power loss due to bending of an optical fiber & to study power loss.
4. Zener diode characteristics and voltages Regulation
5. Determination of wavelength of spectral lines of Mercury light source using diffraction grating under normal incidence.
6. Determination of energy gap of a given semiconductor
7. Study of V-I characteristics of solar cell & to calculate fill factor, efficiency & series resistance.
8. Determination of radius of curvature of a given Plano-convex lens by forming Newton's Rings.
9. Temperature Characteristics of thermistor
10. Fly Wheel –determination of moment of inertia.
11. Torsional Pendulum to calculate rigidity modulus of two different wires
12. Michelson's interferometer
13. Characteristics of Photodiode

II Semester:

1. Study of resonance in LCR series & parallel circuits and to find resonant frequency & Q-factor
2. Determine the specific rotatory power of sugar solutions of different concentration by Lorent's half shade polarimeter
3. Physical Pendulum. Compound Pendulum
4. I-V Characteristics Photocell
5. e/m of electron-Thomson's method
6. B-H curve-Hysteresis loss
7. Melde's experiment
8. Cathode Ray Oscilloscope: Measurement of frequency, amplitude and phase
9. Characteristics of PIN diode
10. Seebeck Effect
11. Hall's effect- determination of Hall's coefficient
12. Gyroscope
13. Helmholtz coil

Student should perform any 8 (eight) experiments in a semester

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DEPARTMENT OF PHYSICS

III Semester B.E Physics Syllabus w.e.f 2019-2020
for Mechanical Branch

UNIT-I: *Electrostatics in vacuum* (8L+3T)
Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

UNIT-II: *Electrostatics in a linear dielectric medium* (9L+3T)
Polar and non-dilectric materials, types of dielectric polarization and polarizability, frequency and temperature dependence of polarizability, dielectric loss and dielectric breakdown.

Electrostatic field and potential due to a dipole, bound charges due to electric polarization; electric displacement; boundary conditions on displacement; solving simple electrostatics problems in presence of dielectrics: internal filed in a dielectric, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field- Clausius- Mossotti equation.

UNIT-III: *Magneto-statics in a linear magnetic medium* (8L+3T)
Magnetization and associated bound currents; auxiliary magnetic field ; Boundary conditions solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

UNIT-IV: *Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations* (8L+3T)
Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples.

UNIT-V:*: Electromagnetic waves* (8L+3T)
The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Suggested Text Books

1. David Griffiths, Introduction to Electrodynamics
2. Halliday and Resnick, Physics Vol.I and Vol.II
3. S.L. Gupta and Sanjeev Gupta, A course in electromagnetic field theory, Dhanpath Rai, 2012