YBN UNIVERSITY

Established by the Act of Government of Jharkhand Act15, 2017
Gazette Notification No.505, Dated 17th July 2017
As per Section 2(f) of UGC Act.1956

NEP-2020
PHYSICS COURSE/STRUCTURE

For

FOUR YEAR UNDERGRADUATE PROGRAMMES
(FYUGP)
UNDER YBNU RANCHI JHARKHAND
Implemented in Department of Physics (School of Science)

Semester-I, II, III & IV

From

Academic Session-2023

RAJAULATU, NAMKUM, RANCHI, JHARKHAND-834010

COURSE OF STUDY OF FOUR YEAR UNDERGRADUATE PROGRAMME FOR (1) YEAR-2023 onwards

COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME

Table l: Course structure for Undergraduate Certificate Programme [May Exit after Sem.-II]

Semester	Common Course		Introductory Course	Major		Total credits	
Sem-I	LCS (MIL/TRL)	Understanding India	Health & Wellness, Yoga Education, Sports & Fitness	IRC-1	IVS-1A	MJ-1	
	(6Credits)	(2Credits)	(2Credits)	(3Credits)	(3Credits)	(6Credits)	(22)
Sem-II	LCS (Hindi)	Global Citizenship	Mathematical & Computational	IRC-2	IVS-1B	MJ-2	
	(6Credits)	Education (2Credits)	Thinking (2Credits)	(3Credits)	(3Credits)	(6Credits)	(22)

Total = 44 Credits

(LCS: Language and Communication Skills; MIL: Modern Indian Languages; TRL: Tribal Regional Languages; IRC: Introductory Regular Courses; IVS; Introductory Vocational Studies, MJ: Major)

Table 2: Course structure for Undergraduate Diploma Programme [May Exit after Sem.-IV]

Semester	Common Course			Introductory Course	Major	Minor	Internship/ Project	Vocational	Total credits
Sem-III	Environmental Studies	Community Engagement/ NCC/NSS	Digital Education	IRC-3	MJ-3		Internship/ Project		
	(3Credits)	(3Credits)	(3Credits)	(3Credits)	(6Credits)		(4Credits)		**(22)**
Sem-IV					MJ-4, MJ-5	MN-1		VS-1	
					(6+6=12 Credits)	(6Credits)		(3Credits)	**(22)**

Total=88Credits

(MN: Minor; VS: Vocational Studies)

Table 3: Course structure for Bachelor's Degree Programme [May Exit after Sem-VI]

Semester	Major Course	Minor Course	Vocational	Total Credits
Sem-V	MJ-6, MJ-7	MN-2	VS-2	
	(6+6=12Credits)	(6Credits)	(4Credits)	(22)
Sem-VI	MJ-8, MJ-9	MN-3	VS-3	
	(6+6=12Credits)	(6Credits)	(4Credits)	(22)

Total=132Credits

Table 4: Course Structure for Bachelor's Degree with Hons. /Research Programme

Semester	Advance course	Research Course		Vocational	Total Credits
Sem-VII	AMJ-1, AMJ-2	Research Methodology			
		(6+6=12Credits)		(4Credits)	(22)
Sem-VIII	AMJ-3, AMJ-4	Research Int./Field Work	Research Report	VSR	
	(6+6=12Credits)	(4Credits)		(2Credits)	(22)

Total=176 Credits

(AMJ: Advance Major: VSR: Vocational Studies associated with Research)

SEMESTER WISE COURSE OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME 2023 ONWORDS B.Sc. PHYSICS

Table 5: Semester Wise Course Code and Credits Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Course		Examination Structure				
	Code	Paper	Credits	Theory	Internal Assessment	Practical	Total
I	1Y4CC-1	Language and Communication Skills (Modern Indian Language including TRL)	6	75	25	--	100
	1Y4CC-2	Understanding India	2	75	25	--	100
	1Y4CC-3	Health & Wellness, Yoga Education, Sports & Fitness	2	50	25	25	100
	1Y4PHYIRC-1	Introductory Regular Course-1 **Introductory Physics**	3	50	25	25	100
	1Y4IVS-1A	Introductory Vocational Studies-I **Computer Basics And Multimedia**	3	50	25	25	100
	1Y4PHYMJ-1	Major paper-1 (Disciplinary/Interdisciplinary Major) **Basic Mathematical Physics & Mechanics**	6	50	25	25	100
II	2Y4CC-4	Language and Communication Skills (Hindi)	6	75	25	--	100
	2Y4CC-5	Mathematical and Computational Thinking Analysis	2	50	25	25	100
	2Y4CC-6	Global Citizenship Education & Education for Sustainable Development	2	50	25	25	100
	2Y4PHYIRC-2	Introductory Regular Course-2 **Introductory Physics**	3	50	25	25	100
	2Y4IVS-2B	Introductory Vocational Studies-2 **Computer Basics And Multimedia**	3	50	25	25	100
	2Y4PHYMJ-2	Major paper-2 (Disciplinary/Interdisciplinary Major) **Electromagnetism**	6	50	25	25	100
III	2Y4EVSCC-7	Environmental Studies/EVS	3	50	25	25	100
	2Y4CC-8	Digital Education (Elementary Computer Applications)	3	50	25	25	100
	2Y4CC-9	Community Engagement & Service (NSS/NCC/Adult education)	3	50	25	25	100

	3Y4PHYIRC-3	Introductory Regular Course-3 **Introductory Physics**	3	50	25	25	100
	3Y4IAP	Internship/Apprenticeship/Project	4	50	25	25	100
	3Y4PHYMJ-3	Major paper-3 (Disciplinary/Interdisciplinary Major) **Waves and Optics**	6	50	25	25	100
IV	4Y4PHYMJ-4	Major paper-4 (Disciplinary/Interdisciplinary Major) **Mathematical Physics**	6	50	25	25	100
	4Y4PHYMJ-5	Major paper-5 (Disciplinary/Interdisciplinary Major) **Thermal and Statistical Physics**	6	50	25	25	100
	4Y4PHYMN-1	Minor paper-1 (Disciplinary/Interdisciplinary Minor) **Mechanics**	6	50	25	25	100
	4Y4VS-1	Vocational Studies-1 (Minor) **Introduction to Stock Market**	4	50	25	25	100
V	5Y4PHYMJ-6	Major paper-6 (Disciplinary/Interdisciplinary Major) **Analog and Digital Electronics**	6	50	25	25	100
	5Y4PHYMJ-7	Major paper-7 (Disciplinary/Interdisciplinary Major) **Elements of Modern Physics**	6	50	25	25	100
	5Y4PHYMN-2	Minor paper-2 (Disciplinary/Interdisciplinary Minor) **Electricity and Magnetism**	6	50	25	25	100
	5Y4VS-2	Vocational Studies-2 (Minor)	4	50	25	25	100
VI	6Y4PHYMJ-8	Major paper-8 (Disciplinary/Interdisciplinary Major) **Quantum Mechanics and Applications**	6	50	25	25	100
	6Y4PHYMJ-9	Major paper-9 (Disciplinary/Interdisciplinary Major) **Solid State Physics**	6	50	25	25	100
	6Y4PHYMN-3	Minor paper-3 (Disciplinary/Interdisciplinary Minor) **Waves And Optics**	6	50	25	25	100
	6Y4VS-3	Vocational Studies-3 (Minor)	4	50	25	25	100
VII	7Y4PHYAMJ-1	Advance Major paper-1 (Disciplinary/Interdisciplinary Major) **Nuclear and Particle Physics**	6	50	25	25	100
	7Y4PHYAMJ-2	Advance Major paper-2 (Disciplinary/Interdisciplinary Major) **Classical Dynamics**	6	50	25	25	100
	7Y4RC-1						

		Research Methodology	6	50	25	25	100
	7Y4RC-2	Research Proposal	4	50	25	25	100
VIII	8Y4PHYAMJ-3	Advance Major paper-3 (Disciplinary/Interdisciplinary Major) **Physics of Devices and Instruments**	6	50	25	25	100
	8Y4PHYAMJ-4	Advance Major paper-4 (Disciplinary/Interdisciplinary Major)**Experimental Techniques**	6	50	25	25	100
	8Y4RC-3	Research Internship/Field Work	4	---	---	---	100
	8Y4RC-4	Research Report	4	---	---	---	100
	8Y4VSR	Vocational Studies (Associated with Research)	2	50	25	25	100
		Total Credits	**176**				

Abbreviations:

CC Common Course
IRC Introductory Regular Courses
IVS Introductory Vocational Courses
IAP Internship/Apprenticeship/Project
VS Vocational Studies
MJ Major Disciplinary/Interdisciplinary Courses
MN Minor Disciplinary/ Interdisciplinary Courses
AMJ Advance Major Disciplinary/ Interdisciplinary Courses
RC Research Courses
VSR Vocational Studies associated with Research

Table 6: Semester Wise Course Code and Credits Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Examination Structure				
	Code	**Papers**	**Credits**	**Theory**	**Internal Assessment**	**Practical**	**Total**
I	1Y4PHYMJ-1	Basic Mathematical Physics & Mechanics	6	50	25	25	100
II	1Y4PHYMJ-2	Electromagnetism	6	50	25	25	100
III	1Y4PHYMJ-3	Waves and Optics	6	50	25	25	100
IV	1Y4PHYMJ-4	Mathematical Physics	6	50	25	25	100
	1Y4PHYMJ-5	Thermal and Statistical Physics	6	50	25	25	100
V	1Y4PHYMJ-6	Analog and Digital Electronics	6	50	25	25	100
	1Y4PHYMJ-7	Elements of Modern Physics	6	50	25	25	100
VI	1Y4PHYMJ-8	Quantum Mechanics and Applications	6	50	25	25	100
	1Y4PHYMJ-9	Solid State Physics	6	50	25	25	100
VII	1Y4PHYAMJ-1	Nuclear and Particle Physics	6	50	25	25	100
	1Y4PHYAMJ-2	Classical Dynamics	6	50	25	25	100
	1Y4PHYRC-1 R	Research Methodology	6	50	25	25	100
	1Y4PHYRC-2	Research Proposal	4	50	25	25	100
VIII	1Y4PHYAMJ-3	Physics of Devices and Instruments	6	50	25	25	100
	1Y4PHYAMJ-4	Experimental Techniques	6	50	25	25	100
	1Y4 RC-3	Research Internship/Field Work	4	---	---	---	100
	1Y4 RC-4	Research Report	4	---	---	---	100
	1Y4 VSR	Vocational Studies (Associated with Research)	2	50	25	25	100
		Total Credit	**98**				

Table 7: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Examination Structure				
	Code	Papers	Credits	Theory (F.M.)	Internal Assessment	Practical	Total
I/ II/ III	IRC	Introductory Physics	3	50	25	25	100
IV	MN-1	Mechanics	6	50	25	25	100
V	MN-2	Electricity and Magnetism	6	50	25	25	100
VI	MN-3	Waves And Optics	6	50	25	25	100

Table 8: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses						
	Code	Papers	Credits	Theory (F.M.)	Internal Assessment	Practical	Total
I	1Y4IVSOF-1A	ORGANIC FARMING – IRC-1	2	50	25	25	100
	1Y4IVSDM-1A	DIGITAL MARKETING – IRC-2	2	50	25	25	100
	1Y4IVSCM-1A	COMPUTER BASICS AND MULTIMEDIA – IRC-3	2	50	25	25	100
	1Y4IVSEWS-1A	ENGINEERING WORKSHOP-IRC-4	2	50	25	25	100
	1Y4IVSED-1A	ENGINEERING GRAPHICS-IRC-5	2	50	25	25	100
	1Y4IVSEMC-1A	ENTREPRENEURSHIP AND MANAGEMENT CONCEPTS-IRC-6	2	50	25	25	100
	1Y4IVSOB-1A	ORGANIZATION BEHAVIOUR-IRC-7	2	50	25	25	100
II	2Y4IVSOF-2B	ORGANIC FARMING – IRC-1	2	50	25	25	100
	2Y4IVSDM-1B	DIGITAL MARKETING – IRC-2	2	50	25	25	100
	2Y4IVSCM-1B	COMPUTER BASICS AND MULTIMEDIA– IRC-3	2	50	25	25	100
	2Y4IVSEWS-1B	ENGINEERING WORKSHOP-IRC-4	2	50	25	25	100

	2Y4IVSED-1B	ENGINEERING GRAPHICS-IRC-5	2	50	25	25	100
	2Y4IVSEMC-1B	ENTREPRENEURSHIP AND MANAGEMENT CONCEPTS-IRC-6	2	50	25	25	100
	2Y4IVOB-1B	ORGANIZATION BEHAVIOUR-IRC-7	2	50	25	25	100

AIMS OF BACHELOR'S DEGREE PROGRAMME IN PHYSICS

The broad aims of bachelor's degree programme in Physics are:

The aim of bachelor's degree programme in Physics is intended to provide:

a) Broad and balance knowledge in Physics in addition to understanding of key Physical concepts, principles, and theories.
b) To develop students' ability and skill to acquire expertise over solving both theoretical and applied Physics problems.
c) To provide knowledge and skill to the students' thus enabling them to undertake further studies in Physics in related areas or multidisciplinary areas that can be helpful for self-employment/entrepreneurship.
d) To provide an environment that ensures cognitive development of students in a holistic manner. A complete dialogue about Physics and its significance is fostered in this framework, rather than mere theoretical aspects
e) To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A Physics graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
f) To mold a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.
g) To enable the graduate, prepare for national as well as international competitive examinations, especially UGC-CSIR NET, GATE, JAM, JEST, and UPSC Civil Services Examination.
h) To enable student, seek their career in the field of Research, Applied Physics, Energy, Technology, Geophysics and meteorology, Space and Astronomy, Radiation Physics, Instrumentation, Oceanography and such many fields with a further specialization in the same.

PROGRAM LEARNING OUTCOMES

The broad aims of Bachelor's degree programme in Physics are:

The student graduating with the Degree Honours/Research in Physics would be able to:

a) Core competency: Students will acquire core competency in the subject Physics, and in allied subject areas.
b) Systematic and coherent understanding of the fundamental concepts in Physics and other related allied Physics subjects.
c) Students will be able to use the evidence based comparative Physics approach to explain the scientific and technological problems.
d) The students will be able to understand the laws of nature.
e) Students will be able to understand the basic principle of equipment, instruments used in the Physics laboratory.
f) Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Physics.
g) Disciplinary knowledge and skill: A graduate student are expected to be capable of demonstrating comprehensive knowledge and understanding of both theoretical and experimental/applied Physics knowledge in various fields of interest like Mathematical Physics, Thermal and Statistical Physics, Electromagnetism, Waves and Optics, Analog and Digital Electronics, Modern Physics, Quantum Mechanics, Solid State Physics, Nuclear and Particle Physics, Classical Dynamics, Experimental Techniques, Devices and Instruments, etc.
h) Skilled communicator: The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.
   Critical thinker and problem solver: The course curriculum also includes components that can be helpful to graduate students to develop critical thinking ability by way of solving problems/numerical using basic Physics knowledge and concepts.
i) Sense of inquiry: It is expected that the course curriculum will develop an inquisitive characteristic among the students through appropriate questions, planning and reporting experimental investigation. Team player: The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field-based situation and industry.
j) Skilled project manager: The course curriculum has been designed in such a manner as to enable a graduate student to become a skilled project manager by acquiring knowledge about Physics project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.
k) Digitally literate: The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, and use of simulation software and related computational work.

l) Ethical awareness/reasoning: A graduate student requires understanding and developing ethical awareness/reasoning which the course curriculum adequately provide.

m) Lifelong learner: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity.

SEMESTER-I

Semester	Course Structure For Semester I Common, Introductory, Major, Minor, Vocational & Internship Course						
	Code	**Paper**	**Credits**	**Theory**	**Internal Assessment**	**Practical**	**Total**
I	1Y4CC-1	Language and Communication Skills (Modern Indian Language including TRL)	6	75	25	--	100
	1Y4CC-2	Understanding India	2	75	25	--	100
	1Y4CC-3	Health & Wellness, Yoga Education, Sports & Fitness	2	50	25	25	100
	1Y4PHYIRC-1	Introductory Regular Course-1 **Introductory Physics**	3	50	25	25	100
	1Y4IVS-1A	Introductory Vocational Studies-I **Computer Basics And Multimedia**	3	50	25	25	100
	1Y4PHYMJ-1	Major paper-1 (Disciplinary/Interdisciplinary Major) **Basic Mathematical Physics & Mechanics**	6	50	25	25	100

SEMESTER I

COMMON COURSE –CC 1:

Language and Communication Skills (Modern Indian Language including TRL)

ENGLISH LANGUAGE &, COMMUNICATION SKILLS (1Y4CC-1)

Credits: 6) Total Marks: 100

OBJECTIVE: - To equip students effectively to acquire skills in reading, writing, comprehension and communication for English language &; Communication.

COURSE OUTCOMES:

- Students will improve their speaking ability in English both in terms of fluency and comprehensibility
- Students will give oral presentations and receive feedback on their performance
- Students will increase their reading speed and comprehension of academic articles
- Students will strengthen their ability to write academic papers, essays and summaries using the process approach.
- Students will enlarge their vocabulary. They will also heighten their awareness of correct usage of English grammar in writing and speaking

Unit I: Communication – Meaning, Types, Channels, Barriers. Skills of Language learning: Listening, Speaking, Reading & Writing.

Unit II: English as a Global Language Growth & Status of English language in India

Unit III: Class-presentation – Introduction, Conversation, Greetings, Likes and Dislikes, Opinion, Agreeing, Disagreeing, Complaint, Apology

Unit IV: Writing skills notice writing, précis writing, essay writing, letter writing resume writing.

Unit V: Vocabulary building: One word substitution, synonyms and antonyms, idioms and phrases, Common Errors, Prefix, Suffix, Homophones, Confusing words

Suggested Reading:

1. Technical Communication, M.H. Rizvi, Tata McGrawhill
2. Everyday Smart English, Dr. Arti Gupta, I.D. Publishers
3. Effective Business Communication, Asha Kaul
4. Developing Communication Skills, Krishnamohan
5. Functional Grammar and Spoken and Written Communication in English, Bikram K. Das, Orient Blackswan
6. Precis, Paraphrase and Summary,P.N. Gopalkrishnan, Authors Press
7. Communication Skills, Sanjay Kumar and Pushplata, Oxford Publication

SEMESTER I

COMMON COURSE –CC 2:Understanding India (1Y4CC-2)

(Credits: 2) Total Marks: 100

Unit I: Background of India's culture: Harappan civilisation and Vedic age Buddhism, Jainism, Sanatan (Hinduism) and Islam

Unit II: Growth and development of Indian Education and literature: Bharat's Natyashastra, Kalidas, Panini, Patanjali Taxila, Nalanda, Vishwa Bharati, BHU, AMU, IIT, IISC, AIIMS

Unit III: Leaders of India's freedom struggle: Mahatma Gandhi, Jawaharlal Nehru, Subhash Chandra Bose, Freedom fighters of Jharkhand (Tilka Manjhi, Sidho-Kanho, , Birsa Munda & Jatra Bhagat)

Unit IV: Geographical features of India

1. India on the map of world and its neighboring Countries.
2. Physical features of India including mountain, plateau, plain, coast, island, vegetation, rivers, soils, and climate

Unit V: The People of India: Racial diversities, Population, its growth, distribution, Migration**.**

Unit VI: Indian Constitution

1. Preamble
2. Salient features
3. Fundamental rights
4. Fundamental duties

Unit VII: Political ideas: Non-violence, Satyagraha and Social Justice

Unit VIII: The Indian Economy: The Indian Economy through the Ages (Agriculture, Industry and Trade-Transport)

Suggested Readings:-

1. L. Basham, A Cultural History of India, Oxford University Press, 1997
2. A. L. Basham, A Wonder that was India, Rupa, New Delhi, 1994
3. N. R. Ray, An Approach to Indian Art, Publication Bureau, Chandigarh, 1974
4. A. L. Basham, A Cultural History of India, Oxford University Press, 199
5. NayanjotLahiri, Marshaling the Past: Ancient India and its Modern Histories, Permanent Black, 2012

6. R.C. Majumdar (ed.), History and Culture of Indian People (Relevant Volumes and Chapters), Bhartiya Vidya Bhawan, Bombay.
7. S. C. Ghosh, History of Education in Modern India, 1758-1986, Orient Longman, Hyderabad, 1995
8. Tirthankar Ray, The Economic History of India 1857-1947, OUP, 2006
9. Vijay Joshi and I.M.D. Little, India's Economic Reforms, 1991-2001, OUP, 1999

SEMESTER I
COMMON COURSE –CC 3:

Health & Wellness, Yoga Education, Sports & Fitness (1Y4CC-3)

(Credits: 2) Total Marks: 100

OBJECTIVE:

- To raise awareness towards fitness among the students.
- To develop the individual as a fit citizen in the society.
- To acquire knowledge about yoga and health &; wellness.

COURSE OUTCOMES:

- Students will understand and learn different dimension of active lifestyle
- Student will learn to apply knowledge and lead better quality life
- The students will be able to continue professional courses and research in health &; wellness &; yoga

HEALTH AND WELLNESS

Unit1:-Introduction

1. Meaning, Definition and Dimensions of Health and Wellness.
2. Factors affecting Fitness and Wellness.
3. Role of Fitness in maintaining Health and Wellness.
4. Importance of Health Education and Wellness.

Unit2:-Methods to Maintain Health and Wellness

1. Role of Physical Activities and Recreational Games for Health and Wellness
2. Role of Yoga asanas and Meditation in maintaining Health and Wellness
3. Nutrition for Health &; Wellness

Unit3:-Anxiety, Stress and Aging

1. Meaning of Anxiety, Stress and Aging
2. Types and Causes of Stress
3. Stress relief through Exercise and Yoga

Suggested Readings:

1. Reklau Marc (2019), “30 Days: Change your habits, Change your life”, Rupa Publications, India
2. Russell, R.P.(1994).Health and Fitness Through Physical Education. USA Human Kinetics.

3. Scates Samantha (2019) " Healthy Habits for a Healthy Life" Samantha, Ireland
4. D.M Jyoti, Yogaand Physical Activities (2015) lulu.com3101, Hillsborough, NC2 7609, United States.

YOGA EDUCATION

Unit -1: Theory

Introduction to Health and Wellness

1. Meaning, definition and importance of Yoga
2. Types of Yoga, Introduction of Sat karma, definition of asana and Pranayama, it's physical and mental benefits
3. Stretching exercises
4. Warming up and limbering down
    a) General warm up exercises
    b) Specific warm up exercises

UNIT II Practical

A. Sukshma Vyayama
B. Suryanamaskara

(12 Poses are Compulsory 1. Ardhachakrasana 2.Padhastasana 3. Ashwasanchalasana 4.Dhandasana. 5 Shasangasana 6.Astangasana 7.Bhujangasana 8.Parvathasana 9. Shashangasana 10. Ashwasanchalasanal 11. Padhastasana 12.Ardhachakrasana)

C. Basic Set of Yoga Asanas -Sitting Poses
Padmasana, Sukhasana, Vajrasana, Gomukhasana,

Prone Position	Supine Position	Invert Position
Noka asang Bhujangasang Salabhasana Marjariasana makarasana	Ustrasana Setu Bandhasana chakrasana	Sarvangasana halasana Salambha Sarvangasana Sirsasana

Relaxing Pose → Shavasana

D. Basic Set of Pranayama, Meditation & Mudra

Pranayama- Anulom-Vilom Pranayama, Bhramari Pranayama, Ujjai Pranayama, Bhastrika Pranayama, Sitali Pranayama

Meditation- Omkar meditation

Mudra – Pranav mudra, Gyan mudra, Hridaya mudra

Suggested Readings:

1. Nagendra, H.R. &; Nagarathna, R. (2002).Samagra Yoga Chikitse. Bengaluru: Swami Vivekananda Yoga Prakasana.
2. Kumar, Ajith. (1984) Yoga Pravesha. Bengaluru: Rashtrothanna Prakashana
3. Shanti KY(1987)& The Science of Yogic Breathier & (Pranayama) DB Bombay
4. Iyengar B.K.S.(2006) " Light on Yoga" Thorsons (Publ.) India

SEMESTER I
INTRODUCTORY REGULAR COURSE (IRC)

(Credits: Theory-02 + Practical 01) Total Marks: 100

INTRODUCTORY PHYSICS (1Y4PHYIRC-1)

Course Learning Outcomes:

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

1. Introduce Physics, Physics and Technology, Symmetry in nature and Conservation laws, Fundamental forces in nature.
2. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
3. Apply Gauss's law of electrostatics to solve a variety of problems.
4. Solve Laplace's and Poisson equation.
5. Describe the magnetic field produced by magnetic dipoles and electric currents.
6. Will be able to demonstrate his/her understanding of Interference, Diffraction and Polarization of light.
7. Explain and differentiate the Zeroth, First, Second and Third law of thermodynamics.
8. Explain the dual nature of matter and radiation, Uncertainty Principle.
9. Describe the basic understanding of radioactivity, mean life, half-life and nuclear fission and fusion.
10. Demonstrate basic understanding of Analog and Digital Electronics.
11. Understand the concepts of Special theory of Relativity

Skills to be learned:

1. This course will develop a liking for the subject and students may explore it as a pre-course towards selection of minor subject papers in the undergraduate program.
2. Basic understanding of Physics as a subject of Natural Science.

Course Content:

Introduction: What is Physics? Scope of Physics, Physics and Technology, Fundamental forces in nature. Conserved quantities, Conservation laws and Symmetry. **(2 Lectures)**

Vector Calculus: Scalar and Vector fields. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). **(5 lectures)**

Mechanics: Review of Newton's Laws of Motion. Impulse. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Angular momentum of a

particle and system of particles. Torque. Principle of conservation of angular momentum. Moment of Inertia. Kinetic energy of rotation. Motion involving both translation and rotation. Elastic constants and interrelation between them. Twisting torque on a Cylinder or Wire. Surface tension, Surface energy, Ripples and Gravity waves. Temperature dependance of Surface Tension. Viscosity, Velocity profile: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube and the corrections. **(6 lectures)**

Electricity and Magnetism: Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Electrostatic Potential. Laplace's and Poisson Equations. Solution of Laplace's equation. Potential and Electric Field due to a dipole. Force and Torque on a dipole. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. Magnetic force between current elements and definition of Magnetic Field B, Magnetic Intensity, H and Magnetization Vector M. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) on point charge (2) on current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. **(7 lectures)**

Optics: Interference of light, Division of amplitude and wavefront. Young's double slit experiment. Diffraction of light, Fresnel and Fraunhoffer diffraction. Polarization of light. Description of Linear, Circular and Elliptical Polarization **(5 lectures)**

Thermal Physics: Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes. Work done during Isothermal and Adiabatic Processes. Reversible and Irreversible process with examples. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: KelvinPlanck and Clausius Statements. Concept of Entropy, Entropy Changes in Reversible and Irreversible processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics (Nearst's Heat Theorem). Unattainability of Absolute Zero. **(6 lectures)**

Elements of Modern Physics: Wave-particle duality, Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables) and some applications: Energytime uncertainty principle. Schrodinger equation; Position, Momentum and Energy operators; physical interpretation of a wave function, probabilities and normalization; Law of radioactive decay; Mean life and half-life; Elementary idea of fission and fusion. **(5 lectures)**

Basic Electronics: P and N type semiconductors. Energy Level Diagram. Barrier Formation in PN Junction Diode. Current Flow Mechanism in Forward and Reverse Biased Diode. Half-wave Rectifier. Centre-tapped Full-wave Rectifiers, Ripple Factor and Rectification Efficiency, Zener Diode and Voltage Regulation. n-p-n and p-n-p Transistors. DC Characteristics of transistor in CE

Configurations. Current gains α and β. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. Octal and Hexadecimal numbers. AND, OR and NOT Gates. De Morgan's Theorems. NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. Boolean Laws. Binary Addition. 1's and 2's complement. **(6 lectures)**

Special Theory of Relativity: Galilean transformation, Postulates of Special Theory of Relativity. Lorentz Transformations. Length contraction, Time-dilation, and relativistic variation of mass. **(3 lectures)**

Reference Books;

1. Mathematical Physics, B. D. Gupta.
2. Mathematical Physics, B. S. Rajput.
3. Mathematical Physics, H. K. Dass.
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. Undergraduate Mechanics, Arun Kumar, J. P. Agarwal and Nutan Lata, Pragati Prakashan
6. Concepts of Electromagnetic Theory, K. Mamta, Raj Kumar Singh and J. N. Prasad, 1/e, 2021, Wiley/I. K. International Publishing House, New Delhi
7. Waves and Acoustics, P. K. Chakraborty and Satyabrata Chowdhury.
8. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
9. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
10. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
11. Electricity and Magnetism, P. K. Chakraborty, New Age International Pvt. Ltd.
12. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
13. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
14. Digital Electronics, Floyd.
15. Digital Computer Electronics, Malvino
16. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
17. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India
18. A First Course in Electronics, Khan and Dey, PHI, 2006
19. Basic Electronics, Arun Kumar, Bharati Bhawan, 2007
20. Digital Systems and Applications, Nutan Lata, Pragati Prakashan, 1/e, 2019 21. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

PHYSICS PRACTICAL
INTRODUCTORY PHYSICS (1Y4PHYIRC-1P)

1. Poiseuille's Equation for Flow of a Liquid through a Capillary Tube and the corrections.
2. Determination of Young's double slit experiments.
3. Demonstrate and analyze polarization states of light
4. Determine equation for Flow of a Liquid through a Capillary Tube and the corrections.

5. Verification Diffraction of light.

Reference Books;

1. Optics, Principles and Applications" by K K Sharma.
2. Principles of Optics" by M Born and E Wolf
3. Electricity and Magnetism, P. K. Chakraborty, New Age International Pvt. Ltd.
4. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
5. Undergraduate Mechanics, Arun Kumar, J. P. Agarwal and Nutan Lata, Pragati Prakashan

SEMESTER – I

COMPUTER BASICS AND MULTIMEDIA – IVS-1A

Course Code: 1Y4IVSCM-1A

(Credits: Theory-01 + Practical 02) Total Marks: 100

Course Content:

UNIT- I Introduction to Computer System: Basic Computer Concept Computer Organisation, Windows OS: Windows XP vs. Windows7

UNIT-II Microsoft Office 2016-I: MS Word-Tools, menu Bar, Insert, Design, Layout, References, Mailing, Review, View

UNIT-III Microsoft Office 2016-II: MS Excel, MS PowerPoint - Tools, menu Bar, Insert, Design, Layout, References, Mailing, Review, View

UNIT-IV Internet & its usage: Social media, Facebook, Instagram, WhatsApp, Telegram, Twitter, LinkedIn, YouTube,

COMPUTER BASICS AND MULTIMEDIA PRACTICAL- IVS-1A

Course Code: 1Y4IVSCM-1A-LAB

PRACTICALS: **60 Lectures**

1. Create a Visiting Card of your college using page size as follows a) Page width=”3.2” b) Page height=”2.2”
2. Write a leave letter to the Principal by using different alignments, correct formats in MSWord
3. Mail Merge in MS Word
4. Creating different types of charts
5. Create different types of power point presentation

SEMESTER I

MAJOR COURSE –MJ 1

BASIC MATHEMATICAL PHYSICS & MECHANICS (1Y4PHYMJ1)

(Credits: Theory-04, Practicals-02)

Course Learning Outcomes:

On successful completion of this course the student should know:

1. Revise the knowledge of calculus. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.
    a. Learn the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.
2. In the laboratory course, learn the fundamentals of the C and C++ programming languages and their applications in solving simple physical problems involving differentiations, integrations, differential equations as well as finding the roots of equations.
3. Understand laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance. He / she will learn the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.
4. Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity
5. Understand simple principles of fluid flow and the equations governing fluid dynamics.
6. Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of Gravitation.
7. Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.
8. Describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting in a merry-goround experiences an outward pull.
9. Describe special relativistic effects and their effects on the mass and energy of a moving object.
10. appreciate the nuances of Special Theory of Relativity (STR)
11. In the laboratory course, the student shall perform experiments related to mechanics (compound pendulum), rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity) and fluid dynamics (verification of Stokes law, Searle method) etc.

Skills to be learned:

1. Training in calculus will prepare the student to solve various mathematical problems.

2. He / she shall develop an understanding of how to formulate a physics problem and solve given mathematical equation risen out of it.
3. Learn the concepts of elastic in constant of solids and viscosity of fluids.
4. Develop skills to understand and solve the equations central force problem.
5. Acquire basic knowledge of oscillation.
6. About inertial and non-inertial systems and special theory of relativity

Course Content:

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

Calculus:

Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions, Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series. **(2 Lectures)**

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Particular Integral. **(6 Lectures)**

Vector Calculus:

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. **(9 Lectures)**

Vector Integration: Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). **(6 Lectures)**

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. **(7 Lectures)**

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

Flexure of Beam: Bending of beam, Cantilever. **(3 Lectures)**

Surface Tension: Ripples and Gravity waves, Determination of surface tension by Jaeger's and Quinke's methods. Temperature dependence of surface tension. **(6 Lectures)**

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

Central Force Motion: 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). **(3 Lectures)**

Oscillations: 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. **(4 Lectures)**

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass- energy Equivalence. Relativistic Doppler effect. **(9 Lectures)**

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. Mathematical Physics, P. K. Chattopadhyaya, 2/e, New Age International Publisher
3. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
4. Differential Equations, George F. Simmons, 2007, McGraw Hill.
5. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
6. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
7. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
8. Mathematical Physics, Goswami, 1st edition, Cengage Learning
9. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
10. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
11. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
12. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.
13. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
14. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
15. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
16. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
17. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
18. Undergraduate Mechanics, Arun Kumar, J. P. Agarwal and Nutan Lata, Pragati Prakashan
19. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

20. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

PHYSICS PRACTICAL- MJ 1 LAB

BASIC MATHEMATICAL PHYSICS & MECHANICS (1Y4PHYMJ1P)

PRACTICALS: **60 Lectures**

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

1. Highlights the use of computational methods to solve physical problems
2. The course will consist of lectures (both theory and practical) in the Lab
3. Evaluation done not on the programming but on the basis of formulating the problem
4. Aim at teaching students to construct the computational problem to be solved
5. Students can use any one operating system Linux or Microsoft Windows

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow- emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. DoWhile Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D & 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs:	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of pi (π)

- Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope. • To study the random error in observations of simple pendulum oscillations.
- To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
- To determine g and velocity for a freely falling body using Digital Timing Technique
- To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
- To determine the Young's Modulus of a Wire by Optical Lever Method.
- To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
- To determine the elastic Constants of a wire by Searle's method.
- To determine the value of g using Bar Pendulum.
- To determine the value of g using Kater's Pendulum.

Reference Books:

1. Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
2. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rdEdn. , 2007, Cambridge University Press.
3. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
4. Elementary Numerical Analysis, K.E. Atkinson, 3 r d E d n., 2 0 0 7, Wiley India Edition.
5. Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
6. An Introduction to computational Physics, T.Pang, 2nd Edn. , 2006, Cambridge Univ. Press
7. Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.
8. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
9. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
10. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
11. Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
12. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

SEMESTER-II

Semester	Course Structure For Semester II Common, Introductory, Major, Minor, Vocational & Internship Course						
	Code	**Paper**	**Credits**	**Theory**	**Internal Assessment**	**Practical**	**Total**
II	2Y4CC-4	Language and Communication Skills (Hindi)	6	75	25	--	100
	2Y4CC-5	Mathematical and Computational Thinking Analysis	2	50	25	25	100
	2Y4CC-6	Global Citizenship Education & Education for Sustainable Development	2	50	25	25	100
	2Y4PHYIRC-2	Introductory Regular Course-2 **Introductory Physics**	3	50	25	25	100
	2Y4IVS-2B	Introductory Vocational Studies-2 **Computer Basics And Multimedia**	3	50	25	25	100
	2Y4PHYMJ-2	Major paper-2 (Disciplinary/Interdisciplinary Major) **Electromagnetism**	6	50	25	25	100

SEMESTER II
COMMON COURSE –CC 4:

Language and Communication Skills (Hindi) 2Y4CC-4

(Credits: 6) अंक: 100

हिंदी भाषा

इकाई-1 हिन्दीव्याकरण और रचना, संज्ञा, सर्वनाम, विशष्ठाण, क्रिया, अव्यय, कारक, वचन, सठिय, उपसर्ग, प्रत्ययासमास, लिगनिर्णय शब्द लोग शब्द, अनेक शब्दों के लिए एक शब्द, शब्द-शुद्धि, वाक्य शुद्धि, मुहावरे ओर लोकोकिया, पल्लवन एवं संक्ष पण।

इकाई-2 निबंध, कला तथा समसामयिक एवं राष्ट्रीय विषय पर लेखन

इकाई-3 संप्रेषण (संचार)- संप्रेषण की अवधारण और महत्व, संप्रष्ठाण के लिए आवश्यक शर्त संप्रेषण के प्रकार, संप्रेषण की तकनीक, वाचनकला, समाचारवाचन, साक्षात्कारकला, रचनात्मक लेखनका लक्ष्य, रचनात्मक लघु का आधार, भारत की भाव औंर विचारो की प्रस्तुति, वाक कला की उपयोहगता।

अनुशंसितपुस्तकें:-

- र्ृहतव्याकरणभास्कर डाे 0 र्चनद र्कुमार
- र्ह तहनबर्धे् भास्कर डाे0 र्चनदर् कु मार
- आधुहनकहहन्दीव्याकरणऔररचना डाे 0 र्ासुद र्नन्दनप्रसाद
- रचनामानस प्रो0 राम श्वरनाथहतर्ारी
- व्यर्हाररकहहन्दी डाे 0 जंग बहादुरपाण्ड य
- रचनात्मक खन डाे 0 रमश्े गौतम
- राजहंसहहन्दीहनबंध प्रो0 आर0 एन0 गौड़
- सफ हहन्दीहनबंध रत्न श्वर
- हनबंध सहचर डाे 0 क्ष्मणप्रसाद
- उपकारमहु र्र और क हियाँ पार् 0 राज श्वरप्रसादचतर्वु दी
- कहाहनयोंकहार्ताे की प्रतापअनम
- सम्प्र षणपरकहहन्दीभाषाहशक्षण डाे 0 र्ैश्नारंग
- शै हर्ज्ञान डाे 0 सुर शकुमार
- शै हर्ज्ञानप्रहतमानऔरहर्श्ल षण डाे0 पाडं य शहशभष्े ण „शीताशें्‟
- शै हर्ज्ञानकाइहतहास डाे0 पाडं य शहशभष्े ण „शीताशंे्‟

SEMESTER II

COMMON COURSE –CC 5:

Mathematical and computational Thinking and Analysis (1Y4CC6)

(Credits: 2) Total Marks: 100

Course Learning Outcomes: This course will enable the students to:

a) Understand the notions of logic and Mathematical Induction.
b) Basic concepts of sets.
c) Analytic approach toward the solution of algebraic equations.
d) Connections of roots and coefficients.
e) Understand basic concept of Probability and statistics
f) Understand and analyze the coordinate systems.

UNIT-1: Logic: statement, truth table, quantifiers, connectives and tautology, Mathematical induction.

UNIT-2: Sets and Number System: operations on sets, Elementary Properties, Decimal system, binary decimal, octal system, hexadecimal system, arithmetic, conversion from binary to decimal and decimal to binary.

UNIT-3: Theory of Equation: Relation between roots and coefficients, Transformation of equation, Symmetric functions of roots, Solutions of cubic and biquadratic equations.

UNIT-4: Statistics and Probability: Data collection and presentation using bar chart, column chart, line chart, pie chart, scatter chart, surface chart. Calculation of frequency. Measure of central tendency, Mean, Median and Mode, Definition of Probability, Elementary properties, addition theorem, multiplication theorem, independent events.

UNIT-5: Geometry: Cartesian, spherical polar and Spherical cylindrical coordinate systems; their interrelationship.

Suggested reading:

1. An introduction to the theory of Numbers, 4th Ed., G. H. HARDY AND E. M. WRIGHT, 1975, Oxford University Press.
2. An Introduction to The Modern Theory of Equations, Florian Cajori, The Macmillan Company ' London: Macmhian & Co., Ltd., 1904.
3. N. K. Singh, A text book of Probability and Statistics, 1st Edition, Pragati Publication, Meerut.
4. Probability and Statistics (4th Edition) 4th Edition, Morris H. DeGroot (Author), Mark J. Schervish, Pearsion Education limited 2014.
5. N. K. Singh, Theory of Equations, 1st Edition, Pragati Publication, Meerut.
6. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis (3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.

SEMESTER II

COMMON COURSE –CC 6:

GLOBAL CITIZENSHIP EDUCATION (1Y4CC6)

(Credits: 2) Total Marks: 100

OBJECTIVE:

- To understand the concept and structure of global governance
- To empower learners to become aware of and understand global and sustainable development issues
- To become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies.
- Enabling students to embrace and practice constitutional, humanistic, ethical, and moral values in conducting one & life, including universal human values and citizenship values.
- To practice responsible global citizenship required for responding to contemporary global challenges

COURSE OUTCOMES:

- Enhance the capacity of the learners to acquire and demonstrate problem-solving skills involving the capacity to solve different kinds of problems in familiar and non familiar contexts and apply one's learning to real-life situations.
- Promote critical thinking involving capability to apply analytical thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well analyze and synthesize data related to global issues from a variety of sources and draw valid conclusions and support them with evidence and examples.
- Creativity characterized by the ability to create or think in different and diverse ways, deal with problems and situations that do not have simple solutions; view a problem or a situation from multiple perspectives; think 'out of the box' and generate solutions to complex problems in unfamiliar contexts.
- Communication Skills characterized by skills that enable a person to present complex information in a clear and concise manner to different groups/audiences; express thoughts and ideas effectively in writing and orally and communicate with 3 others using appropriate media, convey ideas, thoughts and arguments using language that is respectful and sensitive to gender and social groups.
- Coordinating/collaborating with others involving the ability to: work effectively and respectfully with diverse teams, facilitate cooperative or coordinated effort on the part of a group, act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

UNIT 1: Global Citizenship Education (GCE) and Education for Sustainable Development

1. Global Citizenship Education; its meaning, characteristics, scope and subject matter emergence and development.
2. Rights and responsibilities of Global citizenship
3. Benefits, Importance and theories of Global Citizenship
4. Global governance – concept and structure
5. Global Citizenship: (a) General idea, (b) Multi cultureless & diversity, (c) tolerance & ;(d) Acharya Vinoba's ideas of 'Jai Jagat.'

UNIT2: Global Poverty, Inequalities and social change

1. Concept of Global Poverty and its impact on World economy
2. Concept of social change, its types and theories.
3. Human Right Education: Special reference to Universal Declaration of Human Rights, 1943
4. Concept of Peace and Security: Special reference to United Nations Charter

UNIT 3: Sustainable Development – Global Issues and Sustainable Issues

1. Global environment Issue-Climate change mitigation and adaptation
2. Sustainable Development: Brief overview
3. Biodiversity loss, Global warming and carbon emission
4. Effect of Global Issue on Human Species
5. Environmental justice

UNIT 4: Citizenship Education & Culture, Globalization

1. Gender equality
2. Meaning of Globalization and its impact of world economy
3. Meaning of culture, crucial factors in the Globalization of culture

Suggested Readings:

1. Global Politics – Rupak Dattagupta
2. Understanding Global Politics – Chanchal Kumar
3. Global Citizenship Education for Young Children – Robin Elizabeth Hancock
4. A New-World Education: The Global Citizen – Roy Andersen
5. Global Citizenship Education, A Critical and International Perspectives Springer – Adeel Jalil, A.K. Kari, Kathrine Meleg
6. Citizenship in a Globalising World – Ashok Acharya
7. Redesign the World: A Global Call to Action – Sam Pitroda
8. Measuring the World – Daniel Kehlmann
9. Global Citizenship Education: Challenges and Successes – Eva Aboagye &amp S. Nomburo Dlamini
10. Global Citizenship Education - William Gaudelli

11. Multiculturalism: A very short Introduction – Ali Rattansi
12. Diversity and Inclusion Matters – Jason Thompson
13. Multiculturalism – C. W. Watson
14. Multiculturalism, Identity and Rights – Bruce Haddock and P

SEMESTER II
INTRODUCTORY REGULAR COURSE (IRC)
INTRODUCTORY PHYSICS (2Y4PHYIRC2)

(Credits: Theory-02 + Practical 01) **Total Marks: 100**

Course Learning Outcomes:

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

- Introduce Physics, Physics and Technology, Symmetry in nature and Conservation laws, Fundamental forces in nature.
- 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.
- Solve Laplace's and Poisson equation.
- Describe the magnetic field produced by magnetic dipoles and electric currents.
- Will be able to demonstrate his/her understanding of Interference, Diffraction and Polarization of light.
- Explain and differentiate the Zeroth, First, Second and third law of thermodynamics.
- Explain the dual nature of matter and radiation, Uncertainty Principle.
- Describe the basic understanding of radioactivity, mean life, half-life and nuclear fission and fusion.
- Demonstrate basic understanding of Analog and Digital Electronics.
- Understand the concepts of Special theory of Relativity

Skills to be learned:

- This course will develop a liking for the subject and students may explore it as a pre-course towards selection of minor subject papers in the undergraduate program.
- Basic understanding of Physics as a subject of Natural Science.

Course Content:

Introduction: What is Physics? Scope of Physics, Physics and Technology, Fundamental forces in nature. Conserved quantities, Conservation laws and Symmetry. **(2 Lectures)**

Vector Calculus: Scalar and Vector fields. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). **(5 lectures)**

Mechanics: Review of Newton's Laws of Motion. Impulse. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum.

Moment of Inertia. Kinetic energy of rotation. Motion involving both translation and rotation. Elastic constants and interrelation between them. Twisting torque on a Cylinder or Wire. Surface tension, Surface energy, Ripples and Gravity waves. Temperature dependance of Surface Tension. Viscosity, Velocity profile: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube and the corrections. **(6 lectures)**

Electricity and Magnetism: Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Electrostatic Potential. Laplace's and Poisson Equations. Solution of Laplace's equation. Potential and Electric Field due to a dipole. Force and Torque on a dipole. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. Magnetic force between current elements and definition of Magnetic Field B, Magnetic Intensity, H and Magnetization Vector M. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) on point charge (2) on current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. **(7 lectures)**

Optics: Interference of light, Division of amplitude and wavefront. Young's double slit experiment. Diffraction of light, Fresnel and Fraunhoffer diffraction. Polarization of light. Description of Linear, Circular and Elliptical Polarization **(5 lectures)**

Thermal Physics: Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes. Work done during Isothermal and Adiabatic Processes. Reversible and Irreversible process with examples. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: KelvinPlanck and Clausius Statements. Concept of Entropy, Entropy Changes in Reversible and Irreversible processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics (Nearst's Heat Theorem). Unattainability of Absolute Zero. **(6 lectures)**

Elements of Modern Physics: Wave-particle duality, Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables) and some applications: Energytime uncertainty principle. Schrodinger equation; Position, Momentum and Energy operators; physical interpretation of a wave function, probabilities and normalization; Law of radioactive decay; Mean life and half-life; Elementary idea of fission and fusion. **(5 lectures)**

Basic Electronics: P and N type semiconductors. Energy Level Diagram. Barrier Formation in PN Junction Diode. Current Flow Mechanism in Forward and Reverse Biased Diode. Half-wave Rectifier. Centre-tapped Full-wave Rectifiers, Ripple Factor and Rectification Efficiency, Zener Diode and Voltage Regulation. n-p-n and p-n-p Transistors. DC Characteristics of transistor in CE

Configurations. Current gains α and β. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. Octal and Hexadecimal numbers. AND, OR and NOT Gates. De Morgan's Theorems. NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. Boolean Laws. Binary Addition. 1's and 2's complement. **(6 lectures)**

Special Theory of Relativity: Galilean transformation, Postulates of Special Theory of Relativity. Lorentz Transformations. Length contraction, Time-dilation, and relativistic variation of mass. **(3 lectures)**

Reference Books;

- Mathematical Physics, B. D. Gupta.
- Mathematical Physics, B. S. Rajput.
- Mathematical Physics, H. K. Dass.
- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- Undergraduate Mechanics, Arun Kumar, J. P. Agarwal and Nutan Lata, Pragati Prakashan
- Concepts of Electromagnetic Theory, K. Mamta, Raj Kumar Singh and J. N. Prasad, 1/e, 2021, Wiley/I. K. International Publishing House, New Delhi
- Waves and Acoustics, P. K. Chakraborty and Satyabrata Chowdhury.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, P. K. Chakraborty, New Age International Pvt. Ltd.
- Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
- Digital Electronics, Floyd.
- Digital Computer Electronics, Malvino
- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India
- A First Course in Electronics, Khan and Dey, PHI, 2006
- Basic Electronics, Arun Kumar, Bharati Bhawan, 2007
- Digital Systems and Applications, Nutan Lata, Pragati Prakashan, 1/e, 2019 21. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

PHYSICS PRACTICAL

INTRODUCTORY PHYSICS (2Y4PHYIRC2P)

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. Zener diode V-I characteristics.
3. Zener diode as a Voltage regulator.
4. Verification of De Morgan's theorem.

5. To study the interference of light using optical fiber.

Reference Books;

1. B.Sc. Practical Physics – C. L. Arora – S. Chand & Co.
2. Viva-voce in Physics – R.C. Gupta, Pragathi Prakashan, Meerut.
3. Laboratory manual for Physics Course by B.P. Khandelwal.
4. Practical Physics by M. Arul Thakpathi by Comptex Publishers.

SEMESTER – 2
COMPUTER BASICS AND MULTIMEDIA – IVS-2
Course Code: 2Y4IVSCM-2B

(Credits: Theory-01 + Practical 02)

Total Marks: 100 (Theory: 15 Lectures)

Course Content:

UNIT- I Multi Media Fundamentals
Multimedia, Multimedia Objects, Multimedia in business and work, Multimedia Hardware, Memory & Storage devices, Communication devices.

UNIT- II Multimedia Tools
Presentation tools, object generation which includes video sound; image capturing, Authoring tools, card and page-based authoring tools.

UNIT- III Sound/Audio-I
Perception of sound, hearing sensitivity, frequency range, sound- wave length, the speed of sound. measuring the sound, musical sounds, noise signal, dynamic range, pitch, harmonics- equalization- reverberation time, Sound isolation and room acoustics- treatments- studio layout –room dimensions.

UNIT- IV Sound/Audio-II
The Basic set-up of recording system; The production chain and responsibilities. Microphones types -phantom power, noise, choosing the right mike; Mixing console; Input devices; Output devices; Audio Publishing.

COMPUTER BASICS AND MULTIMEDIA PRACTICAL – IRC-3

Course Code: 2Y4IVSCM-1B-LAB

PRACTICALS: **60 Lectures**

1. Photoshop-Use different tools
2. Page maker -Use different tools
3. Corel Draw – Use different tools
4. Flash – Use different tools

SEMESTER II

MAJOR COURSE- MJ 2:

ELECTROMAGNETISM (2Y4PHYMJ2)

(Credits: Theory-04, Practicals-02) **Theory: 60 Lectures**

Course Outcomes:

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

- 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.
- Describe the magnetic field produced by magnetic dipoles and electric currents.
- Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
- Understand the dielectric properties, magnetic properties of materials and the phenomena 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 such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments.

Skills to be learned:

1. This course will help in understanding basic concepts of electricity and magnetism and their applications.
2. Basic course in electrostatics will equips the student with required prerequisites to understand electrodynamics phenomena.
3. Comprehend the role of Maxwell's equation in unifying electricity and magnetism.
4. Derive expression for
    (i) Energy density
    (ii) Momentum density
    (iii)Angular momentum density of the electromagnetic field

5. Learn the implications of Gauge invariance in EM theory in solving the wave equations and develop the skills to actually solve the wave equation in various media like
    (i) Vacuum
    (ii) Dielectric medium
    (iii)Conducting medium
6. Derive and understand associated with the properties, EM wave passing through the interface between two media like
    (i) Reflection
    (ii) Refraction
    (iii)Transmission

Electric Field and Electric Potential

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor.

(6 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. **(5 Lectures)**

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field B. BiotSavart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

(10 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.

(4 Lectures)

Electrical Circuits: AC 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.

(5 Lectures)

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR. **(3 Lectures)**

Maxwell Equations: Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Vector and Poynting Theorem. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. **(10 Lectures)**

EM Wave Propagation in Unbounded Media: Plane 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. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth. **(8 Lectures)**

EM Wave in Bounded Media: Boundary conditions at a plane interface between two 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. Reflection & Transmission coefficients. Total internal reflection,

(9 Lectures)

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, P. K. Chakraborty, New Age International Pvt. Ltd.
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. Concepts of Electromagnetic Theory, K. Mamta, Raj Kumar Singh and J. N. Prasad, 1st Edn a. 2021, Wiley/I. K. International Publishing House, New Delhi
7. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
8. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
9. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
10. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
11. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
12. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
13. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
14. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
15. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

PHYSICS PRACTICAL- MJ 2 LAB:
ELECTROMAGNETISM (2Y4PHYMJ2P)

PRACTICALS: **60 Lectures**

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4.
5. To determine an unknown Low Resistance using Carey Foster's Bridge.
6. To compare capacitances using De' Sauty's bridge.
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self- inductance of a coil by Anderson's bridge.
10. 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.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. To verify the law of Malus for plane polarized light.
14. To determine the specific rotation of sugar solution using Polarimeter.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, 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. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
7. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
8. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
9. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

SEMESTER III

Semester	Course Structure For Semester III Common, Introductory, Major, Minor, Vocational & Internship Course						
	Code	**Paper**	**Credits**	**Theory**	**Internal Assessment**	**Practical**	**Total**
III	2Y4EVSCC-7	Environmental Studies/EVS	3	50	25	25	100
	2Y4CC-8	Digital Education (Elementary Computer Applications)	3	50	25	25	100
	2Y4CC-9	Community Engagement & Service (NSS/NCC/Adult education)	3	50	25	25	100
	3Y4PHYIRC-3	Introductory Regular Course-3 **Introductory Physics**	3	50	25	25	100
	3Y4IAP	Internship/Apprenticeship/Project	4	50	25	25	100
	3Y4PHYMJ-3	Major paper-3 (Disciplinary/Interdisciplinary Major) **Waves and Optics**	6	50	25	25	100

SEMESTER III

Environmental Studies (Course Code: 3Y4CC7)

(Credits: Theory-2 credit + Field Work-1 credit = 3credits)

Course Objectives:

The course will seek to achieve the following objectives:

1. Generating the awareness about environmental problems among people and society.
2. To clarify modern environmental concept like how to conserve biodiversity.
3. Inculcating basic knowledge about the environment and its allied problems.
4. Developing an attitude of concern for the environment.
5. Motivating public to participate in environment protection and environment improvement.
6. Acquiring skills to help the concerned individuals in identifying and solving environmental problems.
7. Striving to attain harmony with Nature.

Course Learning Outcomes:

At the end of the course students will be able to:

1. Know the more sustainable way of living.
2. Use natural resources more efficiently.
3. Know the behaviour of organism under natural conditions.
4. Know the interrelationship between organisms in populations and communities.
5. Aware and educate people regarding environmental issues and problems at local, national and international levels.

Unit 1: Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

(2 lectures)

Unit 2: Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) **(8 lectures)**

Unit 3: Natural Resources: Renewable and Non-renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over-exploitation of surface and ground water, floods, droughts conflicts over water (international & inter-state).
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(10 lectures)

Unit 4: Biodiversity and Conservation

- Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(10 lectures)

Unit 5: Environmental Pollution

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

(9 lectures)

Unit 6: Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(10 lectures)

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.

- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g. CNG vehicles in Delhi).

(6 lectures)

Environment Studies Field Work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted Site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river, spring, etc.

(Equal to 10 lectures)

References:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California
3. Press.
4. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
5. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
6. Room, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology.
7. Sunderland: Sinauer Associates, 2006.
8. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-
9. 37.
10. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
11. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
12. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
13. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
14.]Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
15. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
16. Rosencranz, A., Divan, S., & Noble, M.L. 2001. Environmental law and policy in India. Tripathi 1992.
17. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.

18. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
19. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
20. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
21. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
22. Wilson, E. O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
23. World Commission on Environment and Development. 1987. Our Common Future. Oxford University

SEMESTER III

Digital Education (Elementary Computer Application)

Course code: 3Y4DECC8

Credits: 03

Course Objectives:

This course is specially designed for better understanding of digital education in India. The course has been designed to introduce key concepts in digital education to the students to sharpen their understanding of importance and significance of digital education in India. The students need to develop a critical thinking about the development of India in the background of expanding digital networks and our constant dependence on them in our day-to-day life.

Learning Outcome:

- Students will understand the meaning of digital education and its importance.
- They will be able to focus on different digital platform, its utility and its applications.
- The students will be exposed to different tools of digital education available in India.
- They will understand the importance of E-Learning in the changing context of Digital India.
- They will come to know about their responsibility as citizen in digital growth in India.

UNIT I: Introduction to Digital Education 5 Classes

Meaning & Evolution of Digital Systems. Role & Significance of Digital Technology, digital education vs traditional education, advantages and disadvantages of digital education.

UNIT II: Digital Education Tools (10 Classes+ 5 Hands on Sessions)

Information & Communication Technology & Tools Interactive tools- Microsoft Teams, Google Classroom, Linkedin Creative Tools - Google Slides, Google Spreadsheets, Google form, Youtube)

UNIT III: Digital Education in India (10 Classes + 5 Hands on Sessions)

Government initiatives for Digital education in India: SWAYAM, E-Pathshala, National digital library of India (NDL India), DigiLocker. Advantages & challenges in digital education in India.

UNIT IV: E- Governance 10 Classes)

Introduction of E-Governance in India, Types of E-Governance-G2C (Government to Citizen), G2E (Government to Employee), G2B (Government to Business), G2G (Government to Government), E – Governance in Jharkhand.

Suggested Readings:

1. E-Governance in India: Initiatives and issues by R.P.Sinha
2. Information & Communication Technology (ICT) in Education by Dr. Vanaja M,Dr. S Rajasekar, Dr. S. Arulsamy.
3. Digital India: Understanding Information, Communication and Social Change by Pradip N.

References:

1. www.slideshare.net
2. www.lisportal.com/en/lis-blog

SEMESTER III

COMMUNITY ENGAGEMENT NCC/NSS

Course code (1Y4CC6)

Total Marks: 100

Course Objectives

Understand the community in which they work and their relation, Identify the needs and problems of the community and involve them in problem-solving, develop capacity to meet emergencies and natural disasters, Practice national integration and social harmony and, Utilize their knowledge in finding practical solutions to individual and community problems.

Course Outcomes

- To impart hands-on skills in preparation, In the end of the paper, a student should be able to: - Understand the importance of having community problems and their solutions. It might help in job opportunities in some government approved NGOs, and ministry of youth affairs and sports. The students can carry out basic information about the community, which in turn will be of great help in disaster management fields. Students can also go for social community courses, opening opportunities in different social activity related departments.

Unit-I: NSS:

- Introduction, Origin and growth of NSS, Objectives, Motto, Symbol, NSS, Import National Days, NSS Song, Environmental Awareness : Natural Resources – Conservation and Management, Water conservation and Rain water harvesting, Solid waste management, Pollution control: Water, Air, Noise and Soil; Energy conservation- Wildlife Conservation, Global warming.

Unit-II: Special Programme:

- Legal Awareness – Health awareness –Blood Donation Camp, First –Aid –Career Guidance – Leadership. Training cum –Cultural Programme –Globalization ant its Economic Social and Cultural Impacts. Planning and Preparation of special Camping Programme. Planning at institutions level – Guidelines for the success of camp- Importance of successful camping programme – Guiding principles – organization of camp – Administration of camp.

Unit-III: Social Awareness:

- Basics and Social Service, Weaker Section of our society and their needs – NGOs : Role and Contribution –Civic responsibility – causes and Prevention; role of y uth – Drug Abuse and Trafficking –awareness of IV / AIDS.. National Integration : Impo tance and Necessity – Freedom Struggle and Nationalistic movement in India – National interests, Objectives, Threats and Opportunities – Unity in Diversity – Contribution of Youth in Nation Building.

Unit-IV: First Aid:

- Artificial Respiration – Control of Bleeding – Fractures – Burns – Shock – Wounds – Eye Injures – Heat Stroke – Snake Bite – Dog Bites – Poisoning., Disaster Management : Characteristics and types of Disasters (Geological and Mountain Area Disaster , Wind and Water Related natural Disaster, Man-made Disaster) , Causes and effects, Assistance during Natural / Other Calamities Flood / Cyclone / Earth Quake / Accident etc..

Unit-V: N.S.S. Regular Activities

- NSS Programme Officer – NSS Volunteer – Community – Aims of NSS Programme /Activities – Classification of NSS Programme – Adoption of Villages – Contacting Villages / Area Leaders – Survey of the Villages / Area Identification of Problem(s) Completion of Projects – Evaluation of Project – Adoption of Slums – Survey of the Slum – Services in Slums - Coordination with Voluntary – Organizations.

REFERENCES:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. University of Mumbai National Service Scheme Manual 2009.
3. Avhan Chancellor & Brigade-NSS Wing, Training camp on Disaster Preparedness Guidelines, March 2012.
4. Rashtriya Seva YojanaSankalpana- Prof. Dr. SankayChakane, Dr. Pramod Pabrekar, Diamond Publication, Pune.
5. National Service Scheme Manual for NSS District Coordinators, National Service Scheme Cell, Dept. of Higher and Technical Education, Mantralaya,
6. Annual report of National Service Scheme (NSS) published by Dept. of Higher and Technical Education, Mantralaya,
7. NSS Cell, Dept. of Higher and Technical Education, Mantralaya, UTKARSHA- Socio and cultural guidelines.
8. Case material as a Training Aid for Field Workers, Gurmeet Hans.
9. Social service opportunities in hospita's, Kapil K. Krishnan, TISS
10. New Trends in NSS, Research papers published by University of Pune.
11. ANOOGUNJ Research Journal, published by NSS Unit C. K. Thakur college
12. Training Manual for Field Work published by RGNIYD, Shreeperumbudur
13. Prof. Ghatole R.N. Rural Social Science and Community Development.
14. PurushottamSheth, Dr. Shailaja Mane, National Service Scheme

Related Online Contents:

1. https://en.wikipedia.org/w/index.php?search=National-service-scheme &title=Special%3ASearch&fulltext=1&ns0=1
2. https://nss.gov.in
3. https://twitter.com/nssybnuranchi1
4. https://twitter.com/nssybnuranchi2
5. https://www.facebook.com/profile.php?id=100083943787477

SEMESTER III

INTRODUCTORY REGULAR COURSE (IRC)

INTRODUCTORY PHYSICS (2Y4PHYIRC2)

(Credits: Theory-02 + Practical 01) Total Marks: 100

Course Learning Outcomes:

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

- Introduce Physics, Physics and Technology, Symmetry in nature and Conservation laws, Fundamental forces in nature.
- 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.
- Solve Laplace's and Poisson equation.
- Describe the magnetic field produced by magnetic dipoles and electric currents.
- Will be able to demonstrate his/her understanding of Interference, Diffraction and Polarization of light.
- Explain and differentiate the Zeroth, First, Second and third law of thermodynamics.
- Explain the dual nature of matter and radiation, Uncertainty Principle.
- Describe the basic understanding of radioactivity, mean life, half-life and nuclear fission and fusion.
- Demonstrate basic understanding of Analog and Digital Electronics.
- Understand the concepts of Special theory of Relativity

Skills to be learned:

- This course will develop a liking for the subject and students may explore it as a pre-course towards selection of minor subject papers in the undergraduate program.
- Basic understanding of Physics as a subject of Natural Science.

Course Content:

Introduction: What is Physics? Scope of Physics, Physics and Technology, Fundamental forces in nature. Conserved quantities, Conservation laws and Symmetry.

(2 Lectures)

Vector Calculus: Scalar and Vector fields. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). **(5 lectures)**

Mechanics: Review of Newton's Laws of Motion. Impulse. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Angular momentum of a

particle and system of particles. Torque. Principle of conservation of angular momentum. Moment of Inertia. Kinetic energy of rotation. Motion involving both translation and rotation. Elastic constants and interrelation between them. Twisting torque on a Cylinder or Wire. Surface tension, Surface energy, Ripples and Gravity waves. Temperature dependance of Surface Tension. Viscosity, Velocity profile: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube and the corrections. **(6 lectures)**

Electricity and Magnetism: Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Electrostatic Potential. Laplace's and Poisson Equations. Solution of Laplace's equation. Potential and Electric Field due to a dipole. Force and Torque on a dipole. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. Magnetic force between current elements and definition of Magnetic Field B, Magnetic Intensity, H and Magnetization Vector M. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) on point charge (2) on current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. **(7 lectures)**

Optics: Interference of light, Division of amplitude and wavefront. Young's double slit experiment. Diffraction of light, Fresnel and Fraunhoffer diffraction. Polarization of light. Description of Linear, Circular and Elliptical Polarization

(5 lectures)

Thermal Physics: Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes. Work done during Isothermal and Adiabatic Processes. Reversible and Irreversible process with examples. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: KelvinPlanck and Clausius Statements. Concept of Entropy, Entropy Changes in Reversible and Irreversible processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics (Nearst's Heat Theorem). Unattainability of Absolute Zero. **(6 lectures)**

Elements of Modern Physics: Wave-particle duality, Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables) and some applications: Energytime uncertainty principle. Schrodinger equation; Position, Momentum and Energy operators; physical interpretation of a wave function, probabilities and normalization; Law of radioactive decay; Mean life and half-life; Elementary idea of fission and fusion. **(5 lectures)**

Basic Electronics: P and N type semiconductors. Energy Level Diagram. Barrier Formation in PN Junction Diode. Current Flow Mechanism in Forward and Reverse Biased Diode. Half-wave Rectifier. Centre-tapped Full-wave Rectifiers, Ripple Factor and Rectification Efficiency, Zener Diode and Voltage Regulation. n-p-n and p-n-p Transistors. DC

Characteristics of transistor in CE Configurations. Current gains α and β. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. Octal and Hexadecimal numbers. AND, OR and NOT Gates. De Morgan's Theorems. NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. Boolean Laws. Binary Addition. 1's and 2's complement.

(6 lectures)

Special Theory of Relativity: Galilean transformation, Postulates of Special Theory of Relativity. Lorentz Transformations. Length contraction, Time-dilation, and relativistic variation of mass. **(3 lectures)**

Reference Books;

- Mathematical Physics, B. D. Gupta.
- Mathematical Physics, B. S. Rajput.
- Mathematical Physics, H. K. Dass.
- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- Undergraduate Mechanics, Arun Kumar, J. P. Agarwal and Nutan Lata, Pragati Prakashan
- Concepts of Electromagnetic Theory, K. Mamta, Raj Kumar Singh and J. N. Prasad, 1/e, 2021, Wiley/I. K. International Publishing House, New Delhi
- Waves and Acoustics, P. K. Chakraborty and Satyabrata Chowdhury.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, P. K. Chakraborty, New Age International Pvt. Ltd.
- Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
- Digital Electronics, Floyd.
- Digital Computer Electronics, Malvino
- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India
- A First Course in Electronics, Khan and Dey, PHI, 2006
- Basic Electronics, Arun Kumar, Bharati Bhawan, 2007
- Digital Systems and Applications, Nutan Lata, Pragati Prakashan, 1/e, 2019 21. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

PHYSICS PRACTICAL

INTRODUCTORY PHYSICS (2Y4PHYIRC2P)

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. Zener diode V-I characteristics.
3. Zener diode as a Voltage regulator.
4. Verification of De Morgan's theorem.
5. To study the interference of light using optical fiber.

Reference Books;

1. B.Sc. Practical Physics – C. L. Arora – S. Chand & Co.
2. Viva-voce in Physics – R.C. Gupta, Pragathi Prakashan, Meerut.
3. Laboratory manual for Physics Course by B.P. Khandelwal.
4. Practical Physics by M. Arul Thakpathi by Comptex Publishers.

SEMESTER III

MAJOR COURSE- MJ3: WAVES AND OPTICS

COURSE CODE: (3Y4PHYMJ3)

(Credits: Theory-04, Practicals-02)

Course Outcomes:

This course will enable the student to

1. Recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems.
2. Apply basic knowledge of principles and theories about the behavior of light and the physical environment to conduct experiments.
3. Understand the principle of superposition of waves, so thus describe the formation of standing waves.
4. Explain several phenomena we can observe in everyday life that can be explained as wave phenomena.
5. Use the principles of wave motion and superposition to explain the Physics of polarisation, interference and diffraction.
6. Understand the working of selected optical instruments like biprism, interferometer, diffraction grating, and holograms.
7. In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt firsthand.
8. The motion of coupled oscillators, study of Lissajous figures and behaviour of transverse, longitudinal waves can be learnt in this laboratory course.

Skills to be learned:

1. He / she shall develop an understanding of various aspects of harmonic oscillations and waves specially.
    a. Superposition of collinear and perpendicular harmonic oscillations
    b. Various types of mechanical waves and their superposition.
2. This course in basics of optics will enable the student to understand various optical phenomena, principles, workings and applications optical instruments.

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. **(4 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)**

Superposition of Collinear and two perpendicular 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. Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.

(5 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.

(7 Lectures)

Interference: Temporal and Spatial Coherence. Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

(9 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.

(4 Lectures)

Fraunhofer diffraction: Single slit, Double slit. Multiple slits, Diffraction grating. Circular aperture. Resolving Power of telescope and grating.

(8 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. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

(7 Lectures)

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. 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 **(7 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. Laurent's half-shade polarimeter.

(3 Lectures)

Reference Books:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
4. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
5. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
6. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
7. Concepts of Electromagnetic Theory, K. Mamta, Raj Kumar Singh and J. N. Prasad, 1/e, 2021, Wiley/I. K. International Publishing House, New Delhi
8. Electromagnetic Theory, Chopra & Agarwal, Kedarnath Ramnath & Co.

PHYSICS PRACTICAL- MJ3 LAB:

PRACTICALS:

1. Familiarization with: Schuster`s focusing; determination of angle of prism.
2. To determine refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine wavelength of sodium light using Fresnel Biprism.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
7. To determine dispersive power and resolving power of a plane diffraction grating.
8. To verify the law of Malus for plane polarized light.
9. To determine the specific rotation of sugar solution using Polarimeter.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

SEMESTER IV

Semester	Course Structure For Semester IV Common, Introductory, Major, Minor, Vocational & Internship Course						
	Code	**Paper**	**Credits**	**Theory**	**Internal Assessment**	**Practical**	**Total**
IV	4Y4PHY MJ-4	Major paper-4 (Disciplinary/Interdisciplinary Major) **Mathematical Physics**	6	50	25	25	100
	4Y4PHY MJ-5	Major paper-5 (Disciplinary/Interdisciplinary Major) **Thermal and Statistical Physics**	6	50	25	25	100
	4Y4PHY MN-1	Minor paper-1 (Disciplinary/Interdisciplinary Minor) **Mechanics**	6	50	25	25	100
	4Y4VS-1	Vocational Studies-1 (Minor) **Introduction to Stock Market**	4	50	25	25	100

SEMESTER IV

MAJOR COURSE- MJ 4 MATHEMATICAL PHYSICS

COURSE CODE: 4Y4PHYMJ4

(Credits: Theory-04, Practicals-02)

Course Outcomes:

1. Learn the Fourier analysis of periodic functions and their applications in physical problems such as vibrating strings etc.
2. Learn about the special functions, such as the Hermite polynomial, the Legendre polynomial, the Laguerre polynomial and Bessel functions and their differential equations and their applications in various physical problems such as in quantum mechanics which they will learn in future courses in detail.
3. Learn the beta, gamma and the error functions and their applications in doing integrations.
4. Acquire knowledge of methods to solve partial differential equations with the examples of important partial differential equations in Physics.
5. Apply the Scilab software in curve fittings, in solving system of linear equations, generating and plotting special functions such as Legendre polynomial and Bessel functions, solving first and second order ordinary and partial differential equations.
6. Learn about the Fourier transform, the inverse Fourier transform, their properties and their applications in physical problems. They are also expected to learn the Laplace transform, the inverse Laplace transforms, their properties and their applications in solving physical problems.
7. In the laboratory course, the students should apply their C++/Scilab programming language to solve the following problems:
8. Solution first- and second- order ordinary differential equations with appropriate boundary conditions,
9. Evaluation of the Fourier coefficients of a given periodic function,
10. Plotting the Legendre polynomials and the Bessel functions of different orders and interpretations of the results, Least square fit of a given data to a graph

Skills to be learned:

1. Training in mathematical tools like calculus, integration, series solution approach, special function will prepare the student to solve ODE, PDE's which model physical phenomena.
2. He / she shall develop an understanding of how to model a given physical phenomenon such as pendulum motion, rocket motion, stretched string, etc., into set of ODE's, PDE's and solve them.
3. These skills will help in understanding the behavior of the modeled system/s.
4. Knowledge of various mathematical tools like complex analysis, integral transform will equip the student with reference to solve a given ODE, PDE.
5. These skills will help in understanding the behavior of the modeled system/s.

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of nonperiodic functions over an interval. Even and odd functions and their Fourier expansions and its applications.

(8 Lectures)

Frobenius Method and Special Functions: Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre 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 (Jo(x) and J1(x)) and Orthogonality.

(14 Lectures)

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral)

(2 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.

(4 Lectures)

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, de Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles, order of singularity. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals. **(14 Lectures)**

Integrals Transforms: Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations. **(9 Lectures)**

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

(9 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. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett
4. Computational Physics, D.Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.
5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rdEdn., Cambridge University Press
6. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
7. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
8. Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
9. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing
10. www.scilab.in/textbook_companion/generate_book/291
11. Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
12. Complex Variables, A. S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
13. Complex Variables, A.K. Kapoor, 2014, Cambridge Univ. Press
14. Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGrawHill
15. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett

PHYSICS PRACTICAL- MJ4 LAB:

PRACTICALS:

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of

	loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate spring Constant
Inverse of a matrix, Eigen vectors, Eigen values problems	System of algebraic equation
Generation of Special functions using User defined functions in Scilab	Generating and plotting Legendre Polynomials Generating and plotting Bessel function
Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation Fixed difference method Partial differential equations	First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Second order Differential Equation • Harmonic oscillator (no friction) • Damped Harmonic oscillator • Forced Harmonic oscillator • Transient and • Steady state solution

- Solve the differential equations: dy/dx = e^{-x} with y = 0 for x = 0

$$\frac{dy}{dx} + e^{-x}y = x^2$$

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = -y$$

$$\frac{d^2y}{dt^2} + e^{-t}\frac{dy}{dt} = -y$$

- Fourier series: Program to sum $\sum_{n=1}^{\infty} 0.2^{\ddot{n}}$ Evaluate the Fourier coefficients of a given periodic function (square wave)
- Frobenius method and Special functions:
- $\int_{-1}^{1} Pn(\mu)\, Pm(\mu) d\mu = \delta n, m$ Plot Pn(x), jv(x) Show recursion relation

- Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).
- Evaluation of trigonometric functions e.g. sin θ, Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration.
- Compute the nth roots of unity for n = 2, 3, and 4 Find the two square roots of −5+12j
- Solve Kirchoff's Current law for any node of an arbitrary circuit using Laplace's transform.
- Solve Kirchoff's Voltage law for any loop of an arbitrary circuit using Laplace's transform.
- Perform circuit analysis of a general LCR circuit using Laplace's transform.

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. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
4. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
5. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
6. Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
7. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing
8. https://web.stanford.edu/~boyd/ee102/laplace_ckts.pdf

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SEMESTER IV

MAJOR COURSE- MJ 5: THERMAL AND STATISTICAL PHYSICS

COURSE CODE: 4Y4PHYMJ5

(Credits: Theory-04, Practicals-02)

Course Outcomes:

1. Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.
2. Learn about Maxwell's thermodynamic relations.
3. Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equitation of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.
4. Learn about the real gas equations, Van der Waal equation of state, the Joule-Thompson effect.
5. Understand the concepts of microstate, macrostate, ensemble, phase space, thermodynamic probability and partition function.
6. Understand the combinatoric studies of particles with their distinguishably or indistinguishably nature and conditions which lead to the three different distribution laws e.g. Maxwell-Boltzmann distribution, Bose-Einstein distribution and Fermi-Dirac distribution laws of particles and their derivation.
7. Learn to apply the classical statistical mechanics to derive the law of equipartition of energy and specific heat.
8. Understand the Gibbs paradox, equipartition of energy and concept of negative temperature in two level systems.
9. Learn to derive classical radiation laws of black body radiation. Wiens law, Rayleigh Jeans law, ultraviolet catastrophe. Saha ionization formula.
10. Learn to calculate the macroscopic properties of degenerate photon gas using BE distribution law, understand Bose-Einstein condensation law and liquid Helium. Bose derivation of Plank's law
11. Understand the concept of Fermi energy and Fermi level, calculate the macroscopic properties of completely and strongly degenerate Fermi gas, electronic contribution to specific heat of metals.
12. Understand the application of F-D statistical distribution law to derive thermodynamic functions of a degenerate Fermi gas, electron gas in metals and their properties.
13. Calculate electron degeneracy pressure and ability to understand the Chandrasekhar mass limit, stability of white dwarfs against gravitational collapse.
14. Use Computer simulations to study:
    a) Planck's Black Body radiation Law and compare with the Wien's Law and Raleigh - Jean's Law in appropriate temperature region.
    b) Specific Heat of Solids by comparing, Dulong-Petit, Einstein's and Debye's Laws and study their temperature dependence

15. Compare the following distributions as a function of temperature for various energies and the parameters of the distribution functions:
    a) Maxwell-Boltzmann distribution
    b) Bose-Einstein distribution
    c) Fermi-Dirac distribution
16. Do 3-5 assignments given by the course instructor to apply the methods of Statistical mechanics to simple problems in Solid State Physics and Astrophysics
17. Do the regular weekly assignments of at least 2-3 problems given by the course instructor.

Skills to be learned:

1. Thermodynamically concepts, principles.
2. Learn the basic concepts and definition of physical quantities in classical statistics and classical distribution law.
3. Learn the application of classical statistics to theory of radiation.
4. Comprehend the failure of classical statistics and need for quantum statistics.
5. Learn the application of quantum statistics to derive and understand.
    a) Bose Einstein statistics and its applications to radiation.
    b) Fermi-Dirac statistic and its applications to quantum systems.

Introduction to Thermodynamics: Zeroth Law and First Law of thermodynamics and its differential form. Internal energy. Reversible and Irreversible process with examples. Inter conversion of Work and Heat. Carnot's Theorem. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. **(4 Lectures)**

Entropy: Concept of entropy, Clausius theorem, Clausius inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Entropy Changes in Reversible and Irreversible processes with examples. Principle of Increase of Entropy. Entropy of the Universe. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

(5 Lectures)

Thermodynamic Potentials: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples. **(5 Lectures)**

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases,

(5 Lectures)

Kinetic Theory of Gases

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

(3 Lectures)

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Critical Constants. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. P-V diagrams. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling. **(6 Lectures)**

STATISTICAL PHYSICS

Classical Statistics: Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. **(10 Lectures)**

Quantum Theory of Radiation: Spectral Distribution of Black Body Radiation. Inadequacy of classical radiation theory. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law. **(5 Lectures)**

Bose-Einstein Statistics: B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law. **(6 Lectures)**

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit. **(6 Lectures)**

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Heat and Thermodynamics, P. K. Chakraborty, New Age International Pvt.
3. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
4. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.

6. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa. 7. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.
8. Thermal Physics, B.K. Agrawal, Lok Bharti Publications.
9. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
10. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
11. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
12. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
13. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
14. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

PHYSICS PRACTICAL- MJ5 LAB:

PRACTICALS:

1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee's disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions. Use C/C++/Scilab/other numerical simulations for solving the problems based on Statistical Mechanics like
5. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and low temperature.
6. Plot Specific Heat of Solids
    a) Dulong-Petit law,
    b) Einstein distribution function,
    c) Debye distributions function for high temperature and low temperature and compare them for these two cases.
7. Plot the following functions with energy at different temperatures
    a) Maxwell-Boltzmann distribution
    b) Fermi-Dirac distribution
    c) Bose-Einstein distribution

Reference Books:

1. A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal,1985, Vani Pub.
2. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House

3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
5. Elementary Numerical Analysis, K.E.Atkinson, 3 r d E d n. 2 0 0 7, Wiley India Edition
6. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
7. Introduction to Modern Statistical Mechanics, D. Chandler, Oxford University Press, 1987
8. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
9. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
10. Statistical and Thermal Physics with computer applications, Harvey Gould and Jan Tobochnik, Princeton University Press, 2010.
11. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014Springer ISBN: 978- 3319067896Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
12. Scilab Image Processing: L.M.Surhone. 2010, Betascript Pub., ISBN: 978-6133459274

SEMESTER IV

MINOR ELECTIVE-1 MECHANICS

COURSE CODE: 4Y4PHYMN1

(Credits: Theory-04, Practicals-02)

Course Objectives:

This course is designed:

1. Chemical aspects of some common health hazards.
2. Physics of some common useful materials

Course Outcomes:

On successful completion of this course the student should be able to:

1. Understand laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance. He / she will learn the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.
2. Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.
3. Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.
4. Understand the phenomena of collisions and idea about center of mass and laboratory frames and their correlation.
5. Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity.
6. Understand simple principles of fluid flow and the equations governing
7. Fluid dynamics.
8. Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of Gravitation.
9. Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.
10. Describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting in a merry-ground experiences an outward pull.
11. Describe special relativistic effects and their effects on the mass and energy of a moving object.
12. appreciate the nuances of Special Theory of Relativity (STR)
13. In the laboratory course, the student shall perform experiments related to mechanics (compound pendulum), rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity) and fluid dynamics (verification of Stokes law, Searle method) etc.

Skills to be learned:

1. Understand the analogy between translational

2. Rotational dynamics and application of both motions simultaneously in analyzing rolling with slipping.

Course Content: Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

(4 Lectures)

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients. **(6 Lectures)**

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. **(8 Lectures)**

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. **(6 Lectures)**

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. **(5 Lectures)**

Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global positioning system (GPS). Weightlessness. Physiological effects on astronauts. **(8 Lectures)**

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

(6 Lectures)

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - 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-Determination of Rigidity modulus and moment of inertia - q, η and σ by Searles method.

(7 Lectures)

Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure -Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. 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-lubrication. **(4 Lectures)**

Speed Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

(6 Lectures)

Note: Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate.

Reference Books:

1. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. A textbook of General Physics, Edser
6. Undergraduate Mechanics, Arun Kumar, J. P. Agarwal and Nutan Lata, Pragati Prakashan
7. Oscillations and waves, Satya Prakash.
8. A textbook of oscillation, waves and Acoustics, M. Ghosh and D. Bhattacharya

PHYSICS PRACTICAL- MN1 LAB:

PRACTICALS:

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Young's Modulus of a bar by method of bending.
3. To determine the Elastic Constants of a Wire by Searle's method.
4. To determine g by Bar Pendulum.
5. To determine g by Kater's Pendulum.
6. To study the Motion of a Spring and calculate (a) Spring Constant, (b) g.
7. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
8. To determine the modulus of rigidity of the material of given wire by dynamical method.
9. To determine the coefficient of viscosity of water by capillary tube method.
10. To determine the surface tension of water by rise in capillary tube.

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, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

SEMESTER IV

INTRODUCTION TO STOCK MARKET – VS-1

Subject Code: 4Y4VS-1

(Credits: Theory-01 + Practical 02)

Course Content:

Unit I: Financial System And Services:

Nature and role of financial structure - Financial system and financial markets - Financial system and economic development -Indian financial system: an overview; Investment alternatives and evaluation; Reforms in financial system, Investment banking; Credit Rating; factoring and Forfaiting; Housing Finance; Leasing and hire purchase; Financial inclusion and Microfinance

Unit II: Financial Markets:

Money market- meaning, constituents & function; Money market instruments – call money, treasury bills, and certificate of deposits, Commercial bills, and trade bills, Acceptance Houses, Discount Houses; Capital markets – primary and secondary market; Government securities markets; Role of SEBI - an overview and recent developments. Role of RBI, SEBI. DFHI, SHCI in Financial Markets.

Unit III: Financial Institutions:

Reserve bank of India – organization, management, and function; Commercial banks - meaning, functions and investment policies; Development banks – concept, objectives, and function; Insurance companies – objectives, role, and investment practices, -IRDS; Unit Trust of India – objective, function, and schemes; role and functions of nonbanking financial institutions; Merchant banking-functions and role.

Unit IV: Financial Instruments

Sources of finance – Financial Instruments – Types, Features and advantages – Equity and special types of equity, ADRs & GDRs; Preferred stock - Equity derivatives – Credit derivatives-Asset –backed securities - Convertibles and warrants - Types of Bonds and debentures- Non- Marketable Financial Assets - Options instruments – securitization.

Unit V: Mutual Funds:

Concept and performance of Mutual funds; Regulation of Mutual funds (with special reference to SEBI guidelines); Designing and marketing of mutual fund schemes; Latest mutual funds schemes in India – an overview; Mutual Fund Evaluation and Tax aspects of Mutual Fund Investments.

Unit VI: Capital Markets in India

An overview of Indian Securities Market, Meaning, Functions, Intermediaries, Role of Primary Market – Methods of floatation of capital – Problems of New Issues Market – IPO's- Investor protection in primary market – Recent trends in primary market – SEBI measuresfor primary market.

Unit VII: Stock exchanges and its Functions:
Meaning, Nature, Functions of Secondary Market – Organization and Regulatory framework for stock exchanges in India – SEBI: functions and measures for secondary market – Overview of major stock exchanges in India - Listing of Securities: Meaning – Merits and Demerits – Listing requirements, procedure, fee – Listing of rights issue, bonus issue, further issue – Listing conditions of BSE and NSE – Delisting

Unit VIII: Trading, settlement and Surveillance
System in Stock Exchanges: Different trading systems – BSE - BOLT System – Different types of settlements - Pay-in and Pay-out – Bad Delivery – Short delivery – Auction – NSE – NEAT system options – Market types, Order types and books – De-mat settlement – Physical settlement – Institutional segment – Funds settlement – Valuation debit – Valuation price – Bad and short delivery Risk management system in BSE & NSE – Margins – Exposure limits – Surveillance system in BSE & NSE – Circuit breakers

Unit IX: Stock Market Indices:
Meaning, Purpose, and Construction in developing index – Methods (Weighted Aggregate Value method, Weighted Average of Price Relatives method, Free-Float method) – Stock market indices in India – BSE Sensex - Scrip selection criteria – Other BSE indices (briefly) – NSE indices – S&P CNX Nifty – Scrip selection criteria – Construction – Stock market indices in foreign countries (Overview).

Unit X: Commodity and Currency Markets:
Commodity exchanges: evolution and history- role in globalizing economy – governing regulations – price –risk management – commodity exposure – hedge accounting – currency futures – managing exchange rate – carbon markets – weather derivatives – ETFs – Purpose, Importance, types, construction

PRACTICALS: 60 Lectures

1. Visit to a local market to study various marketing functions performed by different agencies (market functionaries).
2. Identification of marketing channels for selected mutual fund.
3. Identification of marketing channels for selected Equity.
4. Identification of marketing channels for selected commodity.
5. Computation of marketable and marketed surplus of important commodities.
6. Construction of index numbers.
7. Collection of data regarding marketing cost and marketing margins of different commodities and presentation of report in the class.
8. Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning.
9. Application of principles of comparative advantage of international trade
10. Plotting and study of demand and supply curves and calculation of elasticity's.
11. Study of relationship between market arrivals and prices of some selected commodities.
12. Study of price behaviour over time for some selected commodities.