FYUGP

PHYSICS HONOURS/ RESEARCH SYLLABUS

UPTO SEMESTER-IV

FOR UNDER GRADUATE COURSES UNDER

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

Implemented from
Academic Session 2023-2027

Members of Board of Studies of FYUGP Syllabus as per Guidelines of the Binod Bihari Mahto Koyalanchal University, Dhanbad

1. Dr. K. Bandyopadhyay, Associate Professor -Chairman
   University Department of Physics, BBMK University, Dhanbad
2. Dr. D.K. Giri , Assistant Professor -Member
   University Department of Physics, BBMK University, Dhanbad
3. Dr. D. K. Singh , Assistant Professor -Member
   Department of Physics, PKRM College, Dhanbad

Two experts for UG

4. Dr. Umamageswari, Associate Professor -Member
   Department of Physics, B.S. City College, Bokaro
5. Dr. Sayantan Sil, Assistant Professor -Member
   Department of Physics, PKRM College, Dhanbad

24/7/23

24/07/23

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24-07-2023

24/7/23

COURSE STUCTURE FOR FYUGP **'HONOURS/ RESEARCH'**

Table 1: Credit Framework for Four Year Undergraduate Programme (FYUGP) under State Universities of Jharkhand [Total Credits =160]

Level of Courses	Semester	**MJ:** Discipline specific courses-Core or Major (80)	**MN:** Minor from discipline (16)	**MN:** Minor from vocational (16)	**MDC:** Multidisciplinary Courses [Life Sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc.] (9)	**AEC:** Ability Enhancement Courses (Modern Indian Language and English (8)	**SEC:** Ability Enhancement Courses (9)	**VAC:** Value added Courses (6)	**IAP:** Internship / Dissertation (4)	**RC:** Research Courses (12)	**AMJ:** Advanced Courses in lie of Research (12)	**Credits**	**Double Major (DMJ)**
1	2	3	4	5	6	7	8	9	10	11	12	13	14
100-199: Foundation or Introductory courses	I	4	4		3	2	3					**20**	4+4
	II	4+4		4	3	2	3					**20**	4+4
Exit Point: Undergraduate Certificate provided with Summer Internship/Project (4 credits)													
200-299: Intermediate-level courses	III	4+4	4		3	2	3					**20**	
	IV	4+4+4		4		2		2				**20**	4+4
Exit Point: Undergraduate Diploma Certificate provided with Summer Internship in 1st or 2nd year /Project (4 credits)													
300-399: Higher-level courses	V	4+4+4	4						4			**20**	4+4
	VI	4+4+4+4		4								**20**	4+4
Exit Point: Bachelor's Degree													
400-499: Advanced courses	VII	4+4+4+4	4									**20**	4+4
	VIII	4		4						12	4+4+4	**20**	4+4
Exit Point: Bachelor's Degree with Hons. /Research												**160**	**224**

Note: Honours students not undertaking research will do 3 courses for 12 credits in lieu of a Research project / Dissertation

SEMESTER WISE COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME **2023 onwards**

Table 2: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses Code	Papers	Credits
I	AEC-1	Language and Communication Skills (Modern Indian language including TRL)	2
	VAC-1	Value Added Course-1	4
	SEC-1	Skill Enhancement Course-1	3
	MDC-1	Multi-disciplinary Course-1	3
	MN-1A	Minor from Discipline-1	4
	MJ-1	Major paper 1 (Disciplinary/Interdisciplinary Major)	4
II	AEC-2	Language and Communication Skills (English)	2
	SEC-2	Skill Enhancement Course-2	3
	MDC-2	Multi-disciplinary Course-2	3
	MN-2A	Minor from Vocational Studies/Discipline-2	4
	MJ-2	Major paper 2 (Disciplinary/Interdisciplinary Major)	4
	MJ-3	Major paper 3 (Disciplinary/Interdisciplinary Major)	4
III	AEC-3	Language and Communication Skills (Modern Indian language including TRL)	2
	SEC-3	Skill Enhancement Course-3	3
	MDC-3	Multi-disciplinary Course-3	3
	MN-1B	Minor from Discipline-1	4
	MJ-4	Major paper 4 (Disciplinary/Interdisciplinary Major)	4
	MJ-5	Major paper 5 (Disciplinary/Interdisciplinary Major)	4
IV	AEC-3	Language and Communication Skills (MIL-2/English-2)	2
	VAC-2	Value Added Course-2	2
	MN-2B	Minor from Vocational Studies/Discipline-2	4
	MJ-6	Major paper 6 (Disciplinary/Interdisciplinary Major)	4
	MJ-7	Major paper 7 (Disciplinary/Interdisciplinary Major)	4
	MJ-8	Major paper 8 (Disciplinary/Interdisciplinary Major)	4
V	MN-1C	Minor from Discipline-1	4
	MJ-9	Major paper 9 (Disciplinary/Interdisciplinary Major)	4
	MJ-10	Major paper 10 (Disciplinary/Interdisciplinary Major)	4
	MJ-11	Minor Paper 3 (Disciplinary/Interdisciplinary Minor)	4
	IAP	Internship/Apprenticeship/ Field work / Dissertation/ Project	4
VI	MN-2C	Minor from Vocational Studies/Discipline-2	4
	MJ-12	Major paper 12 (Disciplinary/Interdisciplinary Major)	4
	MJ-13	Major paper 13 (Disciplinary/Interdisciplinary Major)	4
	MJ-14	Minor Paper 14 (Disciplinary/Interdisciplinary Minor)	4
	MJ-15	Minor Paper 15 (Disciplinary/Interdisciplinary Minor)	4
VII	MN-1D	Minor from Discipline-1	4
	MJ-16	Major paper 16 (Disciplinary/Interdisciplinary Major)	4
	MJ-17	Major paper 17 (Disciplinary/Interdisciplinary Major)	4
	MJ-18	Minor Paper 18 (Disciplinary/Interdisciplinary Minor)	4
	MJ-19	Minor Paper 19 (Disciplinary/Interdisciplinary Minor)	4
VIII	MN-2D	Minor from Vocational Studies/Discipline-2	4
	MJ-20	Major paper 20 (Disciplinary/Interdisciplinary Major)	4
	RC/ AMJ-1	Research Internship/ Field work/ Dissertation / Advanced Major paper-1 (Disciplinary/Interdisciplinary Major)	12/ 4
	AMJ-2	Advanced Minor Paper 18 (Disciplinary/Interdisciplinary Minor)	4
	AMJ-3	Advanced Minor Paper 19 (Disciplinary/Interdisciplinary Minor)	4
		Total Credits	**160**

Abbreviations:

AEC Ability Enhancement Courses

SEC Introductory Regular Courses

24/7/23

24/7/23

24/07/23 Sayantan Sil 24-07-2023

IAP Internship/Apprenticeship/ Project
MDC Multidisciplinary Courses
MJ Major Disciplinary/Interdisciplinary Courses
DMJ Double Major Disciplinary/Interdisciplinary Courses
AMJ Advance Major Disciplinary/Interdisciplinary Courses
MN Minor Disciplinary/Interdisciplinary Courses
RC Research Courses

AEC (Ability enhancements courses)- 2 Credits

- *Full marks – 50, Pass Marks – 20*
- *In AEC the students of all faculties will have to select either Hindi or English in Semester -1 and those student who have opted Hindi will have to select English as AEC in Semester -2 and vice versa. For 3rd and 4th semester student can opt Sanskrit, Urdu, Bengali, English, Hindi or TRL.*
- *In 4th semester there will be AEC-3 will include Language and Communication Skill in Hindi and English.*
- *No internal examination will be conducted.*

VAC (Value added Courses)- 2 Credits

- *Full marks – 50, Pass Marks – 20*
- *For 1st semester – "Understanding India"*
- *For 4th Semester – "Environmental Studies"*
- *No internal examination will be conducted.*

SEC (Skill Enhancement Courses) – 3 Credits

- *Full Marks – 75, Pass Marks – 30*
- *Digital Education or Mathematical & Computational Thinking Analysis is selected as SEC. Student will have to select or opt either of the two subjects for semester – I, II and III in no case both subject will be allowed to opt.*
- *No internal examination will be conducted.*

MDC (Multidisciplinary Courses) – 3 credits

- *Full Marks – 75, Pass Marks – 30*
- *A student will study three different subjects in the multidisciplinary courses during first three semesters.*
- *No internal examination will be conducted.*

24/07/23 Sayantan Sil 24-07-2023 24/7/23

24/7/23

SEMESTER WISE COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME **2023 onwards**

Table 3: Semester wise Course Code and Credit Points and Marks distribution of Major Papers:

S.N.	Semester	Paper	Credit	Full Marks-100			Pass Marks		
				Internal Theory (Mid Sem.)	End sem. Theory	End sem. Practical	Internal Theory (Mid Sem.)	End Sem. Theory	End sem. Practical
1.	I	MJ-1: Theory	4	25	75	-	10	30	-
2.	II	MJ-2: Theory	4	25	75	-	10	30	-
		MJ-3: Practical- I	4	-	-	100	-	-	40
3.	III	MJ-4: Theory	4	25	75	-	10	30	-
		MJ-5: Practical- II	4	-	-	100	-	-	40
4.	IV	MJ-6: Theory	4	25	75	-	10	30	-
		MJ-7: Theory	4	25	75	-	10	30	-
		MJ-8: Practical-III	4	-	-	100	-	-	40
5.	V	MJ-9: Theory	4	25	75	-	10	30	-
		MJ-10: Theory	4	25	75	-	10	30	-
		MJ-11: Practical-IV	4	-	-	100	-	-	40
6.	VI	MJ-12: Theory	4	25	75	-	10	30	-
		MJ-13: Theory	4	25	75	-	10	30	-
		MJ-14: Theory	4	25	75	-	10	30	-
		MJ-15: Practical-V	4	-	-	100	-	-	40
7.	VII	AMJ-01: Theory	4	25	75	-	10	30	-
		AMJ-02: Theory	4	25	75	-	10	30	-
		AMJ-03: Theory	4	25	75	-	10	30	-
		AMJ-04: Practical-VI	4	-	-	100	-	-	40
8.	VIII	AMJ-05: Theory	4	25	75	-	10	30	-

- *Total theory papers will be 14 and practical papers will be 6.*
- *No internal or mid semester examination will be conducted for practical papers.*

Table 4: Semester wise Course Code and Credit Points and Marks distribution of Minor Papers:

S.N.	Semester	Paper	Credits	Full Marks		Pass Marks	
				Theory (Internal+ End Sem)	Practical End Sem.	Theory (Internal+ End Sem	Practical
1.	I	MN-1A	3+1	15+60	25	30	10
2.	III	MN-1B	3+1	15+60	25	30	10
3.	V	MN-1C	3+1	15+60	25	30	10
4.	VII	MN-1D	3+1	15+60	25	30	10

- *No internal or mid semester examination will be conducted for practical papers.*

24/07/23 Sayantan Sil 24-07-2023 24/7/23 24/7/23

Table 5: Semester wise Papers and Examination Structure for Physics Major:

Semester	Physics Major		Credits	Examination Structure			Pass Marks		
	Code	Papers		Internal (Mid Semester) Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical (F.M.)	Internal Theory (Mid Sem.)	End Sem. Theory	End sem. Practical
I	MJ-1: Theory	Mathematical Physics-I	4	25	75		10	30	-
II	MJ-2: Theory	Mechanics & Waves	4	25	75		10	30	-
	MJ-3: Practical-I	Practical				100	-	-	40
III	MJ-4: Theory	Electricity & Magnetism	4	25	75		10	30	-
	MJ-5: Practical	Practical				100	-	-	40
IV	MJ-6: Theory	Optics & Electromagnetic Theory	4	25	75		10	30	-
	MJ-7: Theory	Mathematical Physics-II	4	25	75		10	30	-
	MJ-8: Practical-II	Practical				100	-	-	40

Table 6: Semester wise Papers and Examination Structure for Physics Minor:

Semester	Code	Minor Papers	Credits	Full Marks		Pass Marks	
				Theory (Internal+ End Sem)	Practical End Sem.	Theory (Internal+ End Sem	Practical End Sem
I	MN-1A	Mechanics	3+1	15+60	25	30	10
III	MN-1B	Electricity & Magnetism	3+1	15+60	25	30	10

24/07/23 Sayantan Sil 24-07-2023

24/7/23

24/7/23

MAJOR PAPERS
SEMESTER I

PHYSICS MJ 1 THEORY: MATHEMATICAL PHYSICS-I

Credits: 04 Lectures: 60

Marks: 100 (End Semester Examination=75, **Pass Marks = 30**
Semester Internal Examination=20, Class Performance & Attendance =05), **Pass Marks=10**

Instruction to Question Setter for
Semester Internal Examination (SIE 25 marks) (20+05):
*There will be **two** groups of questions. **Group A is compulsory** which will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.*

End Semester Examination (ESE 75 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

COURSE OBJECTIVE

- The emphasis of course is to equip students with the mathematical tools required in solving problem of interest to physicists.
- To expose students to fundamental computational physics skills and hence enable them to solve a wide range of physics problems.
- To help students develop critical skills and knowledge that will prepare them not only for doing fundamental and applied research but also prepare them for a wide variety of careers.

COURSE LEARNING OUTCOMES

- Revise the knowledge of calculus, vectors and vector calculus. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.
- Draw and interpret graphs of various functions.
- Solve first order differential equations and apply it to physics problems solve linear second order homogeneous and non-homogeneous differential equations with constant coefficients.
- Calculate partial derivatives of function of several variables Understand the concept of gradient of scalar field and divergence and curl of vector fields.
- Perform line, surface and volume integration and apply Green's, Stokes' and Gauss's Theorems to compute these integrals.
- Apply curvilinear coordinates to problems with spherical and cylindrical symmetries.

SKILLS TO BE LEARNED

- Training in calculus will prepare the student to solve various mathematical problems.
- He / she shall develop an understanding of how to formulate a physics problem and solve given mathematical equation risen out of it.

24/07/23 Sayantan Sil 24-07-2023 24/7/23 24/7/23

COURSE CONTENT

Differential Equations: First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. **(12 Lectures)**

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. **(8 Lectures)**

Vector Calculus: Scalar and Vector fields. Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. **(15 Lectures)**

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications. **(15 Lectures)**

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.**(10 Lectures)**

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn.,Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book.
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Mathematical Physics, Goswami, 1st edition, Cengage Learning.
8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press.
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley&M.P.Hobson, 2011, Cambridge Univ. Press.
11. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.
12. Mathematical Physics, B.S. Rajput, Pragati Prakashan, 21st Edition, 2009.
13. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
14. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.

24/07/23 Sayantan Sil 24-07-2023 24/7/23 24/7/23

SEMESTER II

PHYSICS-MJ 2 THEORY: MECHANICS & WAVES

Credits: 04 Lectures: 60

Marks: 100 (End Semester Examination=75, **Pass Marks = 30**
Semester Internal Examination=20, Class Performance & Attendance =05), **Pass Marks=10**

Instruction to Question Setter for
Semester Internal Examination (SIE 25 marks) (20+05):
*There will be **two** groups of questions. **Group A is compulsory** which will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.*

End Semester Examination (ESE 75 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

COURSE OBJECTIVE

- The emphasis of this course is to enhance the understanding of the basics of mechanics.
- This course also includes the ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves and also acoustics of buildings, growth and decay of sound.
- By the end this course, students should be able to solve the seen or unseen problems/numericals in mechanics and waves and also have an in depth understanding of mechanics, wave phenomena and acoustics.

COURSE LEARNING OUTCOME

After going through the course, the student should be able to

- Understand the phenomena of collisions and idea about center of mass and laboratory frames and their correlation.
- Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity.
- Understand simple principles of fluid flow and the equations governing fluid dynamics.
- Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of Gravitation.
- Explain the phenomena of simple harmonic motion and the properties of systemsexecuting such motions.
- Describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting ina merry-go-round experiences an outward pull.
- Recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems.
- Understand the principle of superposition of waves, so thus describe the formation of standing waves.
- Explain several phenomena we can observe in everyday life that can be explained aswave phenomena.

- Use the principles of wave motion and superposition of waves.

SKILLS TO BE LEARNED

- Learn the concepts of elasticity of solids and viscosity of fluids.
- Develop skills to understand and solve the equations of Newtonian gravity and centralforce problem.
- Learn about inertial and non-inertial systems.
- Acquire basic knowledge of oscillation.
- Learn about superposition of two Collinear Harmonic Oscillations.
- Superposition of two Perpendicular Harmonic Oscillations.
- Lear about Wave Motion in general.
- Learn about Velocity of Waves.
- Learn about acoustics of buildings, growth and decay of sound.
- Acquire knowledge of Superposition of Two Harmonics Waves.

COURSE CONTENT

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. **(3 Lectures)**

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire. **(3 Lectures)**

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. **(2 Lectures)**

Motion under Central Force: Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). **(7 Lectures)**

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. **(8 Lectures)**

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Coriolis force and centrifugal force. Effect of centrifugal force due to rotation of the earth. Coriolis force on a freely falling body. Geographical effects of Coriolis force (qualitative). **(4 Lectures)**

Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **(5 Lectures)**

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **(2 Lectures)**

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. **(6 Lectures)**

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. **(6 Lectures)**

24/07/23 Sayantan Sil 24-07-2023 24/7/23 24/7/23

Sound: Acoustics of buildings, Reverberation and time of reverberation - growth and decay of sound - Sabine's formula, Absorption coefficient & measurement. **(4 Lectures)**

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N-Harmonic Waves. **(10 Lectures)**

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
7. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
8. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
9. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

Additional Books for Reference

1. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000.
2. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
3. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010,Cengage Learning.
4. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

PHYSICS-MJ 3:PRACTICAL-I

Credits: 04 Lectures: 120 (60X2)

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 60 marks*
Practical record notebook	*= 20 marks*
Viva-voce	*= 20 marks*

1. To measure the diameter of a thick wire using vernier caliper.
2. To measure the diameter of a thick wire using screw gauge.
3. To measure the diameter of a thick wire using travelling microscope.
4. To determine the Height of a Building using a Sextant.
5. To study the random error in observations.
6. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by suitable method.
9. To determine the Modulus of Rigidity of a Wire by suitable method.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.
13. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2–T law.
14. To study Lissajous Figures.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn., 2011, KitabMahal
4. Engineering Practical Physics, S.Panigrahi&B.Mallick,2015, Cengage Learning India Pvt.Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. B.Sc. Practical Physics, N. N. Ghosh, BharatiBhawan Publishers.
7. B.Sc. Practical Physics, C. L. Arora, S. Chand & Company, 19th Edition, 1995, Reprint 2014.

SEMESTER III

PHYSICS-MJ 4 THEORY: ELECTRICITY & MAGNETISM

Credits: 04 Lectures: 60

Marks: 100 (End Semester Examination=75, **Pass Marks = 30**
Semester Internal Examination=20, Class Performance & Attendance =05), **Pass Marks=10**

Instruction to Question Setter for
Semester Internal Examination (SIE 25 marks) (20+05):
*There will be **two** groups of questions. **Group A is compulsory** which will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.*

End Semester Examination (ESE 75 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

COURSE OBJECTIVE

- The course covers static and dynamic electric and magnetic field,.
- It also includes analysis of electrical circuits and introduction of network theorems.
- By the end of the course student should be able to have an in depth understanding of electric field and electric potential, dielectric properties of matter, growth and decay of current, magnetic properties of matter analyze electrical circuits using network theorems.
- Also students should learn about the basics of Ballistic galvanometer.

COURSE LEARNING OUTCOME

After going through the course, the student should be able to

- Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems ofpoint charges as well as line, surface, and volume distributions of charges.
- Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electricpotential,

24/07/23 Sayantan Sil 24-07-2023 24/7/23 24/7/23

electric potential energy) formalisms of electrostatics.

- Apply Gauss's law of electrostatics to solve a variety of problems.
- Articulate knowledge of electric current, resistance and capacitance in terms of electricfield and electric potential.
- Demonstrate a working understanding of capacitors.
- Describe the magnetic field produced by magnetic dipoles and electric currents.
- Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electricand magnetic fields.
- Understand the dielectric properties, magnetic properties of materials and thephenomena of electromagnetic induction.
- Describe how magnetism is produced and list examples where its effects are observed.
- Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.
- Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.
- In the laboratory course the student will get an opportunity to verify various laws in electricity and magnetism.
- Should be able to verify of various circuit laws, network theorems elaborated above, using simple electric circuits.

SKILLS TO BE LEARNED

- This course will help in understanding basic concepts of electricity and magnetism and their applications.
- Basic course in electrostatics will equips the student with required prerequisites to understand electrodynamics phenomena.

COURSE CONTENT

Electric Field and Electric Potential: Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations & its solution in Cartesian coordinates, The Uniqueness Theorem. Gauss' law in integral and differential form. Multipole expansion (monopole, dipole & quadrupole), energy density in an electric field. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. **(12 Lectures)**

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics. **(8 Lectures)**

Transients: Growth and Decay of currents in LR, CR, LC and LCR circuits. **(6 Lectures)**

Magnetic Properties of Matter: Magnetization vector (**M**). Magnetic Intensity (**H**). Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis. **(8 Lectures)**

Electrical Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit. Anderson's bridge, De Sauty's Bridge and Owen's bridge & their vector diagram representation. Three phase electrical power supply, delta and star connections.

(12 Lectures)

29/7/23 24/07/23 Sanjantan Sil 24-07-2023 29/7/23

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Maximum Power Transfer theorem and Superposition Theorem. **(8 Lectures)**

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. **(6 Lectures)**

Reference Books:

1. Classical Electromagnetism , H.C. Verma, Bharati Bhawan (Publishers & Distributors); First Edition , 2022.
2. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, TMH
3. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
4. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
5. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
6. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
7. Electricity and Magnetism, J.H.Fewkes&J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
8. Electricity and Magnetism, D. C.Tayal, 1988, Himalaya Publishing House.
9. Electricity and Magnetism K. K. Tewary S. Chand and Company.

PHYSICS-MJ 5:PRACTICAL-II

Credits: 04 Lectures: 120 (60X2)

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 60 marks*
Practical record notebook	*= 20 marks*
Viva-voce	*= 20 marks*

1. To find the value of a resistor and its tolerance by colour coding.
2. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
1. To study the characteristics of a series RC Circuit.
2. To verify the laws of combination (series and parallel) of resistances using a metre bridge
3. To determine an unknown Low Resistance using Potentiometer.
4. To verify Ohm's law for the given unknown resistance.
5. To determine an unknown Low Resistance using Carey Foster's Bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin theorem.
8. To verify the Norton theorem.
9. To verify the Superposition theorem.
10. To verify Maximum power transfer theorem.
11. To determine self inductance of a coil by Anderson's bridge.
12. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
13. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
14. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer.

24/07/23 Sayantan Si 24-07-2023 24/7/23

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse
2. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, KitabMahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
5. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
6. B.Sc. Practical Physics, N. N. Ghosh, Bharati Bhawan Publishers.
7. B.Sc. Practical Physics, C. L. Arora, S. Chand & Company, 19th Edition, 1995, Reprint 2014.

SEMESTER IV

PHYSICS-MJ 6 THEORY: OPTICS & ELECTROMAGNETIC THEORY

Credits: 04 Lectures: 60

Marks: 100 (End Semester Examination=75, **Pass Marks = 30**
Semester Internal Examination=20, Class Performance & Attendance =05), **Pass Marks=10**

Instruction to Question Setter for
Semester Internal Examination (SIE 25 marks) (20+05):
*There will be **two** groups of questions. **Group A is compulsory** which will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.*

End Semester Examination (ESE 75 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

COURSE OBJECTIVE

- The physics and mathematics of wave motion underlie many important phenomena. Light too, often displays properties that are wave-like. There are a number of phenomena in which light behaves as waves and displays wave properties such as interference, diffraction, and polarization with emphasis of examples as seen in daily life.
- The course provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.
- The course also deals with electromagnetic theory covering Maxwell's equations, propagation of electromagnetic (em) waves in different homogeneous-isotropic as well as anisotropic unbounded and bounded media, production and detection of different types of polarized em waves.

COURSE LEARNING OUTCOME

After going through the course, the student should be able to

- Understand Interference as superposition of waves from coherent sources derived from same parent source.
- Demonstrate understanding of Interference experiments: Young's Double Slit, Fresnel's biprism, , Newton's Rings.
- Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from apertures.
- Understand Fraunhofer Diffraction from a slit.
- Achieve an understanding of the Maxwell's equations, role of displacement current, gauge transformations, scalar and vector potentials, Coulomb and Lorentz gauge, boundary conditions at the interface between different media.
- Apply Maxwell's equations to deduce wave equation, electromagnetic field energy, momentum and angular momentum density.
- Analyse the phenomena of wave propagation in the unbounded and bounded, media.
- Understand the laws of reflection and refraction and to calculate the reflection and transmission coefficients at plane interface in bounded media.
- Understand the linear, circular and elliptical polarisations of em waves. Production as well as detection of waves in laboratory.
- Understand propagation of em waves in uni-axial and biaxial crystalsphase retardation plates and their uses.
- Understand the concept of optical rotation, theories of optical rotation and their experimental rotation, calculation of angle rotation and specific rotation.
- Verify the laws of Polarisation for plane polarised light.
- Determine Polarisation of light by Reflection and determine the polarization angle off orair-glass surface.
- Study specific rotation of sugar using Polarimeter.
- Analyze experimentally the Elliptically Polarised light using Babinet's Compensator

SKILLS TO BE LEARNED

- This course in basics of optics and electromagnetic theory will enable the student to understand various optical phenomena, principles, workings and applications optical instruments, propagation of electromagnetic waves through different bound and unbound media.
- He / she shall develop an understanding of Wave Motion and its properties. Comprehend the role of Maxwell's equation in unifying electricity and magnetism.
- Derive expression for Energy density.
- Derive and understand associated with the properties, EM wave passing through the interface between two media like reflection, refraction, transmission.
- Learn the basic physics associated with the polarization of electromagnetic waves by doing various experiments for plane polarized light, circularly polarized light and elliptically polarized light.

COURSE CONTENT

Interference: Division of amplitude and wavefront. Interference in Thin Films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **(5 Lectures)**

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. **(6 Lectures)**

24/07/23 Sayantan Sil 24-07-2023 24/7/23 24/7/23

Fraunhofer diffraction: Single slit. Circular aperture and airy pattern, Resolving Power of a telescope. Double slit. Plane transmission grating. Resolving power of grating. **(7 Lectures)**

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. **(5 Lectures)**

Maxwell Equations: Derivation of Maxwell's field equations. Displacement Current. Boundary Conditions at Interface between Different Media. **(4 Lectures)**

EM Wave Propagation in Unbounded Media: Propagation of EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Poynting Theorem and Poynting Vector. **(8 Lectures)**

EM Wave in Bounded Media: Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. **(8 Lectures)**

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Uniaxial and Biaxial Crystals. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light. **(10 Lectures)**

Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. **(7 Lectures)**

Reference Books:

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
4. Introduction to Geometrical and Physical Optics,B. K. Mathur, Gopal Printing.
5. A Text Book on Light, B. Ghosh and K. G. Mazumdar, 5th Edn.,Reprint 2015, Sreedhar Publishers.
6. Geometricaland Physical Optics, P. K. Chakraborty, New Central Book Agancy (P) Ltd.
7. A Text Book of Optics, Dr. N. Subrahmanyam, Brijlal, Dr. M. N. Avadhanulu, S. Chand Publishers.
8. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
9. Classical Electromagnetism , H.C. Verma, Bharati Bhawan (Publishers & Distributors); First Edition , 2022.
10. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
11. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
12. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
13. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill.
14. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning.
15. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer.
16. Electromagnetic Fields & Waves, P.Lorrain&D.Corson, 1970, W.H.Freeman& Co.
17. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
18. Electromagnetic Theory, Chopra and Agarwal, K. Nath& Co., Meerut.
19. Electromagnetic Theory and electrodynamics Satyaprakash, , KedarNath Ram Nath Publishers
20. Electricity and Magnetism, K.K.Tiwari, S Chand Publishers.
21. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press.

24/7/23 24/07/23 Sayantan Sil 24-07-2023 24/7/23

PHYSICS-MJ 7 THEORY: MATHEMATICAL PHYSICS-II

Credits: 04 Lectures: 60

Marks: 100 (End Semester Examination=75, **Pass Marks = 30**
Semester Internal Examination=20, Class Performance & Attendance =05), **Pass Marks=10**

Instruction to Question Setter for
Semester Internal Examination (SIE 25 marks) (20+05):
*There will be **two** groups of questions. **Group A is compulsory** which will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.*

End Semester Examination (ESE 75 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

COURSE OBJECTIVE

- The emphasis of course is to equip students with the mathematical tools required insolving problem of interest to physicists.
- To expose students to fundamental computational physics skills and hence enable themto solve a wide range of physics problems.
- To help students develop critical skills and knowledge that will prepare them not only for doing fundamental and applied research but also prepare them for a wide variety of careers.
- This course will aim at introducing the concepts of Fourier series, special functions, solving linear partial differential equations by separation of variable method.

COURSE LEARNING OUTCOMES

On successfully completing this course, the students will be able to

- Represent a periodic function by a sum of harmonics using Fourier series and their applications in physical problems such as vibrating strings etc..
- Expand an odd or even function as half range sine and cosine Fourier series.
- Understand properties and applications of special functions like Legendre polynomials, Bessel functions functions and their differential equations and their applications in various physical problems such as in quantum mechanics.
- Learn about gamma and beta functions and their applications.
- Understand Dirac-delta function and its properties.
- Solve linear partial differential equations of second order with separation of variablemethod.
- Generate and plot Legendre polynomials and Bessel functions and verify theirrecurrence relation

SKILLS TO BE LEARNED

- Training in mathematical tools like calculus, integration, series solution approach , special

24/07/23 Sayantan Sil 24-07-2023. 24/7/23 24/7/23

function will prepare the student to solve ODE, PDE's which model physicalphenomena.

- He / she shall develop an understanding of how to model a given physical phenomenasuch as pendulum motion, rocket motion, stretched string, etc., into set of ODE's, PDE's and solve them.
- These skills will help in understanding the behavior of the modeled system/s.

COURSE CONTENT

Fourier series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Fourier series of square, saw-tooth and triangular waves. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. **(16 Lectures)**

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. **(4 Lectures)**

Dirac Delta function and its properties: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. **(6 Lectures)**

Special Functions: Legendre and Bessel Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions and Orthogonality. **(20 Lectures)**

Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. **(4 Lectures)**

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes. **(10 Lectures)**

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence,3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
3. Mathematical Physics with classical Mechanics, Satya Prakash, Sultan Chand & Sons, sixth edn.
4. Mathematical Physics, P. K. Chattopadhyay, New Age International Publishers, 2004.
5. Mathematical Physics, B. D. Gupta, Vikas Publishing House, 4th edition, 2010.
6. Fundamental of Mathematical Physics, A. B. Gupta, Books & Allied Ltd. 2012, 5th edition.
7. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
8. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
9. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
10. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
11. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
12. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press.
13. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books.

14. Mathematical Physics, Goswami, 1st edition, Cengage Learning.
15. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press.
16. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
17. Mathematical Physics, B.S. Rajput, Pragati Prakashan, 21st Edition, 2009.
18. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.

PHYSICS-MJ 8:Practical-III

Credits: 04 Lectures: 120 (60X2)

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines

Experiment	*= 60 marks*
Practical record notebook	*= 20 marks*
Viva-voce	*= 20 marks*

1. To find the focal length of a convex lens by plotting graphs between u and v or between 1/u and 1/v.
2. To determine refractive index (μ) of the material of given prism by plotting a graph between angle of incidence (i) and angle of deviation (δ).
3. To verify the law of Malus for plane polarized light.
4. To determine the specific rotation of sugar solution using Polarimeter.
5. To analyze elliptically polarized Light by using a Babinet's compensator.
6. Familiarization with: Schuster`s focusing; determination of angle of prism.
7. To determine refractive index of the Material of a prism using sodium source.
8. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
9. To determine wavelength of sodium light using Fresnel Biprism.
10. To determine wavelength of sodium light using Newton's Rings.
11. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
12. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
13. To determine dispersive power and resolving power of a plane diffraction grating.
14. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
15. To study the polarization of light by reflection and determine the polarizing angle for air glass interface.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, KitabMahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
5. B.Sc. Practical Physics, N. N. Ghosh, Bharati Bhawan Publishers.
6. B.Sc. Practical Physics, C. L. Arora, S. Chand & Company, 19th Edition, 1995, Reprint 2014.

MINOR PAPERS

SEMESTER I

PHYSICS-MN-1A : MECHANICS

(Credits: Theory-03, Practicals-01)

MN-1A: Theory

Credits: 03 Lectures: 45

Marks: 75 (End Semester Examination=60, Semester Internal Examination=10, Class Performance & Attendance =05) **Pass Marks (Internal + End Semester) = 30**

Instruction to Question Setter for
Semester Internal Examination (SIE 10 marks):
*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

COURSE OBJECTIVE

- This course begins with the review of Vectors and Differential equations and ends with the Special Theory of Relativity. Students will also appreciate the Gravitation, Elasticity, Surface tension, Viscosity and Oscillations.
- The emphasis of this course is to enhance the basics of mechanics. By the end of this course, students should be able to solve the seen or unseen problems/numericals in vectors, differential equations and mechanics and some properties of matter.

COURSE LEARNING OUTCOMES

Upon completion of this course, students are expected to understand the following concepts which would help them to appreciate the application of the fundamental concepts to the analysis of simple, practical situations related to the real world:

- Understand the role of vectors and coordinate systems in Physics.
- Learn to solve Ordinary Differential Equations: First order, Second order Differential Equations with constant coefficients.
- Understand laws of motion and their application to various dynamical situations.
- Apply Kepler's law to describe the motion of planets and satellite in circular orbit through the study of law of Gravitation.
- Explain the phenomenon of simple harmonic motion.
- Understand special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object.

- In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, vernier callipers, Travelling microscope) student shall embark on verifying various principles learnt in theory. Measuring 'g' using Bar Pendulum, Kater's pendulum and measuring elastic constants of materials, viscous properties of liquids etc.

SKILLS TO BE LEARNED

- Learn the concepts of vector calculus.
- Learn the concepts of elasticity of solids and viscosity of fluids.
- Develop skills to understand and solve the equations of Newtonian gravity and central force problem.
- Acquire basic knowledge of oscillation.
- Have an understanding of basic concepts of Special Theory of Relativity.

COURSE CONTENT

Vector Analysis: Triple Scalar product, Triple Vector product, gradient, divergence, Curl and their physical significance, scalar and vector fields, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem. **(10 Lectures)**

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients. **(4 Lectures)**

Central force field: Motion of a particle in a central force field –two body problem. Kepler's Laws and their deduction. **(4 Lectures)**

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. **(4 Lectures)**

Elasticity: Elastic constants and their interrelations, Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion, Torsional pendulum. **(8 Lectures)**

Fluids: Surface Tension: Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature. Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of liquid with temperature. **(8 Lectures)**

Special Theory of Relativity: Galilean transformations . Postulates of Special Theory of Relativity. Lorentz transformation, Length contraction. Time dilation. Relativistic addition of velocities. **(7 Lectures)**

Reference Books:

1. Mathematical Physics, H K Das and Dr. Rama Verma, S. Chand and Company Limited.
2. Mathematical Physics, B D Gupta, Vikash Publishing House, 4th edition.
3. Mathematical Physics, B.S. Rajput, Pragati Prakashan, 21st Edition, 2009.
4. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jonesand Bartlett Learning.
5. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.

6. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley.
7. Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
8. Physics – Resnick, Halliday& Walker 9/e, 2010, Wiley.
9. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
10. Elements of Properties of Matter, D. S. Mathur, S. Chand Publication.
11. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
12. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
13. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
14. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
15. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
16. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
17. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
18. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
19. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
20. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

Additional Books for Reference

1. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
2. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
3. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010,
a. Cengage Learning
4. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

MN-1A: Practical

Credit: 01 Lectures: 30 (15X2)

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 15 marks*
Practical record notebook	*= 05 marks*
Viva-voce	*= 05 marks*

1. To measure the diameter of a thick wire using vernier caliper.
2. To measure the diameter of a thick wire using screw gauge.
3. To measure the diameter of a thick wire using travelling microscope.
4. To study the random error in observations.
5. To study the Motion of Spring and calculate (a) Spring constant, (b) **g**.
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille'smethod).
7. To determine the Young's Modulus of a Wire by suitable method.
8. To determine the Modulus of Rigidity of a Wire by suitable method.
9. To determine the elastic Constants of a wire by Searle's method.
10. To determine the value of g using Bar Pendulum.
11. To determine the value of g using Kater's Pendulum.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse

24/7/23 24/07/23 Sayantan Sil 24-07-2023. 24/7/23

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn, 2011, KitabMahal
4. B.Sc. Practical Physics, N. N. Ghosh, Bharati Bhawan Publishers.
5. B.Sc. Practical Physics, C. L. Arora, S. Chand & Company, 19th Edition, 1995, Reprint 2014.
6. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt.Ltd.
7. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

SEMESTER III

PHYSICS- MN-1B: THEORY ELECTRICITY & MAGNETISM

(Credits: Theory-03, Practicals-01)

MN-1A: Theory

Credits: 03 Lectures: 45

Marks: 75 (End Semester Examination=60, Semester Internal Examination=10, Class Performance & Attendance =05) **Pass Marks (Internal + End Semester)= 30**

Instruction to Question Setter for
Semester Internal Examination (SIE 10 marks):
*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

COURSE OBJECTIVE

This course begins with static electric field and magnetic field. By the end of the course student should have in depth knowledge of electrostatics and magnetostatics, learn about Faraday's and Len'z laws of electromagnetic induction and also appreciate Maxwell's equations.

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

- Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
- Apply Gauss's law of electrostatics to solve a variety of problems.
- Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential.
- Demonstrate a working understanding of capacitors
- Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws)

24/07/23 Sayantan Sil 24-07-2023 24/7/23 24/7/23

- Have brief idea of dia-, para- and ferro-magnetic materials
- Understand the concepts of induction and self-induction, to solve problems using Faraday's and Lenz's laws
- Have an introduction to Maxwell's equations
- In the laboratory course the student will get an opportunity to verify various laws in electricity and magnetism.
- Should be able to verify of various circuit laws, network theorems elaborated above, using simple electric circuits.

SKILLS TO BE LEARNED

- This course will help in understanding basic concepts of electricity and magnetism and their applications.
- He / she shall comprehend the role of Maxwell's equation in unifying electricity and magnetism.
- Enable the student to understand propagation of electromagnetic waves through different bound and unbound media.

COURSE CONTENTS:

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

(20 Lectures)

Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferro- magnetic materials. **(10 Lectures)**

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. **(5 Lectures)**

Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves. **(10 Lectures)**

Reference Books:

1. Classical Electromagnetism , H.C. Verma, Bharati Bhawan (Publishers & Distributors); First Edition (1 February 2022).
2. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
3. Electricity & Magnetism, J.H. Fewkes&J.Yarwood. Vol. I, 1991, Oxford Univ. Press
4. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. Introduction to Electrodynamics, D.J.Griffiths, 3rd Edn, 1998, Benjamin Cummings.
7. Electromagnetic Theory and electrodynamics Satyaprakash, , Kedar Nath Ram Nath Publishers
8. Electricity and Magnetism, K.K.Tiwari, S Chand Publishers.
9. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.

24/7/23 24/07/23 Sayantan Sil 24-07-2023. 24/7/23

10. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
11. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill.
12. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning.
13. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer.
14. Electromagnetic Fields & Waves, P.Lorrain&D.Corson, 1970, W.H.Freeman& Co.
15. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
16. Electromagnetic Theory, Chopra and Agarwal, K. Nath& Co., Meerut.
17. Electromagnetic Theory and electrodynamics, Satyaprakash, , KedarNath Ram Nath Publishers
18. Electricity and Magnetism, K.K.Tiwari, S Chand Publishers.
19. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press.

MN-1B:Practical

Credit: 01 Lectures: 30(15X2)

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 15 marks*
Practical record notebook	*= 05 marks*
Viva-voce	*= 05 marks*

1. To find the value of a resistor and its tolerance by colour coding.
2. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
3. To study the characteristics of a series RC Circuit.
4. To verify the laws of combination (series and parallel) of resistances using a metre bridge.
5. To determine an unknown Low Resistance using Potentiometer.
6. To verify Ohm's law for the given unknown resistance.
7. To verify the Thevenin Norton theorem.
8. To verify the Thevenin Norton theorem.
9. To verify the Superposition theorem.
10. To verify Maximum power transfer theorem.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, KitabMahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
5. B.Sc. Practical Physics, N. N. Ghosh, Bharati Bhawan Publishers.
6. B.Sc. Practical Physics, C. L. Arora, S. Chand & Company.

MDC (Multidisciplinary Course): PHYSICS

SEMESTER I/II/III

MDC-1/2/3: PHYSICS

(Credits: Theory-03 Lectures-45)

Marks: 75 (End Semester Examination=75, ***No*** Semester **Internal Examination** **Pass Marks: = 30**

Instruction to Question Setter for

End Semester Examination (ESE 75 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*

Unit I Motion **(6 lectures)**

Velocity, acceleration, momentum, inertia, force, laws of motion. Newton's law of gravitation, acceleration due to gravity, mass and weight, weightlessness.

Unit II Properties of Matter **(9 Lectures)**

Different phases of matter, surface tension capillary rise, viscosity-Poiseuille's formula, Heat, temperature, different temperature scales: degree Celsius, Fahrenheit and Kelvin, idea of transverse and longitudinal waves.

Unit III Light & lenses **(11 Lectures)**

Reflection, refraction, total internal reflection, dispersion, diffraction, interference, scattering (elementary ideas only), blue color of sky, twinkling of stars. Mirage, rainbow, Concave and convex lenses, focal length, power of a lens, refractive index, defects of the eye– myopia, hypermetropia, presbyopia and astigmatism and their correction by lens.

Unit IV Electricity & Magnetism **(10 Lectures)**

Electricity: Voltage and current, Ohms law, idea of combination of resistance in series and parallel, Electric power (E Bill), calculation of energyrequirement of electric appliances, transformer, generator.
Magnetism: Electromagnetic induction-super conductivity-Meissner effect (qualitative idea), Maglev train.

Unit V Our Universe **(9 Lectures)**

Galaxies- Stars, Planets & satellites – solar system, lunar and solar eclipses, evolution of stars, black holes (basic concept). Artificial satellites: Geo stationary and Polar satellites.

Reference Books:

1. Physics text books for class 11th and 12th , NCERT, New Delhi, revised editions 2022.
2. Concepts of Physics, Part-I and Part-II, H. C. Verma, 2020, Bharati Bhawan.

3. Elements of Properties of Matter, D.S Mathur,2010, S .Chand & Co.
4. Fundamentals of Physics with Applications, Arthur Beiser, 2010, Tata McGraw-Hill publishing Co. Ltd..
5. Optics by Ajay Ghatak, New Delhi, 1998 Tata McGraw-Hill publishing Co. Ltd..
6. Electricity and Magnetism,A S Mahajan, A ARangwala, 2017McGraw Hill, NewDelhi,
7. An Introduction to Astrophysics, Baidyanath Basu, Tanuka Chattopadhyay, sudhindraNath Biswas, Second Edition, 2010, PHI Learning Private Limited.

Additional Books for reference :

1. Mechanics (in SI units) - (Berkley Physics course-volume 1), Charles Kittel, Walter Dknight etc, Tata McGraw Hill publication, 2017,second edition
2. Fundamental of General Properties of Matter, H.R Gulati, R Chand and Co, Fifthedition (1977).
3. A Text book of Optics by Subrahmanyam N., BrijLal and M. N. Avadhanulu,

24/07/23 Sayantan Sil 24-07-2023. 24/7/23 24/7/23

FORMAT OF QUESTION PAPER FOR SEMESTER INTERNAL EXAMINATIONS

Question format for **10 Marks:**

Subject/ Code

F.M. =10 **Time=1Hr.** Exam Year

General Instructions:

i. **Group A** carries very short answer type compulsory questions.
ii. **Answer 1 out of 2** subjective/ descriptive questions given in **Group B.**
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....

Group B

2. ..... [5]
3. ..... [5]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **20 Marks:**

Subject/ Code

F.M. =20 **Time=1Hr.** Exam Year

General Instructions:

i. **Group A** carries very short answer type compulsory questions.
ii. **Answer 1 out of 2** subjective/ descriptive questions given in **Group B.**
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]

Group B

3. ..... [10]
4. ..... [10]

Note: There may be subdivisions in each question asked in Theory Examination.

24/7/23 24/07/23 Sanyuntan Sil 24-07-2023. 24/7/23

FORMAT OF QUESTION PAPER FOR END SEMESTER UNIVERSITY EXAMINATIONS

Question format for **50 Marks:**

Subject/ Code

F.M. =50 **Time=2Hrs.** Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B.**
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....

Group B

2. ..... [15]
3. ..... [15]
4. ..... [15]
5. ..... [15]
6. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **60 Marks:**

Subject/ Code

F.M. =60 **Time=3Hrs.** Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B.**
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]
3. ..... [5]

Group B

4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

Hopz 24/07/23 Sayantan Sil 24-07-2023 29/7/23 24/7/23

Question format for **75 Marks:**

Subject/ Code

F.M. = 75 **Time=3Hrs.** Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B.**
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]
3. ..... [5]

Group B

4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]
9. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

DGpr2 24/07/23 Sayantan Sil 24-07-2023 24/7/24 24/7/2023