MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

Hassan – 573202, Karnataka, India

Autonomous programmes

BACHELOR OF ENGINEERING

DEPARTMENT OF PHYSICS

SYLLABUS
I AND II SEMESTERS

Academic year 2023-24

Vision

To build a foundation for excellence and encourage the development of the Institution as a premier Institution by imparting the quality education in the process of understanding fundamentals of physics based on which the present and future technology is established.

Mission

- To enlighten the students and realize their talents both in theory and experimental Physics, through dedication to teach, commitment towards students and innovative instructional methods.
- To organize and sustain efficient administration in the department to contribute to the development of the Institution.

Scheme of evaluation theory courses

Assessment	Marks
Three CIE's	30
Lab CIE	20
SEE	50
Total	100

Examination		**Maximum marks**	**Minimum marks to qualify**
CIE	Theory	30	12
	Lab	20	08
SEE		50	20

Course Title	PHYSICS FOR CIVIL ENGINEERING		
Course Code	23PHYC12/22	**(L-T-P)C**	(2-2-2)6
SEE duration	3 hour	**Hours / Week**	06
CIE (Theory) marks	30	**CIE (Practicals) marks**	20
SEE marks	50	**Course Type**	IPCC

Course Objective:

The objective of the course is to make students learn principles and theories of physics in **civil and allied engineering** fields and to develop effective solutions for engineering problems.

Course Outcomes (COs): Upon completion of the course, students shall be able to

Sl. No.	Course outcomes	PO	PSO
1.	Discuss the concepts of vibrations, rigid body dynamics, crystallography, photonics and building acoustics.	1	-
2.	Interpret the dynamics of rigid bodies, applications of crystallography and photonics, and characteristics of building acoustics and ultrasonics.	1	-
3.	Solve problems on rigid body dynamics, crystallography, laser, and sound waves.	1	-
4.	Verify experimentally the laws and concepts of rigid body dynamics, crystallography, photonics, and resonance.	1, 10	-

Course Contents:

MODULE –1	10 Hrs.

Vibrations and Rigid Body Dynamics

Simple harmonic vibrations. Free vibrations. Damped vibrations-derivation of expressions for displacement of damped harmonic motion. Discussion of types of damped vibrations. Forced vibrations-derivation of expression for amplitude and phase-variation with frequency, Resonance. Condition for amplitude resonance. Applications of resonance.
Rigid body. Moment of inertia. Torsional pendulum-derivation of expression for time period of oscillation. Mention its uses. Bending of beams- derivation of expression for bending moment of a beam. Cantilever-derivation for depression of loaded end of a single cantilever.

Numerical problems on amplitude and phase of forced vibrations, time-period of oscillation, bending moment and Young's Modulus/depression of a cantilever

MODULE –2	10 Hrs.

Crystallography

Space lattice, Bravais lattice–unit cell, primitive cell. Lattice parameters. 7 basic crystal systems. Directions and planes, Miller indices. Expression for interplanar spacing. Coordination number. Atomic packing factors (SC, FCC, BCC). Density of a unit cell. X-rays and their types. Bragg's law. Bragg's X-ray spectrometer for identification of crystal structure. Importance of X-ray diffraction in material characterisation. De Broglie's concept of matter waves. Exploitation of wave nature of electrons in SEM, list of other applications

Numerical problems on Miller indices, Interplanar space, Bragg's law.

MODULE –3	**10 Hrs.**

Photonics

Interaction of radiation with matter. Expression for energy density in terms of Einstein's coefficients. Requisites of a Laser system. Conditions for laser action. Types of laser sources (to list out Solid, Gas and Semiconductor lasers and to list the contrast between them). CO_2 laser – construction and working, Qualitative discussion of measurement of pollutants (LIDAR), List of other applications: laser fencing, laser cutting, laser drilling, laser welding, laser-guided missiles, LASER Range Finder, Road Profiling, Bridge Deflection, Speed Checker.

Optical fibres. Construction and principle. Ray propagation mechanism. Angle of acceptance and numerical aperture - their relationship with refractive indices of core and clad and condition for ray propagation. Modes of transmission: V-number and number of modes, Types of optical fibres, Attenuation. List of applications of optical fibers. Merits and demerits of optical fibers.

Numerical problems on Boltzmann factor, V-number, Numerical aperture, and attenuation.

MODULE – 4	**10 hrs.**

Acoustics and ultrasonics

Introduction to acoustics, Types of Acoustics, reverberation and reverberation time, absorption power and absorption coefficient, Requisites for acoustics in auditorium, Sabine's formula (No derivation), Eyring's formula (No derivation). Comparison of Eyring's and Sabine's formula, measurement of absorption coefficient, factors affecting the acoustics and remedial measures, Noise and its Insulation,

Ultrasonics. Non-destructive testing of materials using ultrasonics. Measurement of velocity of ultrasonic waves and elastic constants in solids and liquids.

Numerical Problems on reverberation time, absorption power and absorption coefficient, Sabine's formula, Eyring's formula.

List of experiments

1. Measurement of electrical resistivity and energy gap of a semiconductor using four probe technique.
2. Determination of dielectric constant by charging and discharging of a capacitor.
3. Determination of wavelength of LASER by diffraction technique.
4. Verification of Stefan's law of radiation.
5. Determination of Planck's constant using Light Emitting Diodes.

6. Estimation of frequencies of vibrating string and AC using Sonometer.
7. Determination of resonance frequency and inductance using LCR circuits.
8. Determination of Young's modulus using single cantilever.
9. Determination of moment of inertia of rigid bodies and rigidity modulus of a string using torsion pendulum.
10. Determination of numerical aperture and modes of transmission of optical fiber.

Text Books :

1. Engineering physics: R K Gaur and S L Gupta, ISBN: 9788189928223, Dhanpat Rai Publishing Company (P) Ltd. Edition, 2011
2. Solid state physics: S O Pillai, ISBN-10: 9386070928, New Age International Pvt. Ltd, Eighth edition, 9 January 2018.

Reference Books:

1. Fiber Optics: A K Ghatak and K Thyagarajan, ISBN-13: 978-0521577854, Cambridge University Press India Pvt. Limited, 1998.
2. Physics laboratory manual, Dept. of Physics, Malnad College of Engineering, Hassan.

Massive Open Online Courses (MOOC) :

1. https://onlinecourses.nptel.ac.in/noc23_ee84/preview
2. https://onlinecourses.nptel.ac.in/noc23_ar11/preview

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3									1		

Course Title	**PHYSICS FOR MECHANICAL ENGINEERING**		
Course Code	23PHYM12/22	**(L-T-P)C**	**(**2-2-2)6
SEE duration	3 hour	**Hours / Week**	06
CIE (Theory) marks	30	**CIE (Practicals) marks**	20
SEE marks	50	**Type of Course**	IPCC

Course Objective:

The objective of the course is to make students learn principles and theories of physics in **mechanical and allied engineering fields** and to develop effective solutions for engineering problems.

Course Outcomes:
Upon completion of the course, students shall be able to

Sl. No.	Course outcomes	PO	PSO
1.	Discuss the concepts of vibrations, rigid body dynamics, crystallography, photonics and thermoelectricity	1	-
2.	Interpret the dynamics of rigid bodies, applications of crystallography and photonics, and characteristics of thermoelectric materials.	1	-
3.	Solve problems on rigid body dynamics, crystallography, lasers and thermoelectric materials and devices.	1	-
4.	Verify experimentally the laws and concepts of rigid body dynamics, crystallography, photonics and resonance.	1,10	-

Course Contents

MODULE – 1	10 Hrs

Vibrations and Rigid Body Dynamics

Simple harmonic vibrations. Free vibrations. Damped vibrations-derivation of expressions for displacement of damped harmonic motion. Discussion of types of damped vibrations. Forced vibrations-derivation of expression for amplitude and phase-variation with frequency. Resonance. Condition for amplitude resonance. Applications of resonance.

Rigid body. Moment of inertia. Torsional pendulum-derivation of expression for time of oscillation. Mention of uses. Bending of beams- derivation of expression for bending moment of a beam. Cantilever-derivation for depression of loaded end of a single cantilever.

Numerical problems on Amplitude and phase of forced vibrations, time-period of oscillation, bending moment and Young's Modulus/depression of a cantilever.

MODULE – 2	10 Hrs

Crystallography

Space lattice, Bravais lattice–unit cell, primitive cell. Lattice parameters. 7 basic crystal systems. Directions and planes, Miller indices. Expression for interplanar spacing. Coordination number. Atomic packing factors (SC, FCC, BCC). Density of a unit cell. X-rays and their types. Bragg's law. Bragg's X-ray spectrometer for identification of crystal structure. Importance of X-ray diffraction in material characterisation. De Broglie's concept of matter waves. Illustration of wave nature of electrons in SEM, list of other applications

Numerical problems on Miller indices, Interplanar space, Bragg's law.

MODULE – 3	10 hrs

Photonics

Interaction of radiation with matter. Expression for energy density in terms of Einstein's coefficients. Requisites of a Laser system. Conditions for laser action. Types of laser sources (to list out Solid, Gas and Semiconductor lasers and to list the contrast between them). CO_2 laser – construction and working, Measurement of pollutants (LIDAR), List of other applications: laser fencing, laser cutting, laser drilling, laser welding, laser-guided missiles, LASER Range Finder, Road Profiling, Bridge Deflection, Speed Checker.

Optical fibres. Construction and principle. Ray propagation mechanism. Angle of acceptance and numerical aperture - their relationship with refractive indices of core and clad and condition for ray propagation. Modes of transmission: V-number and number of modes, Types of optical fibres, Attenuation. List of applications of optical fibers. Merits and demerits of optical fibers.

Numerical problems on Boltzmann factor, V-number, Numerical aperture, and attenuation

MODULE – 4	10 hrs

Thermoelectric materials and devices

Thermoelectric phenomena. Thermo emf and thermo current, Seebeck effect. Variation of thermo emf with temperature, Peltier effect, Seebeck, Peltier and Thomson coefficients (Mention Expression), laws of thermoelectricity. Experimental demonstration of Peltier effect. Explanation of thermo emf based on Peltier effect. Thermo-electric power. Construction and Working of Thermoelectric generators (General). Construction and working of Thermoelectric coolers (Refrigerators), Construction and working of Exhaust (Automobiles).
Numerical Problems

List of experiments

1. Measurement of electrical resistivity and energy gap of a semiconductor using four probe technique.
2. Determination of dielectric constant by charging and discharging of a capacitor.
3. Determination of wavelength of LASER by diffraction technique.
4. Verification of Stefan's law of radiation.
5. Determination of Planck's constant using Light Emitting Diodes.
6. Estimation of frequencies of vibrating string and AC using Sonometer.
7. Determination of resonance frequency and inductance using LCR circuits.
8. Determination of Young's modulus using single cantilever.
9. Determination of moment of inertia of rigid bodies and rigidity modulus of a string using torsion pendulum.
10. Determination of numerical aperture and modes of transmission of optical fiber.

Text Books:

1. Engineering physics: R K Gaur and S L Gupta, ISBN: 9788189928223, Dhanpat Rai Publishing Company (P) Ltd. Edition, 2011
2. Solid state physics: S O Pillai, ISBN-10: 9386070928, New Age International Pvt. Ltd, Eighth edition, 9 January 2018.
3. Brijlal N Subramanyam : Heat and Thermodynamics ISBN: 81-219-2813-3 S. Chand and Co. Ltd. New Delhi, Edition, 2007.

Reference Books:

1. Fiber Optics: A K Ghatak and K Thyagarajan, ISBN-13: 978-0521577854, Cambridge University Press India Pvt. Limited, 1998
2. E-resources; NPTEL courses on Engineering physics.
3. Singal, Agarwal and Prakash : Heat, Thermodynamics and Statistical Physics, ISBN-13-9789350065235, Pragati Prakashan, India, 2017.
4. Physics laboratory manual, Dept. of Physics, Malnad College of Engineering, Hassan.

Massive Open Online Courses (MOOC) :

1. https://onlinecourses.nptel.ac.in/noc23_ee84/preview
2. https://onlinecourses.nptel.ac.in/noc23_cy37/preview

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3									1		

Course Title	PHYSICS FOR ELECTRONICS AND ELECTRICAL ENGINEERING STREAM		
Course Code	23PHYE12/22	**(L-T-P)C**	(2-2-2)6
SEE duration	3 hour	**Hours / Week**	06
CIE (Theory) marks	30	**CIE (Practicals) marks**	20
SEE marks	50	**Type of Course**	IPCC

Course Objective:

Objective of the course is to make students learn principles and theories of physics in electronics and electrical engineering fields and to develop effective solutions for engineering problems

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course outcomes	PO	PSO
1	Discuss the concepts of materials science, photonics and quantum mechanics	1	-
2	Interpret the laws of materials science, applications of photonics and quantum mechanics.	1	-
3	Solve problems on materials science, lasers, optical fibers and quantum mechanics.	1	-
4	Verify experimentally the laws and concepts of materials science, lasers, optical fibers and quantum mechanics.	1,10	-

Course Contents:

MODULE – 1	10 Hrs

Photonics

Interaction of radiation with matter. Expression for energy density in terms of Einstein's coefficients. Requisites of a Laser system. Conditions for laser action. Types of laser sources (to list out Solid, Gas and Semiconductor lasers and to list the contrast between them). CO_2 laser –construction and working, Measurement of pollutants (LIDAR), List of other applications: laser fencing, laser cutting, laser drilling, laser welding, laser-guided missiles, LASER Range Finder, Road Profiling, Bridge Deflection, Speed Checker.

Optical fibres. Construction and principle. Ray propagation mechanism. Angle of acceptance and numerical aperture - their relationship with refractive indices of core and clad and condition for ray propagation. Modes of transmission: V-number and number of modes, Types of optical fibres, Attenuation. List of applications of optical fibers. Merits and demerits of optical fibers.

Numerical problems on Boltzmann factor, V-number, Numerical aperture, and attenuation.

MODULE – 2	10 Hrs

Electrical Properties of Solids

Free electrons in metals. Classical free electron theory-assumptions. Drift velocity, Mean free path, Mean collision time, Relaxation time. Expression for electrical conductivity in metals. Failures of classical free electron theory. Quantum free electron theory–assumptions. Fermi energy. Fermi-Dirac distribution function (Fermi factor). Merits of quantum free electron theory.
Dielectric materials. Polarization and its types. Frequency dependence of polarizability and permittivity. Expression for internal field. Claussius-Mossotti equation. Applications of dielectrics in capacitors, transformers, LEDs; OLED and QLED and microwave tunable devices.
Numerical problems *on electrical conductivity, Fermi energy, and Claussius-Mossotti equation.*

MODULE – 3	**10 hrs**

Semiconductors and Superconductors

Effects of impurity and temperature on electrical resistivity of metals. Effects of impurity and temperature on their electrical resistivity semiconductors. electrical conductivity of a semiconductor (derivation). Applications in development of electronic devices (mention diodes, transistors, LEDs, etc.,)
Superconductors. Temperature dependence of electrical resistivity in superconductors. Meissner effect (qualitative). Critical magnetic field. Type I and Type II superconductors. BCS Theory. High temperature superconductors. Applications of superconductors; superconducting magnets, MRI, SQUID (to mention) and Maglev Vehicle (qualitative discussion).
Numerical problems *on electrical conductivity and critical magnetic field*

MODULE – 4	**10 hrs**

Quantum mechanics

Origin of quantum mechanics - Black body radiation spectrum, Wien's law and Rayleigh Jeans law, assumptions of quantum theory of radiation, Planck's law. Evidence/explanation of dual nature of matter. Louis de Broglie hypothesis of matter waves. **Relationship between *group velocity, phase velocity, particle velocity and velocity of light.*** Characteristic properties of matter waves. Expression for de Broglie wavelength of electron, its application in SEM and TEM, and advent of nanotechnology (Qualitative). Schrodinger wave equation, wave function, Probability density & normalization of wave function (Max Born's interpretation). Eigen values and Eigen functions, **Application of Schrodinger wave equation for trapped particle and free particle; computation of eigen values and eigen functions.**

Numerical problems *on* Louis de Broglie *equations, group velocity, phase velocity and Eigenvalue equation.*

List of experiments

1. Measurement of electrical resistivity and energy gap of a semiconductor using four probe technique.
2. Determination of dielectric constant by charging and discharging of a capacitor.
3. Determination of wavelength of LASER by diffraction technique.
4. Verification of Stefan's law of radiation.
5. Determination of Planck's constant using Light Emitting Diodes.

6. Estimation of frequencies of vibrating string and AC using Sonometer.
7. Determination of resonance frequency and inductance using LCR circuits.
8. Determination of Young's modulus using single cantilever.
9. Determination of moment of inertia of rigid bodies and rigidity modulus of a string using torsion pendulum.
10. Determination of numerical aperture and modes of transmission of optical fiber.

Text Books:

1. Engineering physics: R K Gaur and S L Gupta, ISBN: 9788189928223, Dhanpat Rai Publishing Company (P) Ltd. Edition, 2011
2. Solid state physics: S O Pillai, ISBN-10: 9386070928, New Age International Pvt. Ltd, Eighth edition, 9 January 2018.

Reference Books:

1. Modern Physics, Kenneth S. Krane, ISBN-13: 9781118061145, John Wiley & Sons, Inc., 3rd Edition, 2012.
2. B.B. Laud - Lasers and non-linear optics, New Age International, ISBN: 9788122430561, 3rdEdition, 2015.
3. Fiber Optics: A K Ghatak and K Thyagarajan, ISBN-13: 978-0521577854, Cambridge University Press India Pvt. Limited, 1998.
4. E-resources; NPTEL courses on Engineering physics.
5. Physics laboratory manual, Dept. of Physics, Malnad College of Engineering, Hassan.

Massive Open Online Courses (MOOC) :

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2. https://onlinecourses.nptel.ac.in/noc23_ph36/preview

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3									1		

Course Title	PHYSICS FOR COMPUTER ENGINEERING STREAM		
Course Code	23PHYS21/22	**(L-T-P)C**	(2-2-2)6
SEE duration	3 hour	**Hours / Week**	06
CIE (Theory) marks	30	**CIE (Practicals) marks**	20
SEE marks	50	**Type of Course**	IPCC

Course Objective:

Objective of the course is to make students learn principles and theories of physics in computer science and allied engineering fields and to develop effective solutions for engineering problems

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course outcomes	PO	PSO
1	Discuss the concepts of materials science, photonics and quantum mechanics in computation.	1	-
2	Interpret the laws of materials science, applications of photonics and quantum mechanics.	1	-
3	Solve problems on materials science, lasers, optical fibers and quantum mechanics.	1	-
4	Verify experimentally the laws and concepts of materials science, lasers, optical fibers and quantum mechanics.	1,10	-

Course Contents:

MODULE 1	10 hrs

Free Electron Theory and Superconductivity

Free electron concept in metals. Classical free electron theory-assumptions. Drift velocity, mean free path, Mean collision time, Relaxation time. Mention of expression for electrical conductivity in metals. Failures of classical free electron theory. Quantum free electron theory–assumptions. Fermi-Dirac distribution function. Merits of quantum free electron theory**.** Effects of impurity and temperature on electrical resistivity of metals.

Superconductors. Temperature dependence of electrical resistivity in superconductors. Meissner effect (qualitative). Critical magnetic field. Type I and Type II superconductors. BCS Theory. High temperature superconductors. Applications of superconductors; MRI and SQUID.

Role of semiconducting and dielectric properties in computation; Elements of memory and processing of tasks in computation using transistors, resistors, capacitors.

Numerical problems on electrical conductivity, Fermi energy, and critical magnetic field

MODULE 2	10 hrs

Photonics

Interaction of radiation with matter. Expression for energy density in terms of Einstein's coefficients. Requisites of a Laser system. Conditions for laser action. Types of laser sources (to list out Solid, Gas and Semiconductor lasers and to list the contrast between them). CO_2 laser –construction and working, Measurement of pollutants (LIDAR), List of other applications: laser fencing, laser cutting, laser drilling, laser welding, laser-guided missiles, LASER Range Finder, Road Profiling, Bridge Deflection, Speed Checker.

Optical fibres. Construction and principle. Ray propagation mechanism. Angle of acceptance and numerical aperture - their relationship with refractive indices of core and clad and condition for ray propagation. Modes of transmission: V-number and number of modes, Types of optical fibres, Attenuation. List of applications of optical fibers. Merits and demerits of optical fibers.

Numerical problems on Boltzmann factor, V-number, Numerical aperture, and attenuation.

MODULE 3	**10 hrs**

Quantum mechanics for computation

Origin of quantum mechanics - Black body radiation spectrum, Wien's law and Rayleigh Jeans law, assumptions of quantum theory of radiation, Planck's law. Evidence/explanation of dual nature of matter. Louis de Broglie hypothesis of matter waves. **Relationship between *group velocity, phase velocity, particle velocity and velocity of light.*** Characteristic properties of matter waves. Expression for de Broglie wavelength of electron, its application in SEM and TEM, and advent of nanotechnology (Qualitative). Schrodinger wave equation, wave function, Probability density & normalization of wave function (Max Born's interpretation). Eigen values and Eigen functions, **Application of Schrodinger wave equation for trapped particle and free particle; computation of eigen values and eigen functions.**

Numerical problems on* Louis de Broglie *equations, group velocity, phase velocity and Eigenvalue equation.

MODULE 4	**10 hrs**

Elements of Quantum Computing

Introduction to quantum computers, difference between classical and quantum computers, exponential growth of quantum computers for artificial intelligence and deep learning. Qubits and working principle of their different types; SQUID, Photonic, NMR, Ion trap. Dirac bracket notation, Bloch sphere, quantum logic gates; single qubit logic gates and multi qubit logic gates. Heisenberg's uncertainty principle, Quantum tunneling, Quantum entanglement, quantum superposition. Quantum Superposition and Quantum Entanglement; circuit building. Operation of logic gates on single and multi-Qubits. *Game on quantum superposition and quantum entanglement*

***Numerical problems**: Logic gates operation on Qubits*

List of experiments

1. Measurement of electrical resistivity and energy gap of a semiconductor using four probe technique.
2. Determination of dielectric constant by charging and discharging of a capacitor.

3. Determination of wavelength of LASER by diffraction technique.
4. Verification of Stefan's law of radiation.
5. Determination of Planck's constant using Light Emitting Diodes.
6. Estimation of frequencies of vibrating string and AC using Sonometer.
7. Determination of resonance frequency and inductance using LCR circuits.
8. Determination of Young's modulus using single cantilever.
9. Determination of moment of inertia of rigid bodies and rigidity modulus of a string using torsion pendulum.
10. Determination of numerical aperture and modes of transmission of optical fiber.

Text Books:

1. **Engineering physics: R K Gaur and S L Gupt**a ; *ISBN*: 9788189928223; *Dhanpat Rai Publishing* Company (P) Ltd. Edition: 2011
2. **Solid state physics: S O Pillai**; *ISBN*-10: 9386070928; New Age International Pvt. Ltd, Eighth edition: 9 January 2018.

Reference Books:

1. **Modern Physics: Kenneth S. Krane**; *ISBN*-13: *9781118061145* ; John Wiley & Sons, Inc., ; 3rd Edition, 2012.
2. **Fiber Optics: A K Ghatak and K Thyagarajan**; *ISBN*-13: 978-0521577854; Cambridge University Press India Pvt. Limited, 1998.
3. **Quantum computation and quantum information** - Michael A. Nielsen, Isaac L. Chuang - Cambridge University Press, 2004.\

Massive Open Online Courses (MOOC) :

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2. https://onlinecourses.nptel.ac.in/noc23_ph29/preview

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3									1		