Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

Course Title	Fundamentals of Physics I	
Course Level (tick (√) in the relevant option)	100 √ ☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐	Semester: Odd √ ☐ Even ☐ Either semester ☐
Course applicable for	BSMS ☐√ Int. PhD. ☐ Ph.D. ☐	
Tag of the course (tick (√) in the relevant option(s))	Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐	
Type of the course	Theory √ ☐ Lab ☐ Project ☐ Non-Credit ☐	

Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits
	3	0	0	3

Course Code:	PS101
Names of faculties who can teach the course	All Departmental Faculty

Will the course require participation of visiting faculties: ~~Yes~~ / No

Prerequisites, if any Course code(s)	Nil

Learning Objective(s): To introduce students to some of the fundamental concepts of physics, including the basics of classical mechanics, general properties of matter, special theory of relativity and heat and thermodynamics.

Expected Learning Outcome(s): On successful completion of this course, students

1) will gain knowledge about the basics of classical mechanics, small oscillations, general properties of matter, special theory of relativity and heat and thermodynamics
2) will be able to solve basic problems on the above topics

Contents of the course:

Mechanics:
i) Introduction to mechanics: Newton's laws of motion, momentum, momentum of system of particles, frames of reference, conservation laws, collisions, center of mass - approximately 5 lecture hours

ii) Rigid body motion: Rigid body, moment of inertia, rigid body Kinematics, rigid body kinetics, motion of gyroscope - approximately 6 lecture hours

iii) Non Inertial Frame: Physics in the rotating coordinate system, fictitious force, central force and motion of planets and satellites - approximately 6 lecture hours

Small oscillations: approximately 3 lecture hours

Properties of matter: Elasticity, stress, strain, Young's modulus - approximately 4 lecture hours

Heat and Thermodynamics:, Concepts of heat flow, entropy, enthalpy, specific heat, Carnot engine, laws of thermodynamics, kinetic theory of gas - approximately 6 lecture hours

Special theory of relativity: Axioms of relativity, Lorentz transformation, length contraction, time dilation, relativistic mass energy, Doppler effect - approximately 6 lecture hours

Problem solving and discussions: approximately 6 lecture hours

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Mechanics: Introduction to mechanics - Newton's laws of motion, momentum, momentum of system of particles	1
2	Mechanics: Introduction to mechanics - frames of reference, conservation laws	2
3	Mechanics: Introduction to mechanics - collisions, center of mass	2
4	Mechanics: Rigid body motion - Rigid body, moment of inertia	2
5	Problem solving and discussions	1
6	Mechanics: Rigid body motion - Rigid body Kinematics, rigid body kinetics, motion of gyroscope	4
7	Non Inertial Frame: Physics in the rotating coordinate system, fictitious force, central force and motion of planets and satellites	3
8	Non Inertial Frame: Central force and motion of planets and satellites	3
9	Problem solving and discussions	1
8	Small oscillations	3
10	Properties of matter	4
11	Problem solving and discussions	1
12	Heat and Thermodynamics: Concepts of heat flow, entropy, enthalpy, specific heat	2
13	Heat and Thermodynamics: Carnot engine, laws of thermodynamics	2
14	Heat and Thermodynamics: Kinetic theory of gas	2
15	Problem solving and discussions	1
16	Special theory of relativity: Axioms of relativity, Lorentz transformation	2
17	Special theory of relativity: Length contraction, time dilation	2
18	Special theory of relativity: Relativistic mass energy, Doppler effect	2
19	Problem solving and discussions	2

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Klepner D. and Kolenkow R., An Introduction to Mechanics (McGraw Hill Education, 2017)
2. Zemansky M. and Dittman R. H., Heat and Thermodynamics (McGraw Hill Education, 2017)
3. Verma H.C., Concept of Physics 1 (Bharati Bhawan, 2025)

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Additional Guidelines:

The number of hours per module given above is approximate.

Name and Signature of course proposer(s):

DUGC Convener (Victor Mukherjee)

HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.	Physical Chemistry I	CH206	Heat and Thermodynamics	14%
2				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

Course Title	Fundamentals of Physics II				
Course Level (tick (√) in the relevant option)	100 √ ☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even √ ☐ Either semester ☐	
Course applicable for	BSMS ☐√ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory √ ☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	PS102				
Names of faculties who can teach the course	All Departmental Faculty				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s): The course aims to give the students an overview of the basics of some of the modern advancements in physics.

Expected Learning Outcome(s): On successful completion of this course, students

1) will gain knowledge about the basics of quantum mechanics, statistical mechanics and nuclear physics
2) will be able to solve basic problems on the above topics

Contents of the course:

Notable experiments on quantum physics: Double-slit experiment, Frank Hertz Experiment, Stern Gerlach experiment - approximately 2 lecture hours

Discrete spectra and Bohr model: Review of Bohr atom model, its successes and failures - approximately 4 lecture hours

Particle properties of waves: light and waves, black body radiation, photoelectric effect, Compton effect, X-ray diffraction, pair production - approximately 6 lecture hours

Wave properties of particles: de Broglie wavelength, wave particle duality, phase and group velocities, particle/electron diffraction – approximately 6 lecture hours

Quantum states and dynamics of particles: Superposition, uncertainty principle, Schrödinger equation, introduction to operators - approximately 4 lecture hours

Physical properties of particles in potentials (without derivation): particle in a box, finite well potential, tunnelling, hydrogen atom - approximately 5 lecture hours

Statistics of particles: distinguishable and indistinguishable particles, Boltzmann statistics, Fermi Dirac statistics, Bosonic statistics - approximately 4 lecture hours

Nuclear physics: radioactivity, fusion, fission, introduction to nuclear shell model - approximately 5 lecture hours

Problem solving and discussions: approximately 6 lecture hours

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Notable experiments on quantum physics: Double-slit experiment, Frank Hertz Experiment, Stern Gerlach experiment	2
2	Discrete spectra and Bohr model: Review of Bohr atom model, its successes and failures	4
3	Problem solving and discussions	1
4	Particle properties of waves: light and waves, black body radiation	2
5	Particle properties of waves: photoelectric effect, Compton effect, X-ray diffraction, pair production	4
6	Wave properties of particles: de Broglie wavelength, wave particle duality	2
7	Wave properties of particles: Phase and group velocities, particle/electron diffraction	3
8	Problem solving and discussions	1
9	Quantum states and dynamics of particles	4
10	Physical properties of particles in potentials: particle in a box, finite well potential, tunnelling	3
11	Physical properties of particles in potentials: Hydrogen atom	2
12	Problem solving and discussions	1
13	Statistics of particles: Distinguishable and indistinguishable particles, Boltzmann statistics	2
14	Statistics of particles: Fermi Dirac statistics, Bosonic statistics	3
15	Problem solving and discussions	1
16	Nuclear physics: radioactivity, fusion, fission	3
17	Nuclear physics: Introduction to nuclear shell model	2
18	Problem solving and discussions	2
total		42 hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Beiser A., Concept of Modern Physics (McGraw Hill Education, 2009)
2. Verma H. C., Quantum Physics (Surya Publications, 2022)
3. Feynman R. P., Leighton R. B. and Sands M., The Feynman Lecture on Physics, Vol 3 (Pearson Education, 2012)
4. Mani H. S. and Mehta G. K., Introduction to Modern Physics (Affiliated East-West Press, 1990)

5. Halliday D., Resnick R. and Walker J., Principles of Physics (Wiley, 2020)

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

30 - 40 % for the mid semester examination, 50 - 60 % for the end semester examination and 0 - 20% for other components, viz. quizzes, assignments and attendance

Additional Guidelines:

1. The number of hours per module given above is approximate.
2. The instructor may need give rigorous derivations of the results introduced in this course

Name and Signature of course proposer(s):

DUGC Convener (Victor Mukherjee)

HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on______________________________________. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

Course Title	Physics Laboratory I				
Course Level (tick (√) in the relevant option)	100 √ ☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even √ ☐ Either semester ☐	
Course applicable for	BSMS ☐√ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☐ Lab √ ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	0	0	3	1	
Course Code:	PS104				
Names of faculties who can teach the course	All Departmental Faculty				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

1. To introduce students to fundamental experiments in classical and modern physics.
2. To develop practical skills in experimental physics, including measurement techniques, data acquisition, data analysis, and error estimation.
3. To cultivate scientific reasoning and enhance the ability to relate physical models to experimental observations.
4. To familiarize students with laboratory equipment and protocols for safe and accurate experimentation.

Expected Learning Outcome(s): On successful completion of this course, students will be able to:

1. Demonstrate understanding of key physics concepts in classical and modern physics
2. Gain knowledge about collecting data in experiments
3. Analyze physical phenomena through graphical representation and quantitative evaluation, including fitting curves to extract physical constants.
4. Interpret experimental data and compare with theoretical predictions, identifying possible sources of systematic and random errors.
5. Communicate experimental findings effectively through clear, structured, and concise lab reports.

Contents of the course:

1) Introduction to the theoretical aspects of the experiments
2) Introduction to basic experimental apparatus, error analysis, plotting and linear regression
3) Measurement of the moment of inertia of a flywheel using a gyroscope
4) Determination of acceleration due to gravity using a bar pendulum
5) Determination of acceleration due to gravity by free fall
6) Measurement of Young's Modulus of the material of a bar using uniform and non uniform bending using pin and microscope method.
7) Investigation of free, forced and chaotic oscillations with various degrees of damping by using Pohl's Pendulum
8) To study the dependence of moment of force as a function of position vector, force and angle between the position vector and force
9) Measurement of the specific heat of a solid
10) Measurement of Planck's constant and workfunction by photoelectric effect.
11) Measurement of the grating constant of a grating by using a spectrometer
12) To study thermoelectric effect and to measure Seebeck and Peltier coefficient.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours
1	Introduction to the theoretical aspects of the experiments	3
2	Introduction to basic experimental apparatus, error analysis, plotting and linear regression	3
3	Measurement of the moment of inertia of a flywheel using a gyroscope	3
4	Determination of acceleration due to gravity by using a bar pendulum	3
5	Determination of acceleration due to gravity by free fall	3
6	Measurement of Young's Modulus of the material (Steel/Plastic/Aluminium) of a bar using uniform and non uniform bending using pin and microscope method.	3
7	Investigation of free, forced and chaotic oscillations with various degrees of damping by using Pohl's Pendulum	3
8	To study the dependence of moment of force as a function of position vector, force and angle between the position vector and force	3
9	Measurement of the specific heat of a solid	3
10	Measurement of Planck's constant and workfunction by photoelectric effect.	3
11	Measurement of the grating constant of a grating by using a spectrometer	3
12	To Study thermoelectric effect and to measure Seebeck and Peltier Coefficient.	3
13	Open Lab	3
14	End semester examination	3

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

Laboratory Manual

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Suggested structure - Laboratory record book + continuous evaluation: 60%, Quiz / viva / lab exam: 40%

Additional Guidelines:

NA

Name and Signature of course proposer(s):
DUGC Convener (Victor Mukherjee) HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs

Recommended / Not Recommended for the approval/ratification by the Senate   Director/Chairperson Senate

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

<table>
<tr><td>Course Title</td><td colspan="5">Classical Mechanics</td></tr>
<tr><td>Course Level (tick (√) in the relevant option)</td><td colspan="3">100 ☐ 200 √☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐</td><td colspan="2">Semester: Odd √ ☐ Even ☐
Either semester ☐</td></tr>
<tr><td>Course applicable for</td><td colspan="3">BSMS ☐√ Int. PhD. ☐ Ph.D. ☐</td><td colspan="2"></td></tr>
<tr><td>Tag of the course (tick (√) in the relevant option(s))</td><td colspan="5">Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐</td></tr>
<tr><td>Type of the course</td><td colspan="5">Theory √ ☐ Lab ☐ Project ☐ Non-Credit ☐</td></tr>
<tr><td rowspan="2">Credit Structure</td><td>Lectures (L)</td><td>Tutorials (T)</td><td>Practicals (P)</td><td>Total Credits</td><td></td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td></td></tr>
<tr><td>Course Code:</td><td colspan="5">PS201</td></tr>
<tr><td>Names of faculties who can teach the course</td><td colspan="5">All Departmental Faculty</td></tr>
<tr><td colspan="6">Will the course require participation of visiting faculties: ~~Yes~~ / No</td></tr>
<tr><td>Prerequisites, if any Course code(s)</td><td colspan="5">Nil</td></tr>
<tr><td colspan="6">Learning Objective(s): The course aims to teach advanced concepts of mechanics. It gives an in-depth understanding of Lagrangian and Hamiltonian mechanics, conservation principles, oscillations and waves, gravitation, central force, scattering, rigid body etc.</td></tr>
<tr><td colspan="6">Expected Learning Outcome(s): On successful completion of the course a student will gain skills in using Lagrangian and Hamiltonian formalism for solving problems in classical mechanics. The tools learnt in this course will be extremely useful to understand wide branches of physics including quantum mechanics, condensed matter, high energy physics and cosmology.</td></tr>
</table>

Contents of the course:

Review of Newtonian mechanics - approximately 2 lecture hours

Lagrangian mechanics Part I: Principle of least action, generalized coordinates, calculus of variations, constraints - approximately 4 lecture hours

Lagrangian mechanics Part II: Principle of virtual work, Lagrange’s equation - approximately 3 lecture hours

Symmetry: symmetry principles, Noether theorem - approximately 3 lecture hours

Central force motion: central forces, planetary motions, Kepler’s laws - approximately 4 lecture hours

Collisions: collisions, scattering - approximately 3 lecture hours

Oscillations: small oscillations, normal modes, forced oscillators, anharmonic oscillators - approximately 4 lecture hours

Perturbation theory - approximately 3 lecture hours

Rigid body dynamics: motion of a top - approximately 3 lecture hours

Hamiltonian mechanics Part I: Hamilton’s equations, phase space & phase trajectories, canonical transformations - approximately 4 lecture hours

Hamiltonian mechanics Part II: Poisson brackets, Hamilton- Jacobi theory - approximately 3 lecture hours

Problem solving and discussion - approximately 6 lecture hours

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Review of Newtonian mechanics	2
2	Lagrangian mechanics Part I: Principle of least action, generalized coordinates, calculus of variations, constraints	4
3	Lagrangian mechanics Part II: Principle of virtual work, Lagrange's equation	3
4	Problem solving and discussions	1
5	Symmetry: symmetry principles, Noether theorem	3
6	Central force motion: central forces, planetary motions, Kepler's laws	4
7	Problem solving and discussions	1
8	Collisions: collisions, scattering	3
9	Oscillations: small oscillations, normal modes, forced oscillators, anharmonic oscillators	4
10	Problem solving and discussions	1
11	Perturbation theory	3
12	Rigid body dynamics: motion of a top	3
13	Problem solving and discussions	1
14	Hamiltonian mechanics Part I: Hamilton's equations, phase space & phase trajectories, canonical transformations	4
15	Hamiltonian mechanics Part II: Poisson brackets, Hamilton- Jacobi theory	3
16	Problem solving and discussions	2
Total		42 hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Goldstein H., Classical Mechanics (Pearson Education, 2011)
2. Landau L. D. and Lifshitz E. M., Mechanics (Course of Theoretical Physics) (Butterworth-Heinemann, 1982)
3. Rana N. C and Joag Joag P. S., Classical Mechanics (McGraw Hill Education, 2017)
4. Morin D., Introduction to Classical Mechanics (Cambridge University Press, 2007).

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Additional Guidelines:

The number of hours per module given above is approximate.

Name and Signature of course proposer(s):

DUGC Convener (Victor Mukherjee)

HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate	

Director/Chairperson Senate

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

Course Title	Quantum Mechanics I	
Course Level (tick (√) in the relevant option)	100 ☐ 200 √☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐	Semester: Odd ☐ Even √☐ Either semester ☐
Course applicable for	BSMS ☐√ Int. PhD. ☐ Ph.D. ☐	
Tag of the course (tick (√) in the relevant option(s))	Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐	
Type of the course	Theory √ ☐ Lab ☐ Project ☐ Non-Credit ☐	

Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	

Course Code:	PS202
Names of faculties who can teach the course	All Departmental Faculty
Will the course require participation of visiting faculties: ~~Yes~~ / No	
Prerequisites, if any Course code(s)	Nil

Learning Objective(s): The course will lay down foundations of quantum mechanics via wave-particle duality, uncertainty principle and Schrodinger's equation. Operator formalism will be developed and applied to various problems in one-dimensional potential and central potential. Particularly, hydrogen atom problem and angular momentum algebra will be discussed in detail.

Expected Learning Outcome(s): It is expected that at the end of the course a student will

1) have an in-depth understanding of the basics of quantum mechanics,
2) will be able to use operator formalism to analyze different problems in quantum mechanics
3) will be able to solve problems involving quantum particles in simple forms of potentials
4) will gain knowledge about dynamics of charged particles in magnetic fields, in the quantum regime

Contents of the course:

Basics of quantum mechanics: Postulates of Quantum Mechanics, Schroedinger equation. Uncertainty Principle; Probability interpretation, probability current, continuity equation - 6 lecture hours

Operator Formalism Part I: Hilbert spaces, Expectation values of dynamical variables. Introduction to Dirac's notation, Hermitian and Unitary operators - 4 lecture hours

Operator Formalism Part II: Eigenvalues; Simultaneous eigenstates of commuting operators, Classical limit, Ehrenfest's theorem - 3 lecture hours

One Dimensional Problems Part I: Harmonic Oscillator, creation and annihilation operators; brief descriptions of potential step, barrier and well, ideas of tunneling - 5 lecture hours

One Dimensional Problems Part II: Bound states, scattering states and resonances; Dirac-delta potential - 3 lecture hours

Theory of Angular Momentum: Orbital angular momentum and eigenvalue problem; spherical harmonics, Spin angular momentum, addition of angular momentum - 5 lecture hours

Three dimensional problems: 3D problems in Cartesian coordinates, free particle, box potential; 3D problems in spherical coordinates; central potential; free particle in spherical coordinates; bound states in three dimensions; hydrogen atom - 6 lecture hours

Charged particle in magnetic field: Gauge invariance of Schroedinger equation; Larmor frequency; Brief discussions on normal and anomalous Zeeman effect, Landau levels - 4 lecture hours

Problem solving and discussions - 6 lecture hours

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1.	Basics of quantum mechanics: Postulates of Quantum Mechanics, Schroedinger equation. uncertainty Principle	4
2.	Basics of quantum mechanics: Probability interpretation, probability current, continuity equation	2
3.	Problem solving and discussions	1
4.	Operator Formalism Part I: Hilbert spaces, Expectation values of dynamical variables	2
5..	Introduction to Dirac's notation, Hermitian and Unitary operators	2
6.	Problem solving and discussions	1
7.	Operator Formalism Part II: Eigenvalues; Simultaneous eigenstates of commuting operators, classical limit, Ehrenfest's theorem	3
8.	One Dimensional Problems Part I: Harmonic Oscillator, creation and annihilation operators;	3
9.	One Dimensional Problems Part I: Brief descriptions of potential step, barrier and well, ideas of tunneling	2
10.	Problem solving and discussions	1
11.	One Dimensional Problems Part II: Bound states, scattering states and resonances, Dirac-delta potential	3
12.	Theory of Angular Momentum: Orbital angular momentum and eigenvalue problem; spherical harmonics	3
13.	Theory of Angular Momentum: Spin angular momentum, addition of angular momentum	2
14.	Problem solving and discussions	1
15.	Three dimensional problems: 3D problems in Cartesian coordinates, free particle, box potential; 3D problems in spherical coordinates; central potential	3
16.	Three dimensional problems: Free particle in spherical coordinates; bound states in three dimensions; hydrogen atom	3
17.	Problem solving and discussions	1
18.	Charged particle in magnetic field: Gauge invariance of Schroedinger equation; Larmor frequency, brief discussions on normal and anomalous Zeeman effect, Landau levels	4
19.	Problem solving and discussions	1
total		42 hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Verma H. C., Quantum Physics (TBS, 2012)
2. Sakurai J. J. and Napolitano J., Modern Quantum Mechanics (Cambridge University Press, 2020)

3. Bransden B. H. and Joachain C. J., Quantum Mechanics (Pearson, 2020)
4. Cohen-Tannoudji C., Quantum Mechanics, (Vol I and II) (John Wiley and Sons, 1977)
5. Shankar R., Principles of Quantum Mechanics (Springer, 2014)
6. Merzbacher E. Quantum Mechanics (Wiley, 1998)
7. Griffiths D. J., Introduction to Quantum Mechanics (Cambridge University Press, 2024)
8. Zettili N., Quantum Mechanics (Wiley, 2009)

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Additional Guidelines:

The number of hours per module given above is approximate.

Name and Signature of course proposer(s):

DUGC Convener (Victor Mukherjee)

HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

<table>
<tr><td>Course Title</td><td colspan="5">Mathematical Methods I</td></tr>
<tr><td>Course Level (tick (√) in the relevant option)</td><td colspan="3">100 ☐ 200 √☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐</td><td colspan="2">Semester: Odd √ ☐ Even ☐
Either semester ☐</td></tr>
<tr><td>Course applicable for</td><td colspan="3">BSMS ☐√ Int. PhD. ☐ Ph.D. ☐</td><td colspan="2"></td></tr>
<tr><td>Tag of the course (tick (√) in the relevant option(s))</td><td colspan="5">Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐</td></tr>
<tr><td>Type of the course</td><td colspan="5">Theory √ ☐ Lab ☐ Project ☐ Non-Credit ☐</td></tr>
<tr><td rowspan="2">Credit Structure</td><td>Lectures (L)</td><td>Tutorials (T)</td><td>Practicals (P)</td><td>Total Credits</td><td></td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td></td></tr>
<tr><td>Course Code:</td><td colspan="5">PS203</td></tr>
<tr><td>Names of faculties who can teach the course</td><td colspan="5">All Departmental Faculty</td></tr>
<tr><td colspan="6">Will the course require participation of visiting faculties: <s>Yes</s> / No</td></tr>
<tr><td>Prerequisites, if any Course code(s)</td><td colspan="5">Nil</td></tr>
<tr><td colspan="6">Learning Objective(s): This course is the first part of a two parts course that aims to introduce the mathematical techniques commonly used in other physics courses of the BSMS curriculum, including in Quantum Mechanics I, Quantum Mechanics II, Electricity and Magnetism and Electrodynamics.</td></tr>
<tr><td colspan="6">Expected Learning Outcome(s): This course prepares a student for more advanced topics to be taught in Mathematical Methods II, and helps a student in solving problems in different courses in physics, including Quantum Mechanics I, Quantum Mechanics II, Electricity and Magnetism and Electrodynamics, that will be taught in the BSMS curriculum.</td></tr>
<tr><td colspan="6">Contents of the course:

Vector space: Linear Vector space with examples, Hilbert space, Inner product, Orthonormal Basis and Dimensionity, Bra-Ket notation, Tensor product of vector spaces - approximately 6 lecture hours

Vector analysis in curvilinear coordinates: Review of Vector algebra, dot, cross and scalar triple product. Directional derivative, Grad, Div, Curl and their representation in cartesian, spherical and cylindrical coordinates. Line and surface integral, Gauss Divergence theorem, Stokes theorem. - approximately 6 lecture hours

Matrix Algebra: Determinant and Trace of matrix, Inverse of a Matrix, Characteristic equation, Eigenvalues and Eigenvectors,, Hermitian and Unitary Matrices, Similarity Transformation, Diagonalization of matrices - approximately 6 lecture hours

Fourier and Laplace: Fourier series expansion and Fourier integrals, their use in some simple problems, Fourier and Laplace transforms - approximately 4 lecture hours

Ordinary differential equations (ODE): Solution methods of ODE with constant coefficients, Inhomogeneous ODE, particular and complementary solution - approximately 4 lecture hours

Sturm-Liouville theory: Sturm-Liouville theory, orthogonal expansions - approximately 2 lecture hours

Singular point and series solution method of ODE - approximately 2 lecture hours

Special functions Part I: Legendre and Bessel equations and their solutions - approximately 3 lecture hours

Special functions Part II: Hermite and Laguerre equations and their solutions - approximately 3 lecture hours

Problem Solving & Discussions: approximately 6 lecture hours</td></tr>
</table>

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Vector space: Linear Vector space with examples, Hilbert space, Inner product	3
2	Vector space: Orthonormal Basis and Dimensionity, Bra-Ket notation, Tensor product of vector spaces	3
2	Problem solving and discussion	1.5
3	Vector analysis in curvilinear coordinates: Review of Vector algebra, dot, cross and scalar triple product. Directional derivative, Grad, Div, Curl and their representation in cartesian, spherical and cylindrical coordinates	4
	Vector analysis in curvilinear coordinates: Line and surface integral, Gauss Divergence theorem, Stokes theorem	2
4	Problem solving and discussion	1.5
5	Matrix Algebra: Determinant and Trace of matrix, Inverse of a Matrix, Characteristic equation, Eigenvalues and Eigenvectors, Hermitian and Unitary Matrices, Similarity Transformation, Diagonalization of matrices	6
6	Fourier and Laplace: Fourier series expansion and Fourier integrals, their use in some simple problems, Fourier and Laplace transforms	4
7	Problem solving and discussion	1.5
8	Ordinary differential equations (ODE): Solution methods of ODE with constant coefficients, Inhomogeneous ODE, particular and complementary solution	4
9	Sturm-Liouville theory: Sturm-Liouville theory, orthogonal expansions	2
10	Singular point and series solution method of ODE	2
11	Special functions Part I: Legendre and Bessel equations and their solutions	3
12	Special functions Part II: Hermite and Laguerre equations and their solutions	3
15	Problem Solving & Discussions	1.5
Total		42 hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Arfken B. and Weber H. J., Mathematical Methods for Physicists, (Elsevier, 2012)
2. Boas M. L., Mathematical Methods in the Physical Sciences (Wiley, 2005)
3. Joglekar S. D. , Mathematical Physics: The Basics (CRC Press, 2007)
4. A. K. Ghatak A. K., Goyal I. C. and Chua S. J.,, Mathematical Physics (Laxmi Publications, 2016)
5. Joshi A. W., Elements of Group Theory for Physicists (New Age International Publishers, 2018)
6. Dennery P. and Krzywicki A., Mathematics for Physicists (Dover Publications, 1996)
7. Mathews J. and Walker R. L., Mathematical Methods of Physics (Pearson Addison-Wesley, 1971)

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Additional Guidelines: The number of hours per module given above is approximate.

Name and Signature of course proposer(s):
DUGC Convener (Victor Mukherjee) HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any: 10%

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.	Groups And Symmetry	MS202	Vector space	10%

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

<table>
<tr><td>Course Title</td><td colspan="5">Electricity and Magnetism</td></tr>
<tr><td>Course Level (tick (√) in the relevant option)</td><td colspan="3">100 ☐ 200 √☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐</td><td colspan="2">Semester: Odd ☐ Even √☐
Either semester ☐</td></tr>
<tr><td>Course applicable for</td><td colspan="3">BSMS ☐√ Int. PhD. ☐ Ph.D. ☐</td><td colspan="2"></td></tr>
<tr><td>Tag of the course (tick (√) in the relevant option(s))</td><td colspan="5">Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐</td></tr>
<tr><td>Type of the course</td><td colspan="5">Theory √ ☐ Lab ☐ Project ☐ Non-Credit ☐</td></tr>
<tr><td rowspan="2">Credit Structure</td><td>Lectures (L)</td><td>Tutorials (T)</td><td>Practicals (P)</td><td>Total Credits</td><td></td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td></td></tr>
<tr><td>Course Code:</td><td colspan="5">PS204</td></tr>
<tr><td>Names of faculties who can teach the course</td><td colspan="5">All Departmental faculty</td></tr>
<tr><td colspan="6">Will the course require participation of visiting faculties: ~~Yes~~ / No</td></tr>
<tr><td>Prerequisites, if any Course code(s)</td><td colspan="5">Nil</td></tr>
<tr><td colspan="6">Learning Objective(s): The course aims to teach the students about the physics of generation of electric and magnetic fields, and interaction of charged particles with such fields.</td></tr>
<tr><td colspan="6">Expected Learning Outcome(s): On successful completion of the course a student will

i) gain knowledge about generation of electric fields through charges at rest
ii) gain knowledge about generation of magnetic fields through steady currents
iii) gain knowledge about interaction of electric charges and electric currents with electric and magnetic fields
iv) gain skills in solving problems on the above topics</td></tr>
<tr><td colspan="6">Contents of the course:

Electrostatics I: Coulomb’s Law, Gauss’s law and its applications, electric potential, Laplace’s and Poisson’s equations - approximately 6 lecture hours

Electrostatics II: Energy of a charge distribution, boundary conditions, formal solution with Green functions, conductors, capacitance, uniqueness theorem, method of images- approximately 6 lecture hours

Electric fields in matter I: Field and Potential due to dipole, multipole expansion, polarization in a dielectric - approximately 5 lecture hours

Electric fields in matter II: Vectors D, P and E, linear dielectrics, force on dielectrics - approximately 3 lecture hours

Electric currents: Line, surface and volume currents and current densities, electrical conductivity and Ohm’s law, equation of continuity, energy dissipation, motion of charged particles in electric fields - approximately 5 lecture hours

Magnetostatics: Biot-Savart and Ampere’s law, motion of charged particles in magnetic fields, divergence and curl of B, integral and differential forms of Ampere’s law, vector potential, Boundary conditions - approximately 6 lecture hours

Magnetic fields in matter: Magnetic dipoles, multipole expansion, magnetization in materials, H, B and M, Dia-, para- and ferro-magnetism, B and H in bar-magnet - approximately 5 lecture hours

Problem solving and discussion - approximately 6 lecture hours</td></tr>
</table>

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Electrostatics I: Coulomb's Law, Gauss's law and its applications, electric potential	3
2	Electrostatics I: Laplace's and Poisson's equations	3
3	Problem solving and discussions	1
4	Electrostatics II: Energy of a charge distribution, boundary conditions, conductors	3
5	Electrostatics II: uniqueness theorem, method of images	3
6	Problem solving and discussions	1
7	Electric fields in matter I: Field and Potential due to dipole, multipole expansion, polarization in a dielectric	5
8	Electric fields in matter II: Vectors D, P and E, linear dielectrics, force on dielectrics	3
9	Problem solving and discussions	1
10	Electric Currents: Line, surface and volume currents and current densities, electrical conductivity and Ohm's law	2
11	Electric currents: Equation of continuity, energy dissipation, motion of charged particles in electric fields	3
12	Problem solving and discussions	1
13	Magnetostatics: Biot-Savart and Ampere's law, motion of charged particles in magnetic fields, divergence and curl of B, integral and differential forms of Ampere's law	4
14	Magnetostatics: Vector potential, Boundary conditions	2
15	Problem solving and discussions	1
16	Magnetic fields in matter: Magnetic dipoles, multipole expansion, magnetization in materials, H, B and M, Dia-, para- and ferro-magnetism, B and H in bar-magnet	5
17	Problem solving and discussions	1
Total		42 hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Griffiths D. G., Introduction to Electrodynamics (Pearson, 2015)
2. Purcell E. M. and Morin D. J., Electricity and Magnetism (Cambridge University Press, 2013)

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

30 - 40 % for the mid semester examination, 50 - 60 % for the end semester examination and 0 - 20% for other components, viz. quizzes, assignments and attendance

Additional Guidelines:

The number of hours per module given above is approximate.

Name and Signature of course proposer(s):
DUGC Convener (Victor Mukherjee) HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

Course Title	Physics Laboratory II
Course Level (tick (√) in the relevant option)	100 ☐ 200 √ ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐ ; Semester: Odd √ ☐ Even ☐ Either semester ☐
Course applicable for	BSMS ☐√ Int. PhD. ☐ Ph.D. ☐
Tag of the course (tick (√) in the relevant option(s))	Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐
Type of the course	Theory ☐ Lab √ ☐ Project ☐ Non-Credit ☐
Course Code:	PS205
Names of faculties who can teach the course	All Departmental Faculty

Credit Structure

Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
0	0	3	1	

Will the course require participation of visiting faculties: ~~Yes~~ / No

Prerequisites, if any Course code(s)	Nil

Learning Objective(s):

1. To introduce students to fundamental experiments in general properties of matter, electromagnetism, optics, and modern physics that reinforce theoretical concepts taught in lectures.
2. To develop practical skills in experimental physics, including measurement techniques, data acquisition, data analysis, and error estimation.
3. To cultivate scientific reasoning and enhance the ability to relate physical models to experimental observations.
4. To familiarize students with laboratory equipment and protocols for safe and accurate experimentation.

Expected Learning Outcome(s):

On successful completion of this course, students will be able to:

1. To introduce students to fundamental experiments in general properties of matter, electromagnetism, optics, and modern physics, that reinforce theoretical concepts taught in lectures.
2. Analyze physical phenomena through graphical representation and quantitative evaluation, including fitting curves to extract physical constants.
3. Interpret experimental data and compare with theoretical predictions, identifying possible sources of systematic and random errors.
4. Understand and verify quantum phenomena, such as the quantization of atomic energy levels using the Frank-Hertz experiment.
5. Determine material properties such as surface tension, and understand their dependence on experimental conditions.
6. Communicate experimental findings effectively through clear, structured, and concise lab reports.

Contents of the course:

1) Introduction to the theoretical aspects of the experiments
2) Determination of the moment of inertia of a flywheel by measurement of gyroscope frequency and precision frequency
3) Determination of surface tension using the ring detachment method
4) To investigate resonance in Force oscillation and to find the spring constant
5) Verification of atomic energy quantization via the Franck-Hertz experiment
6) To study the charging and discharging behaviour of a capacitor in RC circuit
7) Determination of the numerical aperture angle of an optical fiber
8) Determination of the wavelength of a monochromatic light by Young's double slit
9) Determination of the refractive index of a prism using a spectrometer
10) Determination of particle size using LASER diffraction
11) Study of temperature dependent resistance in metal and semiconductor
12) Verification of the Heisernberg's uncertainty principle of quantum mechanics

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours
1	Introduction to the theoretical aspects of the experiments	3
2	Determination of the moment of inertia of a flywheel by measurement of gyroscope frequency and precision frequency	3
3	Determination of surface tension using the ring detachment method	3
4	To investigate resonance in Force oscillation and to find the spring constant	3
5	Verification of atomic energy quantization via the Franck-Hertz experiment	3
6	To study the charging and discharging behaviour of a capacitor in RC circuit	3
7	Determination of the numerical aperture angle of an optical fiber	3
8	Determination of the wavelength of a monochromatic light by Young's double slit	3
9	Determination of the refractive index of a prism using a spectrometer	3
10	Determination of particle size using LASER diffraction	3
11	Study of temperature dependent resistance in metal and semiconductor	3
12	Verification of the Heisenberg's uncertainty principle of quantum mechanics	3
13	Open Lab	3
14	End semester examination	3

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

A separate manual and recommended references will be provided for each experiment.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

The assessment of students in Physics Laboratory II will be carried out continuously, emphasizing regular participation, hands-on skills, analytical thinking, and communication of experimental results. The breakdown of assessment components and their respective weightage is as follows:

Suggested structure - Laboratory record book + continuous evaluation: 60%, Quiz / viva / lab exam: 40%

Additional Guidelines:

NA

Name and Signature of course proposer(s):

DUGC Convener (Victor Mukherjee)

HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on__________________________________. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Physical Sciences

Course Title	Physics Laboratory III				
Course Level (tick (√) in the relevant option)	100 ☐ 200 √ ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even √ ☐ Either semester ☐	
Course applicable for	BSMS ☐√ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core √ ☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☐ Lab √ ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	0	0	3	1	
Course Code:	PS206				
Names of faculties who can teach the course	All Departmental faculty				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

1. To deepen understanding of wave optics, electromagnetism and the quantum nature of matter.
2. To provide hands-on experience with a range of optical and electron-based experiments.
3. To train students in using standard laboratory equipment such as Helmholtz coils, diffraction gratings, and electron diffraction tubes.
4. To train students in scientific measurement techniques, data analysis, error estimation, and effective documentation of experimental work.

Expected Learning Outcome(s):

On successful completion of this course, students will be able to:

1. To introduce students to fundamental experiments in quantum mechanics and electricity and magnetism that reinforce theoretical concepts taught in lectures.
2. Demonstrate understanding of key physics concepts such as magnetic fields, electric circuits, electromagnetic induction, atomic energy quantization, and light refraction through structured experiments.
3. Carry out accurate measurements and calibrations using laboratory instruments such as Helmholtz coils, gauss meters, spectrometers and oscilloscopes.
4. Apply concepts of symmetry, superposition, and conservation laws to explain observed behaviors in electric and magnetic systems.
5. Demonstrate the wave nature of matter and light by observing electron diffraction patterns and verifying the de Broglie hypothesis, analyzing interference and diffraction phenomena.
6. Apply experimental techniques to determine charge-to-mass ratio (e/m) of the electron using magnetic and electric field interactions, and estimating the resolving power of diffraction gratings. Also, apply experimental techniques to Determination of the Rydberg's constant and the wavelengths involved in the emission spectrum of the Hydrogen atom
7. Using capacitance meter and a dielectric cell, students will be able to to measure the capacitance of a material and correctly apply the formula to determine its dielectric constant.
8. By using LCR series and parallel circuits, the students will be able to measure the resonance frequency experimentally.

Contents of the course:

1) Introduction to the theoretical aspects of the experiments
2) Determination of magnetic field by a pair of Helmholtz coils
3) Measurement of magnetic moment of a coil in a uniform magnetic field using Helmholtz coils
4) Verification of the de Broglie hypothesis through electron diffraction
5) Determination of the charge-to-mass ratio (e/m) of the electron using electron beam deflection tube

6) Determination of wavelength of light and radius of curvature using Newton's rings
7) Verification of Lenz law
8) Measurement of the resolving power of a diffraction grating using spectrometer
9) Resonance behavior in LCR series and parallel circuits
10) Study of diffraction patterns arising from single slit, thin wire, cross wire, and grating
11) Measurement of dielectric constant of a solid using dielectric cell
12) Determination of the Rydberg's constant and the wavelengths involved in the emission spectrum of the Hydrogen atom in the visible range (Balmer series)

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours
1	Introduction to the theoretical aspects of the experiments	3
2	Determination of magnetic field by a pair of Helmholtz coils	3
3	Measurement of magnetic moment of a coil in a uniform magnetic field using Helmholtz coils	3
4	Verification of the de Broglie hypothesis through electron diffraction	3
5	Determination of the charge-to-mass ratio (e/m) of the electron using electron beam deflection tube	3
6	Determination of wavelength of light and radius of curvature using Newton's rings	3
7	Verification of Lenz law	3
8	Measurement of the resolving power of a diffraction grating using spectrometer	3
9	Resonance behavior in LCR series and parallel circuits	3
10	Study of diffraction patterns arising from single slit, thin wire, cross wire, and grating	3
11	Measurement of dielectric constant of a solid using dielectric cell	3
12	Determination of the Rydberg's constant and the wavelengths involved in the emission spectrum of the Hydrogen atom in the visible range (Balmer series)	3
13	Open day	3
14	End semester examination	3

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

A separate manual and recommended references will be provided for each experiment.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

The assessment of students in Physics Laboratory II will be carried out continuously, emphasizing regular participation, hands-on skills, analytical thinking, and communication of experimental results. The breakdown of assessment components and their respective weightage is as follows:

Suggested structure - Laboratory record book + continuous evaluation: 60%, Quiz / viva / lab exam: 40%

Additional Guidelines:

NA

Name and Signature of course proposer(s):
DUGC Convener (Victor Mukherjee)
HOD (Shashi Bhuashan Singh)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on____________________________________. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	