JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(Autonomous)
OOTY ROAD, MYSURU- 570 025

DEPARTMENT OF PHYSICS

Syllabus under
National Educational Policy

For B.Sc programmes

- ✓ **Physics, Chemistry**
- ✓ **Physics, Mathematics**
- ✓ **Physics, Computer Science**
- ✓ **Physics, Electronics**

Wef

2021-22

Scheme of Evaluation for DSC papers

Sem	Course No	Course Code	Combination	Title of the course	Course type	Credit pattern L:T:P	Total credit	Teaching/week	Evaluation pattern			
									C1	C2	C3	Total Marks
I	C1/C2	FSA41031	PC	Mechanics & Properties of Matter	DSC	4:0:0	4	4hrs/week	20	20	60	100
		FSA41032	PM									
		FSA41033	PE									
		FSA41035	PCs	Practical - I		0:0:2	2	4hrs/week	10	15	25	50
II	C1/C2	FSB41031	PC	Electricity and Magnetism	DSC	4:0:0	4	4hrs/week	20	20	60	100
		FSB41032	**PM**									
		FSB41033	PE									
		FSB41035	PCs	Practical - II		0:0:2	2	4hrs/week	10	15	25	50
III	C1/C2		PC	Wave motion and optics	DSC	4:0:0	4	4hrs/week	20	20	60	100
			PM									
			PE									
			PCs	Practical-III		0:0:2	2	4hrs/week	10	15	25	50
IV	C1/C2		PC	Thermal Physics & Electronics	DSC	4:0:0	4	4hrs/week	20	20	60	100
			PM									
			PE									
			PCs	Practical-IV		0:0:2	2	4hrs/week	10	15	25	50

Scheme of Evaluation for OE (Open Elective papers)
(Open elective paper will be given to students in first four semesters)

Sem	Course No	Course Code	Combinations	Title of the course	Course type	Credit pattern L:T:P	Total credit	Teaching/week	Evaluation pattern			
									C1	C2	C3	Total Marks
I	C1/C2	FSA800	KG, HP, EG	Energy Sources	OE	2:1:0	3	3hrs/week	20	20	60	100
II	C1/C2	FSA800	KG, HP, EG	Astronomy	OE	2:1:0	3	3hrs/week	20	20	60	100

Scheme of Evaluation for DSC papers

Course type	L:T:P	Total credits	Maximum Marks in the Examination/Assessment										Examination Duration	
			SEE		IA									
			Theory	Practical	Theory				Practical				Theory	Practical
DSC	4:0:2	4+2=6	60	25	40 (C1+C2)				25(C1+C2)				3h	3h
					C1		C2		C1	C2				
					IA	Assignment	IA	Seminar/ Assignment	IA	IA	Record			
					10	10	10	10	10	10	05			

Scheme of Evaluation for OE (Open Elective) papers

(Open elective paper will be given to students in first four semesters)

Course type	L:T:P	Total credits	Maximum Marks in the exam/Assessment						Exam Duration	
			SEE		IA					
			Theory	Practical	Theory			Practical	Theory	Practical
OE	3:0:0	3	60	-	40 (C1+C2)			-	3h	-
					C1		C2			
					IA	Assignment	IA	Seminar/ Assignment		
					10	10	10	10		

Scheme of Evaluation for DSC papers

Course type	L:T:P	Total credits	Maximum Marks in the Examination/Assessment										Examination Duration	
			SEE		IA									
			Theory	Practical	Theory				Practical				Theory	Practical
DSC	4:0:2	4+2=6	60	25	40 (C1+C2)				25(C1+C2)				3h	4h
					C1		C2		C1	C2				
					IA	Assignment/ Field work	IA	Seminar/ Assignment/ Activity	IA	IA	Record			
					10	10	10	10	10	10	05			

Scheme of Evaluation for OE (Open Elective) papers

(Open elective paper will be given to students in first four semesters)

<table>
<tr><th rowspan="4">Course type</th><th rowspan="4">L:T:P</th><th rowspan="4">Total credits</th><th colspan="8">Maximum Marks in the exam/Assessment</th><th colspan="2" rowspan="2">Exam Duration</th></tr>
<tr><th colspan="2">SEE</th><th colspan="5">IA</th></tr>
<tr><th>Theory</th><th>Practical</th><th colspan="4">Theory</th><th>Practical</th><th>Theory</th><th>Practical</th></tr>
<tr><td rowspan="3">OE</td><td rowspan="3">3:0:0</td><td rowspan="3">3</td><td rowspan="3">60</td><td rowspan="3">-</td><td colspan="4">40 (C1+C2)</td><td rowspan="3">-</td><td rowspan="3">3h</td><td rowspan="3">-</td></tr>
<tr><td colspan="2">C1</td><td colspan="2">C2</td></tr>
<tr><td>IA</td><td>Assignment /Field work</td><td>IA</td><td>Seminar/ Assignment/ Activity</td></tr>
<tr><td>10</td><td>10</td><td>10</td><td>10</td><td></td><td></td><td></td></tr>
</table>

Programme Educational Objectives:

1. Graduates will demonstrate competence in respective domain as they apply skills to conduct scientific research and contribute to quality education.
2. Graduates will be recognized as experts in educational and research institutes as well as industries in identifying and solving global challenges.
3. Graduates will become leading researchers and professors who create and disseminate new knowledge in scientific and allied fields.

Graduate Attributes and Programme Outcomes:

Exit with:	Credits Required
Certificate upon the Successful Completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	44 - 48

1. **Discipline Knowledge:** Knowledge of science and ability to apply to relevant areas.
2. **Problem solving:** Execute a solution process using first principles of science to solve problems related to respective discipline.
3. **Modern tool usage:** Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
4. **Ethics:** Apply the professional ethics and norms in respective discipline.
5. **Individual and teamwork:** Work effectively as an individual as a team member in a multidisciplinary team.
6. **Communication:** Communicate effectively with the stake holders, and give and receive clear instructions.

Exit with:	Credits Required
A **Diploma** upon the Successful Completion of the Second Year (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	88 - 96

1. **Discipline Knowledge:** Knowledge of science and ability to apply to relevant areas.
2. **Conduct investigations:** Conduct investigations of technical issues as per their level of understanding and knowledge.
3. **Problem solving:** Formulate and implement a solution process using first principles of science to solve problems related to respective discipline.
4. **Modern tool usage:** Apply a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
5. **Ethics:** Apply and commit to the professional ethics and norms in respective profession.
6. **Individual and teamwork:** Work effectively as an individual in a multidisciplinary team.
7. **Communication:** Communicate effectively with the stake holders, and give and receive clear instructions.

Exit with:	Credits Required
Basic Bachelor Degree at the Successful Completion of the Third Year (Six Semesters) of the multidisciplinary Four- year Undergraduate Programme/Five-year Integrated Master's Degree Programme	132 - 144

1. **Discipline Knowledge:** Knowledge of basics of science and ability to apply the understanding of fundamentals of major discipline in solving complex problems.
2. **Conduct investigations:** Conduct investigations of issues in their respective disciplines and arrive at valid conclusions.
3. **Problem solving:** Implement a solution process using first principles of science to solve problems related to respective discipline.
4. **Modern tool usage:** Select and use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
5. **Environment and Society:** Evaluate the impact of scientific solutions on society and environment and the need for sustainable solutions.
6. **Ethics:** Demonstrate professional ethics, responsibilities and norms in respective profession.
7. **Individual and teamwork:** Work effectively as an individual as a team member and as a leader in a multidisciplinary team.
8. **Communication:** Communicate effectively with the stake holders, write and comprehend project reports and documentation, deliver effective presentations, and give and receive clear instructions.
9. **Project Management and Finance:** Apply the knowledge of scientific and technological principles to one's own work to manage projects in multidisciplinary settings.
10. **Lifelong Learning:** Engage in lifelong learning in the context of changing trends in respective discipline.

Exit with:	Credits Required
Bachelor Degree with Honours in a Discipline at the Successful Completion of the Fourth Years (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	176 - 192

1. **Discipline Knowledge:** Knowledge of basics of science and research, and ability to apply the understanding of fundamentals of specialized discipline in solving complex scientific problems.
2. **Conduct investigations:** Conduct investigations of issues using research methods and research-based discipline knowledge including design of experiments, data collection, interpretation and analysis to arrive at valid conclusions.
3. **Problem analysis:** Identify, formulate and analyse complex scientific problems using first principles of respective discipline.
4. **Design and Development of solutions:** Design solutions for complex scientific problems and execute them by considering the environmental, societal and public safety aspects appropriately.

5. **Modern tool usage:** Identify, select and use a modern scientific, engineering and IT tool or technique for modelling, prediction, data analysis and solving problems in the areas of their discipline.
6. **Environment and Society:** Evaluate the impact of scientific solutions on society and environment and design sustainable solutions.
7. **Ethics:** Demonstrate professional ethics, responsibilities and norms in respective profession.
8. **Individual and teamwork:** Work effectively as an individual as a team member and as a leader in a multidisciplinary team.
9. **Communication:** Communicate effectively with the stakeholders with emphasis on communicating with scientific community, comprehend scientific reports, write research papers and projects proposals and reports, deliver effective presentations, and give and receive clear instructions.
10. **Project Management and Finance:** Apply the knowledge of scientific and technological principles to one's own work to manage projects in multidisciplinary settings.
11. **Lifelong Learning:** Identify knowledge gaps and engage in lifelong learning in the context of changing trends in respective discipline.

Options for Study

- The programmes are flexible enough to allow liberty to students in designing them according to their requirements. Students may choose a single Major, one Major with a Minor, and one Major with two Minors. Teacher Education or Vocational courses may be chosen in place of Minor/s. Below listed are the various options students may choose from.

- One Major subject/discipline, Two Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities.

- One Major and one Minor subject/discipline along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities

- Two Major subject/disciplines along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses, including Extracurricular Activities (subject to fulfilling the requirements as stated in 3.i and 3.ii)

- One Major subject/discipline and one Vocational course along with Languages, Generic Electives, Ability Enhancement and Skill Development and courses including Extracurricular Activities.

- One Major Discipline and One Education Discipline along with Languages, Generic Electives, Ability Enhancement and Skill Development Courses including Extracurricular Activities.

Proposed Curriculum Framework for Multidisciplinary Four- year Undergraduate Programme

Year	Objective	Nature of Courses	Outcome	No. of courses
1st year – (1st & 2nd Semesters)	Understanding and Exploration	1. Major Core Courses 2. Minor/Related Discipline 3. Languages, 4.Ability Enhancement Compulsory Courses 5. Skill Enhancement/ Development Courses	Understanding of Disciplines Language Competency Gaining perspective of context/Generic skills Basic skills sets to pursue any vocation	1+1 1+1 2+2 1+1 1+1
Exit option with Certification				
2nd Year - (3rd & 4th Semesters)	Focus and Immersion	1. Major Core Courses 2. Minor/ Related Discipline 3. Ability Enhancement 4. Skill based Vocational 5. Extra-Curricular Activities	Understanding of disciplines Gaining perspective of context Skill sets to pursue vocation Development of various Domains of mind &Personality	2+2 1+1 1+1 1+1 1+1
Exit Option with Diploma				
3rd Year - (5th & 6th Semesters)	Real time Learning	1. Major Discipline Core and Elective Courses 2. Minor Discipline/ Generic or Vocational Electives /Field based Learning/ Res. Project	In depth learning of major and minor disciplines, Skill sets for employability. Exposure to discipline beyond the chosen Subject Experiential learning/ Res.	2+2 1+1 1+1
Exit option with Bachelor Degree				
4th Year - (7th &8th Semesters)	Deeper Concentration	Major Discipline Core and Elective courses Research/Project Work with Dissertation	Deeper and Advanced Learning of Major Discipline Foundation to pursue Doctoral Studies & Developing Research competencies	4+4
Bachelor Degree with Honours				
5th Year - (9th & 10th Semesters)	Master of the subject	Major Discipline Core and Elective courses/Research/Project Work with Dissertation	Deeper and Advanced Learning of the Major Discipline towards gaining proficiency over the subject	4+4/6+6
Master's Degree				

MODEL FOUND APPROPRIATE AND ADOPTED

IIA. Model Program Structures for the Under-Graduate Programs

Bachelor of Science (Basic/ Hons.) in subjects with practical, with one major and one minor Sem.	Discipline Core (DSC) (Credits) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)	Skill Enhancement Courses (SEC)		Total Credits
Skill based (Credits) (L+T+P)			**Value based (Credits) (L+T+P)**			
I	Discipline A1(4+2) Discipline B1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs each)	SEC-1: Digital Fluency (2) (1+0+2)	Physical Education for fitness(1)(0+0+2)	Health & Wellness (1) (0+0+2)	25
II	Discipline A2(4+2) Discipline B2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs each)	Environmental Studies (2)	Physical Education - Yoga(1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
Exit option with Certificate (50 credits)							
III	Discipline A3(4+2) Discipline B3(4+2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs each)	SEC-2: Artificial Inte-lligence (2)(1+0+2)	Physical Education- Sports skills(1)(0+0+2)	NCC/NSS/R&R(S&G)/Cultural (1) (0+0+2)	25
IV	Discipline A4(4+2) Discipline B4(4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs each)	Constitution of India (2)	Physical Education -Games (1) (0+0+2)	NCC/NSS/R&R(S&G)/Cultural (1) (0+0+2)	25
Exit option with Diploma (100 credits) OR Choose any one of the core subjects as Major and the other as Minor							
V	Discipline A5(3+2) Discipline A6(3+2) Discipline B5(3+2)		Vocational-1 (3)	SEC-3: SEC such as Cyber Security (2) (1+0+2)			20
VI	Discipline A7(3+2) Discipline A8(3+2) Discipline B6(3+2)		Vocational-2 (3) Internship (2)	SEC-4: Professional Communication (2)			22
Exit option with Bachelor of Arts, B.A./ Bachelor of Science, B.Sc. Basic Degree (142 credits) or continue studies with the Major							
VII	Discipline A9(3+2) Discipline A10(3+2) Discipline A11(3)	Discipline A, E-1 (3) Discipline A, E-2 (3) Res.Methodology (3)					22
VIII	Discipline A12(3+2) Discipline A13(3) Discipline A14(3)	Discipline A, E-3(3) Research Project (6)*					20
Award of Bachelor of Arts Honours, B.A. (Hons.)/ Bachelor of Science Honours, B.Sc. (Hons) degree in a discipline (184 credits)							

Curriculum Structure-Physics

(Core and Electives)

Semesters- I to X

SEM	DSC	Core Papers
Sem-1 :	A1	Mechanics & Properties of Matter
Sem -2 :	A2	Electricity and Magnetism
Sem-3 :	A3	Wave motion and optics
Sem-4:	A4	Thermal Physics & Electronics
Sem-5 :	A5 A6	1. Classical Mechanics and Quantum Mechanics- I 2. Elements of Atomic, Molecular Physics
Sem -6 :	A7 A8	1. Elements of Nuclear Physics and Nuclear Instruments 2. Elements of Condensed Matter Physics
Sem-7	A9 A10 A11	1. Mathematical Methods of Physics – I 2. Classical Electrodynamics. 3. Experimental methods of Physics 4. Research Methodology (Select Two DSE subjects from the Pool B-I shown below)
Sem-8	A12 A13 A14	1. Classical Mechanics and Quantum Mechanics-II 2. Statistical Mechanics 3. Astrophysics & Astronomy 4. Research Project* (Select Two DSE subjects from the Pool B-II shown below) *In lieu of the research Project, two additional elective papers/ Internship may be offered.
Sem-9	A15	1. Mathematical Methods of Physics – II (Select One DSE subjects from the Pool B-III shown below) 2. Research Project
Sem-10	A17	1. Quantum Mechanics – III (Select One DSE subjects from the Pool B-IV shown below) 2. Research Project

** The Topics of 5th Sem and above need to be revisited*

Open Electives for 1st to 4th Semesters

Sl.No.	1 to 4 Semester
1.	Energy Sources
2.	Climate Science
3.	Astronomy
4.	Medical Physics
5.	Optical Instruments
6.	Sports Science
7.	Nanotechnology
8.	Electrical Instruments
9.	Electronic Instruments
10.	Physics for all
11.	Space Missions

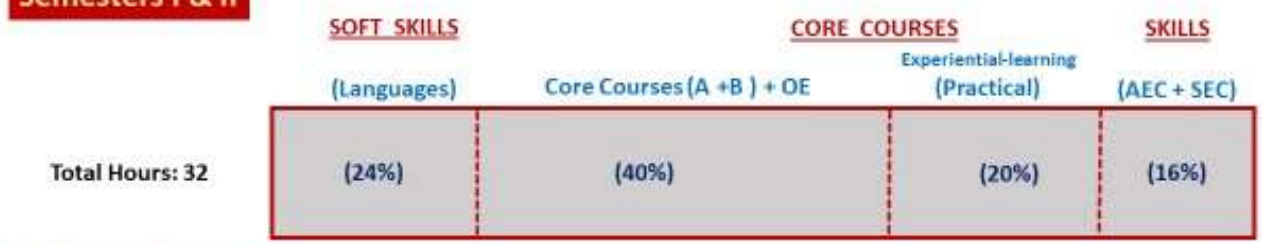
Discipline Specific Electives for 7th to 10th Semesters

	7th Sem Electives Pool B-I (Select any two)		8th Sem Electives Pool B-II (Select any two)
A.	Condensed Matter Physics-1	A.	Atomic & Molecular Physics-1
B.	Nuclear and Particle Physics	B.	Materials Physics & Nano materials
C.	Theoretical and Computational Physics-I	C.	Lasers and non-linear optics
D.	Biophysics	D.	Plasma Physics
E.	Astronomy and Astrophysics	E.	Physics of Semiconductor devices

	9th Sem Electives (Specialization papers) Pool B-III		10th Sem Electives (Specialization papers) Pool B-IV
A.	Condensed Matter Physics-2	A.	Condensed Matter Physics-3
B.	Nuclear and Particle Physics-2	B.	Nuclear and Particle Physics-3
C.	Atomic & Molecular spectroscopy-1	C.	Atomic & Molecular spectroscopy-2
D.	Materials Physics & Nanophysics –1	D.	Materials Physics & Nanophysics -2
E.	Theoretical and Computational Physics-I	E.	Theoretical and Computational Physics-2
F.	Astronomy and Astrophysics-1	F.	Astronomy and Astrophysics-2

Detailed Syllabus for Semesters I & II
B.Sc., Physics
Detailed Syllabus for Semesters I & II

Semesters I & II



Exit with Certificate:

POSSIBLE JOBS after EXIT:

1. Lab Technicians
2. Data Entry Operators
3. Mechanical Repair and Maintenance
4. Electrical Repair and Maintenance
5. Electronics Repair and Maintenance

Technical Skills (Options):

1. ICT
2. Equations and Graphs
3. Chemical Handling
4. Materials testing
5. Electrical Maintenance
6. Basic- Data Mgmt.
7. Electronic Maintenance
8. Laboratory practices and safety

Observations:

1. Focus on two Languages, (Kannada Compulsory)
2. Core learning theory component of 40%
3. Core Experiential Learning (Practical & Field Work) of 20%
4. Formative Assessment 30% including Activity based Pedagogy (20%)
5. Summative Assessment 70%
6. Compulsory Courses include Digital Fluency, Health & Wellness, Yoga, NCC/NSS/Cultural, etc.

I Semester
Detailed Syllabus of I Semester Physics

Mechanics and Properties of Matter

Course Title: Mechanics and Properties of Matter	Course Credits:4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors: Physics Expert Committee	

Programme Outcomes (POs)

PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO-3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO-4: Ethics: Apply the professional ethics and norms in respective discipline.

PO-5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO-6: Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs) *(UGC guidelines)*	1	2	3	4	5	6
CO-1: Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)	**x**	**x**				x
CO-2: Will learn about accuracy of measurement and sources of errors, importance of significant figures.	**x**	**x**				
CO-3: Will know how g can be determined experimentally and derive satisfaction.	**x**					
CO-4: Will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters.	**x**			**x**	**x**	**x**
CO-5: Will come to know how various elastic moduli can be determined.	**x**				x	**x**

CO-6: Will measure surface tension and viscosity and appreciate the methods adopted.	**x**	**x**				
CO-7: Will get hands on experience of different equipment.	**x**	**x**	**x**		**x**	**x**

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course are Marked 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Mechanics & Properties of Matter		Hrs
Credit : 4+2	**Unit – 1** **Theory : 4 hours /Week**	
Chapter No. 1	**Topics** to be covered/taught/learnt: **Units and measurements:** System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae. Minimum deviation, errors.	(13)
Chapter No. 2	**Momentum and Energy**: Work and energy, Conservation of momentum (linear). Conservation of energy with examples. Motion of rockets.	
Chapter No. 3	**Special Theory of Relativity:** Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	
Topics for self study(If any)	**Self Study** Chapter.4 Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass. Ref: 1-4,9,10	
	Suggested Activities	
Activity No. 1	1. i). Students can measure diameters of small balls of different size and estimate their volumes. 2. ii). Students can measure lengths of nails of different size. iii). Students can measure volume of a liquid iv). Students can measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Ask them to mention the precession of the measurement. v). students can estimate standard deviations wherever possible.	
Activity No. 2	Students can try and understand conservation of energy in every day examples. For example: i) What happens in solar conservation panels ii) Pushing an object on the table it moves iii) Moving car hits a parked car causes parked car to move. In these cases, energy is conserved. How? Understand and verify if possible.	
Unit – 2		
Chapter No. 4.	**Laws of Motion:** Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass.	(13)
Chapter No. 5.	**Dynamics of Rigid bodies**: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. moment of inertia: M I of a rectangular Lamina and solid cylinders. Flywheel, Theory of compound pendulum and determination of g.	
Chapter No. 6.	**Gravitation:** 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 (statements). Satellite in a circular orbit.	

Topics for self study(If any)	**Chapter 7**: Geosynchronous orbits. Basic idea of global positioning system (GPS). Ref: 1-4,9,10	
	Suggested Activities	
Activity No. 3	Activity: Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m. Students by referring to websites, can construct and perform simple experiments to verify that MI α mr^2. Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn	
Activity No. 4	Activity: Prepare suitable charts and give seminar talks in the class.	

Unit - 3		
Chapter No. 8	**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. Torsional pendulum-Determination of rigidity modulus and moment of inertia - q, η and σ by Searle's method	(13)
	Suggested Activities	
Activity No. 5	**Activity:** Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material.	
Activity No.6	**Activity:** Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	

Unit - 4		
Chapter No. 9	**Surface tension:** Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact.	(13)
Chapter No. 11	**Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method. Problems.	
Topics for self study(If any)	Capillarity determination of surface tension by drop weight method. Ref: 6,7,9,10	
	Suggested Activities	
Activity No.7	1. Measure surface tension of water and other common liquids and compare and learn i) Why water has high ST? think of reasons. ii) Check whether ST is a function of temperature? You can do it by heating the water to different temperatures and measure ST. iii) Plot ST versus T and learn how it behaves. Mix some quantity of kerosene or any oil to water and measure ST. Check whether ST for the mixture is more or less than pure water. List the reasons.	
Activity No. 8	Activity: 2. Collect a set of different liquids and measure their viscosity. i) Find out whether sticky or non-sticky liquids are most viscous. List the reasons. ii) Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non-sticky liquid concentration. iii) Do the above experiment by mixing sticky liquid to the non sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid. List the applications where concept of Viscosity plays a dominant role	

Text Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Mechanics by, New Eition	D. S. Mathur	S.Chand & Co.	2000
2	Mechancis and Relativity by 3rd Edition,	Vidwan Singh Soni,	PHI Learning Pvt. Ltd.	
3	Mechanics Berkeley Physics Course, Vol.1:	Charles Kittel, *et.al*.	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal & Subramanyam.		

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics. 9th Edn,	Resnick, Halliday & Walter,	Wiley	2010
2	Physics Vol-I	Halliday and Resnick,		

List of Experiments to be performed in the Laboratory:

1.	Determination of g using bar pendulum (L versus T and L versus LT^2 graphs).
2.	Determination of moment of inertia of a Fly Wheel.
3.	Determination of rigidity modulus using torsional pendulum.
4.	Modulus of rigidity of a rod – Static torsion method.
5.	Determination of elastic constants of a wire by Searle's method.
6.	Young's modulus by Koenig's method.
7.	Viscosity by Stoke's method.
8.	Verification of Hook's law.
9.	Determination of surface tension of a liquid and the interfacial tension between two liquids using drop weight method.
10.	Study of motion of a spring and to calculate Spring constant, g and unknown mass.
11.	Determination of Young's modulus of a bar by the single cantilever method.
12.	Determination of Young's modulus of a bar by uniform bending method.
13.	Radius of capillary tube by mercury pellet method.
14	Verification of parallel and perpendicular axis theorems.

(Minimum EIGHT experiments have to be carried out)

Reference Book for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B.Saraf	Vikas Publications	2013
2	A lab manual of Physics for undergraduate classes, 1st Edition,		Vikas Publications.	
3	BSc Practical Physics Revised Ed	CL Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd.	2002

Semester – II

Detailed Syllabus of II Semester Physics

Electricity & Magnetism

Course Title: Electricity and Magnetism	Course Credits: 4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Model Syllabus Authors:	Physics Expert Committee

Programme Outcomes

1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
2. Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
3. Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
4. Ethics: Apply the professional ethics and norms in respective discipline.
5. Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
i. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.	x	x				
ii. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.	x					
iii. Apply Gauss's law of electrostatics to solve a variety of problems.	x	x			x	
iv. Describe the magnetic field produced by magnetic dipoles and electric currents.	x					
v. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.	x					
vi. Describe how magnetism is produced and list examples where its effects are observed.	x				x	x
vii. 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.	x	x			x	x
viii. 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.	x	x			x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Electricity & Magnetism		**Hrs**
Unit – 1		
Chapter No. 1	**Topics to be covered/taught/learnt:** Electric charge and field Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy)	3
Chapter No. 2	**Topics to be Covered** Gauss's law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge).	3
Chapter No. 3	**Topics to be Covered** Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole.	7
Topics for self study(If any)	*Constant potential surfaces - for self learning* *Work out problems listed in the reference*	
	Suggested Activities	
Activity No. 1	1. Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries. 2. A small project report on production of electricity as a source of energy: Different methods	
Activity No. 2	1. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. 2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
Unit – 2		

Chapter No. 4.	**Topics to be covered** Conductors in electrostatic field Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Guass's law.	6
Chapter No. 5.	**Topics to be covered** Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination. force on a moving charge.	7
Topics for self study(If any)	*Currents and voltage in combination of R, L and C circuits*	
	Suggested Activities	
Activity No. 3	1. Learn about electrical appliances which work with AC and DC electricity 2. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic)	
Activity No. 4	1. Learn about power transmission: 3-phase electricity, voltage and phase 2. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? 3. Prepare a small project report on street lighting and types of electrical bulbs.	

Unit – 3		
Chapter No.6	**Topics to be covered** Magnetism Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect. Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field.	7
Chapter No. 7	**Topics to be covered** Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits.	6
Topics for self study(If any)	Hall Effect	
	Suggested Activities	
Activity No. 5	**Activity:** 1. Prepare a small project report on street lighting and types of electrical bulbs. 2. Learn the measurement of electric current using tangent galvanometer.	
Activity No.6	**Activity:** Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
Unit - 4		
Chapter No. 8	Electromagnetic waves: Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.	8
Chapter No. 9	**Topics to be covered:** Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves.	5
Topics for self study(If any)	*B-H curves and its characteristics* *Ferrites*	

	Suggested Activities	
Activity No.7	**Activity:** 1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. 2. Learn the principle of working of a Gauss meter to measure magnetic field	
Activity No. 8	**Activity:** 1. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years.	

References Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics-Part-II,	David Halliday and Robert Resnick	Wiley Eastern Limited	2001
2	Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition	Edward M Purcell	Tata Mc Graw-Hill Publishing Company Ltd, New Delhi	2008

List of Experiments to be performed in the Laboratory

1.	Experiments on tracing of electric and magnetic flux lines for standard configuration.
2.	Determination of components of earth's magnetic field using a Ballistic galvanometer.
3.	Determination of capacitance of a condenser using B.G.
4.	Determination of high resistance by leakage using B.G.
5.	Determination of mutual inductance using BG.
6.	Charging and discharging of a capacitor (energy dissipated during charging and time constant measurements.
7.	Series and parallel resonance circuits (LCR circuits).
8.	Impedance of series RC circuits- determination of frequency of AC.
9.	Study the characteristics of a series RC and RL Circuit.
10.	Determination of self-inductance of a coil.
11.	Verification of laws of combination of capacitances and determination of unknown capacitance using de - Sauty bridge.
12.	Determination of B_H using Helmholtz double coil galvanometer and potentiometer.

(Minimum EIGHT experiments have to be carried out)

Semester – III
Detailed Syllabus of III Semester Physics

Program Outcomes:	
1.	Disciplinary knowledge
2.	Communication Skills
3.	Critical thinking, Reflective thinking, Analytical reasoning, Scientific reasoning
4.	Problem-solving
5.	Research-related skills
6.	Cooperation/ Teamwork/ Leadership readiness/Qualities
7.	Information/ Digital literacy/Modern Tool Usage
8.	Environment and Sustainability
9.	Multicultural competence
10.	Multi-Disciplinary
11.	Moral and ethical awareness/Reasoning
12.	Lifelong learning / Self Directed Learning

Course Content Semester -III Wave Motion and Optics	
Course Title: Wave Motion and Optics	Course Credits:4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors: Physics Expert Committee	

Prerequisites	
i.	Fundamentals of waves

Course Learning Outcomes	
At the end of the course students will be able to:	
i.	Identify different types of waves by looking into their characteristics.
ii.	Formulate a wave equation and obtain the expression for different parameters associated with waves.
iii.	Explain and give a mathematical treatment of the superposition of waves under different conditions, such as, when they overlap linearly and perpendicularly with equal or different frequencies and equal or different phases.
iv.	Describe the formation of standing waves and how the energy is transferred along the standing wave in different applications, and mathematically model in the case of stretched string and vibration of a rod.
v.	Give an analytical treatment of resonance in the case of open and closed pipes in general and Helmholtz resonators in particular.
vi.	Describe the different parameters that affect the acoustics in a building, measure it and control it.
vii.	Give the different models of light propagation and phenomenon associated and measure the parameters like the wavelength of light using experiments like Michelson interferometer, interference and thin films.
viii.	Explain diffraction due to different objects like singles slit, two slits, diffraction of grating, oblique incidence, circular aperture and give the theory and experimental setup for the same.
ix.	Explain the polarization of light and obtain how the polarization occurs due to quarter wave plates, half wave plates, and through the optical activity of a medium.

Course Articulation Matrix

Mapping of Course Outcomes (CO) Program Outcomes

Course Outcomes / Program Outcomes		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
i.	Identify different types of waves by looking into their characteristics.	X	X	X	X	X	X					X	X
ii.	Formulate a wave equation and obtain the expression for different parameters associated with waves.	X	X	X	X	X	X					X	X

iii.	Explain and give a mathematical treatment of the superposition of waves under different conditions such as when they overlap linearly and perpendicularly	X	X	X	X	X	X					X	X
	with equal or different frequencies and equal or different phases.												
iv.	Describe the formation of standing waves and how the energy is transferred along the standing wave in different applications, and mathematically model in the case of stretched string and vibration of a rod.	X	X	X	X	X	X					X	X
v.	Give an analytical treatment of resonance in the case of open and closed pipes in general and Helmholtz resonators in particular.	X	X	X	X	X	X					X	X
vi.	Describe the different parameters that affect the acoustics in a building, measure it and control it.	X	X	X	X	X	X					X	X
vii.	Give the different models of light propagation and phenomenon associated and measure the parameters like the wavelength of light using experiments like Michelson interferometer, interference and thin films.	X	X	X	X	X	X					X	X
viii.	Explain diffraction due to different objects like singles slit, two slits, diffraction grating, oblique incidence, circular aperture and give the theory and experimental setup for the same.	X	X	X	X	X	X					X	X
ix.	Explain the polarization of light and obtain how the polarization occurs due to quarter wave plates, half wave plates, and through the optical activity of a medium.	X	X	X	X	X	X					X	X

Wave Motion and Optics

Unit – 1 - Waves and Superposition of Harmonic Waves

The Portion to be Covered

Waves: Plane and Spherical Waves. Longitudinal and Transverse Waves. Characteristics of wave motion, Plane Progressive (Travelling) Wave and its equation, Wave Equation – Differential form (derivation). Particle and Wave Velocities: Relation between them, Energy Transport – Expression for intensity of progressive wave, Newton's Formula for Velocity of Sound. Laplace's Correction (Derivation). Brief account of Ripple and Gravity Waves. **(Text Book : 1-4) (5 Hours)**

Superposition of Harmonic Waves : Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats) – Analytical treatment. Superposition of two perpendicular Harmonic Oscillations: Lissajous Figures with equal and unequal frequency- Analytical treatment. Uses of Lissajous' figures. **(Text Book : 1-4) (6 Hours)**

Topic Learning Outcomes
At the end of the topic, students should be able to:

SL No	TLO 's	BL	CO	PO
i.	Explain the difference between plane and spherical waves, longitudinal and transverse waves and give their characteristics.	L2	1	1-6, 11-12
ii.	Write down an equation for the progressive wave in its differential form.	L2	1	1-6, 11-12
iii.	Obtain the relation between particle and wave velocity.	L2	1	1-6, 11-12
iv.	Obtain an expression for intensity of progressive waves.	L2	1	1-6, 11-12
v.	Obtain Newton's formula for the velocity of sound and discuss the factors for which sound velocity is dependent.	L2	2	1-6, 11-12
vi.	Apply the Laplace's correction to the equation of motion of a progressive wave.	L2	2	1-6, 11-12
vii.	With examples explain ripple and gravity waves.	L1	2	1-6, 11-12
viii.	Give the theory of superposition of two linear waves having equal frequencies and different frequencies.	L2	3	1-6, 11-12
ix.	Discuss the formation of different Lissajous figures under different conditions of amplitude and frequency when they superimpose perpendicularly.	L2	3	1-6, 11-12
x.	Give some applications of an Lissajous figures.	L1	3	1-6, 11-12
xi.	Higher order problems.	L3	1,2,3	1-6, 11-12

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.
Assessment Techniques
One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc
Suggested Activities (2 Hours)

Activity No. 1	We know that sound is produced because of vibration. Look into at least 10 musical instruments and identify the regions of vibrations that produces the sound and those parts which enhances the sound because of reverberation. 1. Identify one common element in all of these. 2. Identify equipment which creates beats and try to explain the underlying basic principles. Demonstrate the examples of beats using two tuning forks. 3. Identify what will happen when you drop a stone in a standing water, and when your drop two stones side by side. 4. Make your observations sketch them and comment on it in a report.
Activity No. 2	Draw two sine waves (Amplitude vs time) one shifted with other in phase. Identity where the resonation occurs for each phase shift. Plot phase vs time taken for resonance.
Activity No. 3	Take smooth sand, place a pointed edged pen vertically on the sand. To the mid of the pen, connect two perpendicular threads. Pull these perpendicular threads by varying the forces and timings. Note down the different shapes produced on the sand. Try to interpret the shapes. Make a report of it
Activity No. 4	Hang a pot with sand, which has a hole in the bottom. Gently pull the pot on one side and observe the pattern formed by the sand on the floor. Report the observations.
Activity No. 5	Design a coupled pendulum. Study the impact of the motion of one pendulum over the other pendulum by varying the length, direction of the motion of one pendulum and mass of pendulum and observe the resultant changes. Trace the path of the bobs and make a report.
Activity No. 6	**Note for the teachers for the activity:** Make 3 groups among students and assign each group the activity of drawing one of the 3 graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation,

	teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. **Activity:** Take a stretched spring. Stretch it across two edges. Put a weight on the string, pluck it and measure the amplitude of the vibration. All group will measure the total damping time of oscillating spring. (Using mobile or scale) And plot a graph of the- 1. Varying load on the spring and amplitude at the centre. 2. Take another weight and put that in another place and measure the amplitude of vibration at the centre. 3. Vary the load in the centre of the spring and measure the amplitude at the centre.

Wave Motion and Optics

Unit – 2 - Standing Waves and Acoustics

The Portion to be Covered

Standing Waves : Velocity of transverse waves along a stretched string (derivation), Standing (Stationary) Waves in a String - Fixed and Free Ends (qualitative). Theory of Normal modes of vibration in a stretched string, Energy density and energy transport of a transverse wave along a stretched string. Vibrations in rods – longitudinal and transverse modes (qualitative). Velocity of Longitudinal Waves in gases (derivation). Normal Modes of vibrations in Open and Closed Pipes – Analytical treatment. Concept of Resonance, Theory of Helmholtz resonator. **(Text Book : 1-4)** **(8 Hours)**

Acoustics: Absorption coefficient, Reverberation and Reverberation time, Sabine's Reverberation formula (derivation), Factors affecting acoustics in buildings, Requisites for good acoustics. Acoustic measurements – intensity and pressure levels. **(Text Book : 1-4) (3 Hours)**

Topic Learning Outcomes
At the end of the topic, students should be able to:

SL No	TLO's	BL	CO	PO
i.	Discuss the Transverse waves produced in stretched string and obtain the expression for the same.	L2	3	1-6, 11-12
ii.	Give a qualitative treatment of vibration of a string when it's both ends are fixed and free.	L2	3	1-6, 11-12

iii.	Explain normal modes of a stretched string. Obtain an expression for the energy density and discuss how this energy is transported along a stretched string.	**L2**	**3**	**1-6, 11-12**
iv.	Quantitatively bring about the mode of vibrations created in a rod.	**L2**	**4**	**1-6, 11-12**
v.	Explain types of waves that are produced in gas. Obtain an expression for the same.	**L2**	**4**	**1-6, 11-12**
vi.	With an analytical treatment explain the concept of resonance using the normal modes of vibrations of open and closed pipes.	**L2**	**5**	**1-6, 11-12**
vii.	Give the theory of Helmholtz resonator and explain how it is used to calculate some parameters of the way the standing waves are set in there.	**L2**	**5**	**1-6, 11-12**
viii.	Define Reverberation, Reverberation time and absorption coefficient of a material.	**L1**	**5**	**1-6, 11-12**
ix.	Obtain Sabine's Reverberation formula and discuss what are the factors on which the Reverberation time depends on?	**L2**	**5**	**1-6, 11-12**
x.	List out which are different parameters within a building which effects the acoustics.	**L1**	**6**	**1-6, 11-12**
xi.	Explain what good acoustics of a building are and how acoustics is measured in terms of intensity and pressure inside a building.	**L2**	**6**	**1-6, 11-12**
xii.	Higher order problems.	**L3**	**4,5,6**	**1-6, 11-12**

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.

Formative Assessment Techniques

One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc.

Suggested Activities (2 Hours)	
Activity No. 7	List different phenomenon where standing waves are found in nature. Identify the phenomena and reason for standing waves. Also identify the standing waves in musical instruments. Make a report.
Activity No. 8	1. Go to 5 different newly constructed houses when they are not occupied and when they are occupied. Make your observations on sound profile on each room. Give the reasons. Make a report**.** 2. Visit three very good auditoriums, list out different ways in which the acoustic arrangements have been done (as decoration and Civil works). Look for the reasons in Google and identify which is acoustically the best auditorium among the three you visited. Make a report.
Activity No. 9	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. **Activity:** Take a bowl of different liquids (water, milk, kerosene, salt water, Potassium Permanganate (KMNO4) solution. Place a small non oily floating material (ex: thin plastic) on the surface of the liquid. Drop a marble on the liquid at the centre of the bowl. Repeat the experiment by dropping the marble from the different heights. Plot a graph of- 1. Height v/s time of oscillation 2. Weight of the marble v/s time of oscillation
Activity No. 10	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study.

	Activity: Take two marble of same weight. Drop both the marbles on the surface of the liquid from some height. With the help of the mobile take the picture and measure the position of interface of two wave fronts formed in the liquid. Plot graphs for different activities by doing the following activities. 1. By dropping two marbles of same weight from different heights. 2. By dropping two marbles of different weight from the same height

Wave Motion and Optics

Unit – 3 - Nature of light and Interference

The Portion to be Covered

Nature of light : To Determine wavelength of light, distances and shapes using Michelson interferometer. The corpuscular model of light-The wave model - Maxwells electromagnetic waves-Wave Particle Duality **(Text Book No 5; Sections 2.1 to 2.4 and 2.8) (2 Hours)**

Interference of light by division of wave front: Huygen's theory-Concept of wave-front-Interference pattern produced on the surface of water-Coherence-Interference of light waves by division of wave- front- Young's double slit experiment- derivation of expression for fringe width-Fresnel Biprism- Interference with white light (Text Book No 5; Sections 12.1 to 12.2, 14.1 to 14.5, 14.7 to 14.9) **(4 Hours)**

Interference of light by division of amplitude: Interference by division of amplitude-Interference by a plane parallel film illuminated by a plane wave-Interference by a film with two non-parallel reflecting surfaces- color of thin films—Newton's rings-(Reflected light)-Michelson Interferometer-Determination of wavelength of light* (Text Book No 5; Sections 15.1 to 15.2, 15.8 to 15.11) **(5 Hours)**

Topic Learning Outcomes
At the end of the topic, students should be able to:

SL No	TLO 's	BL	CO	PO
i.	Explain using Michelson interferometer how to determine the wavelength of light.	L2	7	1-6, 11-12
ii.	Give an account of the different possible shapes that are obtained in Michelson interferometer experiment and their relevance.	L2	7	1-6, 11-12
iii.	Discuss the wave model and the Corpuscular model of light.	L2	7	1-6, 11-12
iv.	Explain Maxwells electromagnetic waves.	L2	7	1-6, 11-12
v.	Give an account of the phenomenon of wave-particle duality.	L1	7	1-6, 11-12
vi.	Give the Huygen theory of wave-front.	L1	7	1-6, 11-12

vii.	Define Interference. Give some examples of Interference.	**L1**	**7**	**1-6, 11-12**
viii.	Give the theory of interference due to two coherent sources of light and obtain an expression for the wavelength of monochromatic source of light (Young's double slit experiment)	**L 2**	**7**	**1-6, 11-12**
ix.	Explain how using personal biprism, a monochromatic coherent source of light are obtained. Using this experimental setup explain how the wavelength of monochromatic sources of light is determined.	**L 2**	**7**	**1-6, 11-12**
x.	Give the theory of interference due to division of amplitude by parallel and non-parallel plates.	**L 1**	**7**	**1-6, 11-12**
xi.	Explain how Newton's rings are obtained and discuss how the wavelength of light is determined using this experiment.	**L 2**	**7**	**1-6, 11-12**
xii.	Higher order problems.	**L 3**	**7**	**1-6, 11-12**

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.

Formative Assessment Techniques

One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Suggested Activities (2 Hours)	
Activity No. 11	In the table given below explore which phenomenon can be explained by what and Make a report**.**
Activity No. 12	Why colour strips are seen in paddles on roads in rainy seasons try to simulate the same. Give the reasons. Make a report**.**
Activity No. 13	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. **Activity:** Take a bowl of different liquids (water, milk, kerosene, salt water, Potassium Permanganate (KMNO4) solution. Place a small non oily floating material (ex: thin plastic) on the surface of the liquid. Drop two marbles of same weight (mass) from the same height on to the surface of the water but at the different time intervals. Plot graph for the different observations. **For teachers:** Demonstrate the formation of Lissajous Figure using a CRO. Give different shapes of Lissajous Figure with varying frequency and amplitude. Ask the students to comment on the observations.

Wave Motion and Optics

Unit – 4 - Diffraction and Polarisation

The Portion to be Covered

Fraunhofer diffraction : Introduction- Fraunhofer diffraction- Single slit diffraction pattern-position of Maxima and Minima (Qualitative arguments)- Two slit diffraction pattern-position of Maxima and minima- Theory of plane diffraction Grating-Grating spectrum- normal and oblique incidence-Resolving power and dispersive power of a grating Single slit; Double Slit. Multiple slits & Diffraction grating. (Text Book No 5; Sections 18.1 to 18.2, 18.6,18.8 to 18.9) **(4 Hours)**

Fresnel Diffraction- Fresnel half period zones-Diffraction by a circular aperture-diffraction by an opaque disc-The zone plate -comparison between zone plate and convex lens. (Text Book No 5; Sections 20.1 to 20.3) **(3 Hours)**

Polarisation: Introduction-Production of polarized light- The wire Grid polarizer and Polaroid-Superposition of two disturbances-Phenomenon of double refraction-Quarter wave plates and half wave plates- Analysis of polarized light-optical activity**.** (Text Book No 5; Sections 22.1, 22.3,22.4,22.6 to 22.8**) (4 Hours)**

Topic Learning Outcomes

At the end of the topic, students should be able to:

SL No	TLO 's	BL	CO	PO
i.	Define Fraunhofer diffraction.	**L2**	**8**	**1-6, 11-12**
ii.	Give a qualitative treatment of single slit/diffraction double slit diffraction.	**L2**	**8**	**1-6, 11-12**
iii.	Explain the theory of diffraction due to grating and the normal and oblique incidence.	**L2**	**8**	**1-6, 11-12**
iv.	Explain how the resolving power of a grating depends of the number of slits used.	**L2**	**8**	**1-6, 11-12**
v.	Give the theory of Fersnel half period zones.	**L2**	**8**	**1-6, 11-12**
vi.	Discuss zone plates with respect to convex lenses.	**L2**	**8**	**1-6, 11-12**
vii.	Explain optical polarization and polaroids.	**L2**	**9**	**1-6, 11-12**
viii.	Give different types of polaroids.	**L2**	**9**	**1-6, 11-12**
ix.	Give the theory of phenomenon of double refraction and explain what are ordinary and extraordinary rays.	**L2**	**9**	**1-6, 11-12**
x.	Give the theory of quarter wave plates and half wave plates.	**L2**	**9**	**1-6, 11-12**
xi.	Explain optical activity with theory. Give an experimental method to measure the optical activity of a material.	**L2**	**9**	**1-6, 11-12**
xii.	Higher order problems.	**L3**	**8,9**	**1-6, 11-12**

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.
Assessment Techniques
One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Suggested Activities (2 Hours)	
Activity No. 14	Explain polarization of light through a chart. List out the surfaces that reflect polarized light. Learn how polarization of light can be done by both transmission and reflection. Perform an experiment and make a report. USING CDs AND DVDs AS DIFFRACTION Gratings Ref:https://www.nnin.org/sites/default/files/files/Karen_Rama_USING_CDs_AND_DVDs_AS_DIFFRACTION_GRATINGS_0.pdf Obtain the diffraction spectra using a CD and design an experiment to find the distance between the tracks on it) (Ref: https://www.brighthubeducation.com/science-lessons-grades-9-12/39347-diffraction-experiment-measuring-groove-spacing-on-cds/, https://silo.tips/download/diffraction-from-a-compact-disk)
Activity No. 15	What is the physics behind making 3D movies? Group Discussion (https://www.slideserve.com/rae/physics-behind-3d-movies-powerpoint-ppt-presentation) Make a report.
Activity No. 16	List out different types of zone plates and look for their applications in day to day life. Make a report.
Activity No. 17	Collect information and study how optically polarizing lenses are made. Visit a nearby lens making facility. Learn the principle behind sunglasses. Make a report.
Activity No. 18	**Note for the teachers for the activity:** Make 3 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment.

	2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. **Activity:** Identify any 3 sharp edges of varying thickness and assign them to 3 groups. Shine a laser light pointing towards the edge of the needle. Observe the patterns formed on the wall or screen and measure the distance between the bands. Correlate the distance between the bands formed with the thickness of the edge and the distance from the edge to the screen. By this, calculate the wavelength of the laser light used.

Textbooks

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1.	The Physics of Waves and Oscillations,	N K Bajaj	Tata McGraw-Hill Publishing Company Ltd., Second Edition,	1984
2.	Waves and Oscillations	N Subramanyam and Brij Lal	Vikas Publishing House Pvt. Ltd., Second Revised Edition	2010
3.	A Text Book of Sound	D R Khanna and R S Bedi	Atma Ram & Sons, Third Edition	1952
4.	Oscillations and Waves	Satya Prakash	Pragathi Prakashan, Meerut, Second Edition	2003
5.	Optics	Ajoy Ghatak	McGraw Hill Education (India) Pvt Ltd	2017
6.	A text Book of Optics	Brij Lal, M N Avadhanulu & N Subrahmanyam	S. Chand Publishing	2012

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1.	Berkeley Physics Course – Waves,	Frank S Crawford Jr.	Tata Mc Graw-Hill Publishing Company Ltd., Special Indian Edition,.	2011
2.	Optics	Eugene *Hecht*	Pearson Paperback	2019
3.	Introduction To Optics	Pedrotti and Frank L ,	Pearson India	3rd Edition

4.	Fundamentals of Optics	Francis Jenkins Harvey White	McGraw Hill Education	2017

Formative Assessment	
Assessment	**Marks**
Internal Assessment	10
Activity	10
REU based Group Activity (Conduct, Report, Presentation)	10
Science Communication Seminar/Poster etc.)	10
Total	40

List of Experiments to be performed in the Laboratory (Minimum 8 experiments are to be conducted)	
1.	Velocity of sound through a wire using Sonometer.
2.	Frequency of AC using Sonometer.
3.	Study of Lissajous' Figures
4.	To verify the laws of transverse vibration using Melde's apparatus.
5.	Helmholtz resonator using tuning fork.
6.	Helmholtz resonator using electrical signal generator.
7.	To determine refractive index of the Material of a prism using sodium source.
8.	To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
9.	To determine the wavelength of sodium source using Michelson's interferometer.
10.	To determine wavelength of sodium light using Fresnel Biprism.
11.	To determine wavelength of sodium light using Newton's Rings
12.	To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
13.	To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
14	To determine dispersive power and resolving power of a plane diffraction grating.

Reference Book for LaboratoryExperiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1.	Advanced Practical Physics for students	B.L. Flint and H.T. Worsnop	Asia Publishing House.	1971
2.	A Text Book of Practical Physics	I. Prakash & Ramakrishna	Kitab Mahal, 11th Edition	2011
3.	Advanced level Physics Practicals	Michael Nelson and Jon M. Ogborn	Heinemann Educational Publishers, 4th Edition	1985
4.	A Laboratory Manual of Physics for undergraduate classes	D.P.Khandelwal	Vani Publications.	1985

Open Elective : OPTICAL INSTRUMENTS (III SEM)

Time: 3 hrs./week **Max Marks: 60**

Unit 1.	**Basics of Optics** Scope of optics, optical path, laws of reflection and refraction as per Fermat's principle, magnifying glass, Lenses (thick and thin), convex and concave lenses, Lens makers formulae for double concave and convex lenses, lens equation. Focal and nodal points, focal length, image formation, combination of lenses,	13
	dispersion of light: Newton's experiment, angular dispersion and dispersion power. Dispersion without deviation. (Expressions need not be derived, but have to be discussed qualitatively).	
Unit 2.	**Camera and microscopes** Human eye (constitution and working), Photographic camera (principle, construction and working), construction, working and utilities of Simple microscopes, Compound microscope, Electron microscopes, Binocular microscopes **Self study** Experimental determination of magnifying power of a microscope. (Construction part can be discussed through block diagrams)	14
Unit 3.	**Telescopes and Spectrometer** Construction, working and utilities of Astronomical telescopes Terrestrial telescopes Reflecting telescopes, Construction, working and utilities of Eyepieces or Oculars (Huygen, Ramsden's, Gauss) Spectrometer - Construction, working and utilities, measurement of refractive index. **Self study** Telescopes used at different observatories in and outside India.	13
	Activities: Find position and size of the image in a magnifying glass and magnification. Observe rain bows and understand optics. Create a rainbow. Find out what makes a camera to be of good quality. Observe the dispersion of light through prism. Make a simple telescope using magnifying glass and lenses. Learn principle of refraction using prisms. Check bending of light in different substances and find out what matters here. Learn about different telescopes used to see galaxies and their ranges. Many more activities can be tried to learn optics by going through you tubes and webistes such as https://spark.iop.org, http://www.yenka.com, https://publiclab.org etc.	

Open Elective: Sports Science (III Sem)

Time: 3 hrs./week **Max Marks: 60**

Content (Use maths of 10th Std only – Only qualitative discussion)		**Hrs**
Unit - 1		
Chapter No. 1	**Measurement**: Physical quantities. Standards and Units. International system of Units. Standards of time, length and mass. Precision and significant figures.	o4
Chapter No. 2	**Newton's laws of motion**: Newton's first law. Force, mass. Newton's second law. Newton's third law. Mass and weight. Applications of Newton's laws.	03
Chapter No. 3	**Projectile motion**: Shooting a falling target. Physics behind Shooting, Javelin throw and Discus throw.	03
Topics for self study (If any)	**https://www.real-world-physics-problems.com/physics-of-sports.html**	
Unit - 2		
Chapter No. 4.	**Conservation laws**: Conservation of linear momentum, collisions – elastic and inelastic. Angular momentum. (Physics behind Carom, Billiards, Racing)	04
Chapter No. 5.	**Centre of mass**: Physics behind Cycling, rock climbing, Skating,	02
Chapter No. 6.	**Gravitation**: Origin, Newton's law of gravitation. Archimedes's principle, Buoyancy (Physics behind swimming)	04
Topics for self study (If any)	Archimedes' Principle: Made EASY | Physics in You tube	
Unit - 3		
Chapter No.7	**Food and Nutrition:** Proteins, Vitamins, Fat, Blood pressure. Problems due to the deficiency of vitamins.	04
Chapter No. 8	**Energy:** Different forms of Energy, Conservation of mass-energy.	03
Chapter No . 9	**Physical exercises:** Walking, Jogging and Running, Weight management.	03
Topics for self study (If any)	10 Best Exercises for Everyone – Healthline	
	Suggested Activities	
Activity No. 1	Identify the methods of measurement of time, length and mass from ancient time and build models for them.	02
	Reference : History of measurement - Wikipedia *https://en.wikipedia.org › wiki › History_of_measurem*	
Activity No. 2	Identify Physics principles behind various Sports activities.	01

	https://www.real-world-physics-problems.com/physics-of-sports.html	
Activity No. 3	List the difficulties experienced in Gymnastics, Cycling and weight lifting.	02
Activity No. 4	List the difficulties experienced in swimming.	01
Activity No. 3	List the difficulties experienced in Gymnastics, Cycling and weight lifting.	02
Activity No. 4	List the difficulties experienced in swimming.	01
Activity No. 5	Learn breathing exercises. Reference : 1)Simple Breathing Exercise for Beginners | Swami Ramdev *2) https://www.yogajournal.com*	02
Activity No.6	Write an essay on Physical health v/s Mental health or conduct a debate on Physical health v/s Mental health.	01

Text Books

Sl No	**Title of the Book**	**Authors Name**	**Publisher**	**Year of Publication**
1	Physics for Entertainment	Yakov Perelman	Createspace Independent Pub.	
2	Physics Everywhere	Yakov Perelman	Prodinnova	2014
3	Mechanics for Entertainment	Yakov Perelman	Prodinnova	2014
4	Handbook of Food and Nutrition	M.Swaminathan	Bangalore Press 2012	2012
5	Food Science	B. Srilakshmi	New Age International Pub	2015

References Books

Sl No	**Title of the Book**	**Authors Name**	**Publisher**	**Year of Publication**
1	Physics	Resnick, Halliday and Krane, Vol 1	Wiley Student Edition.	
2	For the love of Physics	Walter Lewin	Taxmann Publications Private Limited	2012
3	An Introduction to the Physics of Sports	VassiliosMcInnesSpathopoulos	CreateSpace Independent Publishing Platform	2013

Internet resources
https://www.topendsports.com/biomechanics/physics.htm
https://www.real-world-physics-problems.com/physics-of-sports.html
https://www.healthline.com/
https://www.mayoclinic.org/
https://www.who.int/news-room/

Semester – IV
Detailed Syllabus of IV Semester Physics

Program Outcomes:	
1.	Disciplinary knowledge
2.	Communication Skills
3.	Critical thinking, Reflective thinking, Analytical reasoning, Scientific reasoning
4.	Problem-solving
5.	Research-related skills
6.	Cooperation/ Teamwork/ Leadership readiness/Qualities
7.	Information/ Digital literacy/Modern Tool Usage
8.	Environment and Sustainability
9.	Multicultural competence
10.	Multi-Disciplinary
11.	Moral and ethical awareness/Reasoning
12.	Lifelong learning / Self Directed Learning

Course Content Semester – IV Thermal Physics and Electronics	
Course Title: Thermal Physics and Electronics	Course Credits:4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors: Physics Expert Committee	

Prerequisites	
i.	Study of Pre-University

Course Learning Outcomes	
At the end of the course students will be able to:	
i.	Apply the laws of thermodynamics and analyze the thermal system.
ii.	Apply the laws of kinetic theory and radiation laws to the ideal and practical thermodynamics systems through derived thermodynamic relations.
iii.	Use the concepts of semiconductors to describe different Semiconductor devices such as diode transistors, BJT, FET etc and explain their functioning.
iv.	Explain the functioning of OP-AMPS and use them as the building blocks of logic gates.
v.	Give the use of logic gates using different theorems of Boolean Algebra followed by logic circuits.

Course Articulation Matrix

Mapping of Course Outcomes (CO) Program Outcomes

Course Outcomes / Program Outcomes		1	2	3	4	5	6	7	8	9	10	11	12
i.	Apply the laws of thermodynamics and analyze the thermal system.	X	X	X	X	X	X					X	X
ii.	Apply the laws of kinetic theory and radiation laws to the ideal and practical thermodynamics systems through derived thermodynamic relations.	X	X	X	X	X	X					X	X
iii.	Use the concepts of semiconductors to describe different Semiconductor devices like diode transistors, BJT, FET etc and explain their functioning.	X	X	X	X	X	X					X	X
iv.	Explain the functioning of OP-AMPS and them as the building blocks of logic gates.	X	X	X	X	X	X					X	X
v.	Give the use of logic gates using different theorems of Boolean Algebra followed by logic circuits.	X	X	X	X	X	X					X	X

Thermal Physics and Electronics

Unit – 1

The Portion to be Covered

Laws of Thermodynamics:
Review of the concepts of Heat and Temperature. **(1 Hour)**
First Law of Thermodynamics: Differential form, Internal Energy. Equation of state for an adiabatic process, Work Done during Isothermal and Adiabatic Processes. **(3 Hours)**
Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Reversible and Irreversible processes with examples. Heat Engines: Carnot engine & efficiency (no derivation). Refrigeration & coefficient of performance, Applications of Carnot engine in locomotion, Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. Concept of Entropy, Second Law of Thermodynamics in terms of Entropy **(5 Hours)**
Third Law of Thermodynamics: Statement, Significance and Unattainability of Absolute Zero. **(2 Hours)**

Topic Learning Outcomes
At the end of the topic, students should be able to:

SL No	TLO's	BL	CO	PO
i.	Explain the first law of thermodynamics.	L1	1	1-6,11-12
ii.	Give the differential form of the first law of thermodynamics and define what the internal energy is.	L2	1	1-6,11-12
iii.	Obtain an expression for work done in isothermal and adiabatic processes.	L2	1	1-6,11-12
iv.	Give two systems of units of temperature measurement and give their equivalence.	L2	1	1-6,11-12
v.	Describe and Discuss heat engine based on Carnot cycle.	L2	1	1-6,11-12
vi.	Explain how the efficiency of refrigeration is measured?	L2	1	1-6,11-12
vii.	Detail out the application of the Carnot engine to a locomotion system.	L1	1	1-6,11-12
viii.	Define entropy and write an expression for entropy using the second law of thermodynamics.	L2	1	1-6,11-12
ix.	State the third law of thermodynamics and give its significance using the third law of thermodynamics describing why absolute zero temperature is not unattainable.	L2	1	1-6,11-12

x.	High Order Problems.	**L3**	**1**	**1-6,11-12**

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.

Assessment Techniques

One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Suggested Activities (2 Hours)

Activity No. 1	I feel cold because coldness enter my body. Discuss the statement in day-to-day life. Approximately give examples of **(i)** open system **(ii)** closed system and **(iii)** isolated system Discuss when the temperature of the body is locked until what time you hold the thermometer in contact with a body. Discuss it in contact with laws of thermodynamics. Discuss why when a person works or does exercise, he sweats. Reason it with the laws of thermodynamics.

Activity No. 2	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study. **Activity:** Take four different sizes of same metal, preferable of same shape and give one piece to each group. Heat it uniformly on a hot plate. Keep a beaker of water with a thermometer immersed in it. Drop one hot metal into the water and record the temperature with time. Repeat the experiment for the other heated metal pieces of different sizes. **(i)** Plot a graph for the volume of the metal piece used v/s respective temperature change observed. **(ii)** Determine the heat capacity and specific heat of the metal used.
	All groups shall also do the following activity:
Activity No. 3	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study. **Activity:** Take ice cubes of different size and immerse in water and measure the temperature change with time and repeat the experiment. Graph the observations.

Thermal Physics and Electronics

Unit – 2

The Portion to be Covered

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Properties and Applications. **(1 Hour)**

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations (1) First order Phase Transitions with examples, Clausius - Clapeyron Equation (2) Values of Cp-Cv (3) Joule- Thomson Effect and Joule-Thomson coefficient and Derive an equation for Vander Walls gas. Attainment of low temperature by liquefaction of gases and adiabatic demagnetization. **(3 Hours)**

Kinetic Theory of Gases: Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas: Mean, RMS and Most Probable Speeds. Degrees of Freedom, Law of Equipartition of Energy. Specific heats of Gases. **(3 Hours)**

Radiation: Blackbody radiation, spectral distribution, the concept of energy density and pressure of radiation, Wien's law, Wien's displacement law, Stefan-Boltzmann law, Rayleigh-Jeans law,
Ultraviolet Radiation catastrophe and Planck's law of radiation. **(3 Hours)**

Topic Learning Outcomes
At the end of the topic, students should be able to:

SL No	TLO's	BL	CO	PO
i.	State Maxwell relations.	**L1**	**2**	**1-6, 11-12**
ii.	Give examples where Maxwells relations are used.	**L1**	**2**	**1-6, 11-12**
iii.	Explain the phase transition. Which is called as first order phase transition? Give Examples	**L2**	**2**	**1-6, 11-12**
iv.	State Clausius - Clapeyron Equation.	**L1**	**2**	**1-6, 11-12**
v.	Obtain an equation for difference in C_P - C_V.	**L2**	**2**	**1-6, 11-12**
vi.	State Joule-Thomson effect and Joule-Thomson coefficient.	**L1**	**2**	**1-6, 11-12**
vii.	Obtain an expression, giving the relation between pressure, volume and temperature for a real gas (Vander Waals gas).	**L2**	**2**	**1-6, 11-12**
viii.	Explain adiabatic demagnetization and how it is used to obtain low temperature by the liquidation of gases?	**L2**	**2**	**1-6, 11-12**
ix.	State Maxwell-Boltzmann Law of Distribution of Velocities in Ideal gases.	**L1**	**2**	**1-6, 11-12**
x.	Explain the mean RMS and most probable speeds in ideal gases.	**L1**	**2**	**1-6, 11-12**
xi.	Explain degrees of freedom associated with particles in an ideal gas?	**L2**	**2**	**1-6, 11-12**

xii.	Define the specific heat of a gas.	**L1**	**2**	**1-6, 11-12**
xiii.	Explain black body radiation and its spectral distribution.	**L1**	**2**	**1-6, 11-12**
xiv.	Explain the different laws used to describe different parts of the curves of a spectral distribution of black body radiation.	**L2**	**2**	**1-6, 11-12**
xv.	Define ultraviolet radiation catastrophe? Discuss its importance in the explanation of black body radiation.	**L2**	**2**	**1-6, 11-12**
xvi.	Define Planck's law of radiation and discuss how it could describe the whole black body radiation curve.	**L2**	**2**	**1-6, 11-12**
xvii.	High Order Problems.	**L3**	**2**	**1-6, 11-12**

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.

Assessment Techniques

One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Suggested Activities (2 Hours)

Activity No. 4

(i) Measuring the Solar Constant
Materials: Simple flat sided Jar and Thermometer.
Activity: Bottle containing water is exposed to solar radiation. The rise in temperature and time taken are noted. Calculate the heat absorbed by water and relate it to the output of the Sun.
(ii) Thermo emf
Materials: Suitable two dissimilar metal wires, voltage measuring device.
Activity: In this experiment student will assemble the thermocouple and study the three effects namely, Seebeck, Peltier, and Thompson.
(iii) Inverse square law of radiation
Materials: A cardboard with a grid, cardboard with a hole, supporting clips, a ruler, candle.
(iv) Activity: Students set the device. They count the lighted squares on the cardboard with the grid by varying the distance. And make necessary measurements and calculations to arrive at the inverse square law of radiation.
Ref: Activity Based Physics Thinking Problems in Thermodynamics: Kinetic Theory
http://www.physics.umd.edu/perg/abp/think/thermo/kt.htm

Activity No. 5	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study. **Activity:** Take two dissimilar metal wires. Spot weld them forming two junctions. Dip one junction in ice and heat the other junction with a burner. Plot a graph of time of heating v/s Thermo EFM generated in the voltmeter.
Activity No. 6	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study.
	Activity: Make 4 groups and give different-sized balloons to each group. Fit different-sized nozzles into the mouth of the large balloons. Measure the temperature or the EMF generated using a thermocouple placed at the mouth of the nozzle as the pressurised gas is released. Plot a graph of time v/s temperature. Vary the volume of the balloon and repeat the experiment. Plot the graph of volume v/s temperature difference created.

Thermal Physics and Electronics
Unit – 3
The Portion to be Covered

Semiconductor devices: Review of Intrinsic and Extrinsic semiconductors, p-n junction and its Characteristics and Parameters, Diode approximations, Half-wave rectifier, Full-wave rectifier, Zener diode voltage regulators: Regulator circuit with no load, Loaded Regulator. **(5 hours)**

Junction Transistors: Basics of Bipolar Junction Transistors (BJT), BJT operation, Common Base, Common Emitter and Common Collector Characteristics. Field Effect Transistor (FET) and its
characteristics. Transistor as an Amplifier and Oscillator. **(6 hours)**

Topic Learning Outcomes
At the end of the topic, students should be able to:

SL No	TLO 's	BL	CO	PO
i.	Define Semiconductors and Band Gap. Explain on what basis they are classified as intrinsic and extrinsic.	L2	3	1-6, 11-12
ii.	Define PN junction. Explain it's functioning in forward and reverse bias.	L1	3	1-6, 11-12
iii.	Explain the approximation used in a real diode with respect to an ideal PN Junction?	L2	3	1-6, 11-12
iv.	With a schematic diagram, explain half wave and full wave rectifiers.	L1	3	1-6, 11-12
v.	Define a Zener diode and explain how it is different from an ordinary diode using V-I curves?	L2	3	1-6, 11-12
vi.	With the schematic diagram, explain the working of voltage regulators of different types using a Zener diode.	L1	3	1-6, 11-12
vii.	Give the basic concepts used in the instruction of bipolar junction transistor and its operation.	L1	3	1-6, 11-12
viii.	Compare the V-I curve of common base common emitter and common collector BJT curves while explaining their working principles.	L2	3	1-6, 11-12
ix.	Define FET? Give its characteristics.	L1	3	1-6, 11-12
x.	Explain how a transistor can be used as an amplifier and an oscillator using a circuit diagram.	L2	3	1-6, 11-12
xi.	High Order Problems.	L3	3	1-6, 11-12

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.
Assessment Techniques
One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Suggested Activities (2 Hours)	
Activity No. 7	Wire a regulated DC power supply on a bread board or groove board to give a regulated output voltage of + 5 V; +15 V; Dual power output : ± 5 V; Dual power output : ± 15 V. Use: 3-pin voltage regulators. Components required: 1. Step down transformer- 1 No. (5 V tapping, 100 – 500 mA current rating), BY 127 semiconductor diodes – 4 Nos, Inductor -1, Capacitor - 1, 3 pin 5V regulator-1 Search for circuit diagram in books/net. **Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study.
	Activity: Form 3 groups and tell them to make a DC supply of low current of different voltages like 5V, 10V, and 15V on a breadboard
Activity No. 8	**(i)** Learn to identify the terminals of different types (packages) of BJTs. **(ii)** In the case of power transistors, learn how to fix a heat sink for the transistor. **(iii)** Learn the difference between BJT and FET in its operational characteristics.

Activity No. 9	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study. **Activity:** Take any 3 diode and assign one to each group. Measure its resistance when dipped in ice and heating the ice till it boils. Using this data, plot calibration curve of temperature v/s resistance and also the cooling curve of temperature V/s time for the diode by each group.

Thermal Physics and Electronics

Unit – 4

The Portion to be Covered

Electronics: Integrated Circuits (Analog and Digital), Operational Amplifier, Ideal characteristics of Op-Amp, Inverting and Non-Inverting Configurations. Applications- Voltage Follower, Addition and Subtraction. **(4 hours)**

Digital: Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary. **(3 hours)**

Boolean Algebra Theorems: De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, NAND Gate, NOR Gate, Algebraic Simplification, Implementation of NAND and NOR
functions. **(4 hours)**

Topic Learning Outcomes
At the end of the topic, students should be able to:

SL No	TLO 's	BL	CO	PO
i.	Define op-amps and give the characteristics of an ideal op-amp.	**L 1**	**4**	**1-6, 11-12**
ii.	Explains an inverting and non-inverting configuration of typical op-amps, with a schematic diagram.	**L 2**	**4**	**1-6, 11-12**

iii.	Explain how op-amps can be used as a voltage follower, with a schematic diagram and with relevant expressions.	**L 2**	**4**	**1-6, 11-12**
iv.	Explain how op-amps can be used as a voltage follower, adder and subtractor, with a schematic diagram and with relevant expressions.	**L 2**	**4**	**1-6, 11-12**
v.	Give different digital wave forms and explain how one can visualize the switching and logic levels.	**L 1**	**5**	**1-6, 11-12**
vi.	Write any four-digit numbers other than zero in the decimal number system and convert that into binary and hexadecimal.	**L 2**	**5**	**1-6, 11-12**
vii.	Write any number in a Binary System of 8 digits other than zero and convert it into decimal and hexadecimal.	**L 2**	**5**	**1-6, 11-12**
viii.	Write any number in the hexadecimal system of 4 digits other than zero and converted it into a binary and decimal number.	**L 2**	**5**	**1-6, 11-12**
ix.	Give simplified diagram for a given Boolean circuit diagram of logic gates, and verify using the De-Morgans theorem.	**L 2**	**5**	**1-6, 11-12**
x.	Why are X-NOR gates called Universal Gates?	**L 2**	**5**	**1-6, 11-12**
xi.	High Order Problems.	**L 3**	**4, 5**	**1-6, 11-12**

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.

Assessment Techniques

One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Suggested Activities (2 Hours)

Activity No. 10	Learn how to implement logic functions (AND, OR, NOT) using just diodes and resistors.
	With a circuit diagram show how different types of gates can be built by X-NOR gates.

Activity No. 11	**Operational Amplifiers** **(i)** Understand the concept of virtual ground of an OP-AMP. **(ii)** Learn the different types of op-amps used for different applications. **(iii)** What is a buffer? Prepare a report on buffers and its application in instrumentation electronics.
Activity No. 12	**(i)** A man has to take a wolf, a goat, and some cabbage across a river. His rowboat has enough room for the man plus either the wolf or the goat or the cabbage. If he takes the cabbage with him, the wolf will eat the goat. If he takes the wolf, the goat will eat the cabbage. Only when the man is present are the goat and the cabbage safe from their enemies. All the same, the man carries wolf, goat, and cabbage across the river. How? Write the truth table for the above story and implement using gates. **(ii)** A locker has been rented in the bank. Express the process of opening the locker in terms of digital operation. **(iii)** A bulb in a staircase has two switches, one switch being at the ground floor and the other one at the first floor. The bulb can be turned ON and also can be turned OFF by and one of the switches irrespective of the state of the other switch. The logic of switching of the bulb resembles.

Textbooks

Sl No	Title of the Book
1.	Electronic Devices and Circuits, David A. Bell, 2004, PHI, New Delhi
2.	Integrated Electronics, Jacob Millman and CC Halkias
3.	Digital Fundamentals, Floyd, 2001, PHI, New Delhi

References Books

Sl No	Title of the Book
1.	Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2.	Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
3.	A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
4.	Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5.	Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
6.	An Introduction to Thermal Physics, Daniel V Schroeder, 2020, Oxford University Press

Formative Assessment	
Assessment	**Marks**
Internal Assessment	10
Activity	10
REU based Group Activity (Conduction, Report, Presentation)	10
Science Communication (Seminar/Poster etc)	10
Total	40

List of Experiments to be performed in the Laboratory	
1.	Mechanical Equivalent of Heat by Callender and Barne's method
2.	Coefficient of thermal conductivity of Copper by Searle's apparatus
3.	Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method
4.	Determination of Stefan's constant/ Verification of Stefan's law
5.	Variation of thermo-emf across two junctions of a thermocouple with temperature
6.	Verification of Clausius –Clapeyron equation and determination of specific enthalpy
7.	V-I Characteristics of Silicon & Germanium PN Junction diodes (FB & RB) OR V-I Characteristics of Zener Diode and voltage regulator
8.	Characteristics of BJT in Common Emitter Configuration OR Frequency response of CE Amplifier
9.	Half Wave and Full Wave Rectifier with and without Filter
10.	Non-inverting and Inverting op-amp circuits OR Voltage follower, Adder and Subtractor circuits
11.	Truth table verification of logic gates using TTL 74 series ICs. OR Logic Gates; Combinational Circuits; Sequential Circuits

Minimum 8 experiments are to be conducted

Reference Book for Laboratory Experiments	
Sl No	**Title of the Book**
1.	Basic Electronics Lab (P242) Manual 2015-16, National Institute of Science Education and Research, Bhubaneswar, 2015.
2.	**Suggested Readings:** 1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e. 2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e.

SYLLABUS FOR OPEN ELECTIVES

(SEM I to IV)

3 Credits: 3 Lectures + 1 Tutorial

SYLLABUS FOR OPEN ELECTIVE

ENERGY SOURCES

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

		No. of lectures
Unit-I	**Non-Renewable energy sources**	
	Chapter-1: Introduction	
	Energy concept-sources in general, its significance & necessity. Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resources.	**04**
	Chapter-2: Conventional energy sources	
	Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology.	**09**
	Total	**13**
Unit-II	**Renewable energy sources**	
	Chapter-1: Introduction:	
	Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	**05**
	Chapter 2 : Solar energy:	
	Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	**08**
	Total	**13**
Unit-III	**Chapter-3: Wind and Tidal Energy harvesting**:	
	Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.	**08**
	Chapter-4 : Geothermal and hydro energy	
	Geothermal Resources, Geothermal Technologies.	**02**
	Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	**03**
	Carbon captured technologies, cell, batteries, power consumption	**01**
	Total	**13**

	Activity for tutorial classes 01 lectures/week 1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs. 2. Conversion of vibration to voltage using piezoelectric materials. 3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules. 4. Project report on Solar energy scenario in India 5. Project report on Hydro energy scenario in India 6. Project report on wind energy scenario in India 7. Field trip to nearby Hydroelectric stations. 8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc. 9. Field trip to solar energy parks like Yeramaras near Raichur. 10. Videos on solar energy, hydro energy and wind energy.	
	Reference Books: 1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi 2. Solar energy - M P Agarwal - S Chand and Co. Ltd. 3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University. 5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009 6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7. http://en.wikipedia.org/wiki/Renewable_energy	

Climate Science

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Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Module 1:	**Atmosphere** Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds.	(13 hours)
Module 2:	**Climate Science** Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. Modelling of the atmosphere: General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models. R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more	(13 hours)
Module 3:	**Global Climate Change** Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. Geo-engineering as a tool to mitigate global warming? Schemes of geo-engineering.	(13 hours)
	Activities to be carried out on Climate Science: 1. Try to find answer to the following questions: (a) Imagine you are going in a aircraft at an altitude greaten than 100 km. The air temperature at that altitude will be greater than 200^{o}C. If you put your hands out of the window of the aircraft, you will not feel hot. (b) What would have happened if ozone is not present in the stratosphere. 2. Visit a nearby weather Station and learn about their activities. 3. Design your own rain gauge for rainfall measurement at your place.	

	4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers. 5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction. 6. Learn about ozone layer and its depletion and ozone hole. 7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades. 8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC).	
	References: 1. Basics of Atmospheric Science – A Chndrashekar, PHI Learning Private Ltd. New Delhi, 2010. 2. Fundamentals of Atmospheric Modelling- Mark Z Jacbson, Cambridge University Press, 2000.	

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Astronomy

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Content		Hrs
Unit – 1 -History and Introduction		
Chapter 1	Ancient Astronomy Greek Observations, Sumerian Observations,Mayan Observations, Arabic Observations ,Chinese Observations	2
Chapter 2	Indian Astronomy Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara Astronomy in Indian Scriptures, Precession of the Equinox,Celebrations of Equinox	2
Chapter 3	Medieval & Modern Astronomy Invention of Telescopes, Models of the Solar System & Universe, Observations by Tycho Brahe, Kepler, Galileo, Herschel and Other,Modern Astronomy	2
Chapter 4	Optical tools for Astronomy Pin Hole, Binoculars, Telescopes & Imaging.	1
Chapter 5	Mathematical Methods of Observations Angular Measurement, Trigonometric functions, Stellar Parallax	1
Chapter 6	Observational Terminologies Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors etc.	2
Unit – 2: Unit 2: Observations of the Solar System		
Chapter 7.	The Sun Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Eclipses, Zero-shadow day, Sunspots	1
Chapter 8	The Moon Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names	1
Chapter 9.	Inner Planets: Mercury & Venus Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits.	2
Chapter 10	**Outer Planets** **Outer Planets: Mars, Jupiter & Saturn** Observational History.Observational Windows, Appearance, Frequency of Oppositions Oppositions, Conjunctions, Moons Eclipses.Galilean Moons, Saturn's Rings	2

Unit III Major Astronomy Observations		
Chapter 11	March to June Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 12	June to September Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 13	September to December Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 14	December to March **Pr**ominent Stars and Constellations Visible during this period, Methods of Spotting.	2

Reference Books:

1. The Stargazer's Guide - How to Read Our Night Sky by Emily Winterburn
2. A guide to the Night Sky – Beginner's handbook by P.N. Shankar
3. The Complete Idiot's guide to Astronomy by Christopher De Pree and Alan Axelrod

Text Books

1. P. N. SHANKAR A GUIDE TO THE NIGHT SKY
   https://www.arvindguptatoys.com/arvindgupta/nightskyshankar.pdf
2. BimanBasu , Joy of Star Watching , National Book Trust of India 2013

References Books

Christopher De Pree :The Complete Idiot's Guide to Astronomy, Penguin USA, 2008

Emily Winterburn ,The Stargazer's Guide: How to Read Our Night Sky, Constable and Robinson, 2008

Activities

Sl No	Experiment
1	Measuring Seasons using Sun's Position.
2	Measuring Distance using Parallax
3	Estimation of the Stellar Diameter using Pin Hole
4	Measuring Height of an Object Using Clinometer.
5	Star spotting using constellation maps
6	Constellation spotting using Skymaps
7	Estimation of 'Suitable Periods' to observe deep sky objects using Planisphere.
8	Estimation of the Size of the Solar System in using Light Years.
9	Identification of Lunar Phases across a year.
10	Measuring Constellation of the Sun using Night Skymaps or Planispheres.

Medical Physics

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit I:	**Human Anatomy and Physiology** Overview of human anatomy - cells, cell structure, type of cells and their functions, tissues, organs, and their functions. Different systems in the human body, their structure and function, physiological properties of the circulatory system, digestive system, respiratory system, reproductive system, excretory system, endocrine system and nervous system	(13 hours)
Unit II:	**Physics of Medical Diagnostics** Principle of production of X-rays. Use of X-rays in medical diagnosis, X-ray imaging systems. Computed Tomography (CT): principle and generation of CT. Magnetic Resonance Imaging (MRI): basic principle and image characteristics. Ultrasound Imaging: Interaction of sound waves with body tissues, production of ultrasound, transducers, acoustic coupling, image formation, modes of image display and color Doppler.	(13 hours)
Unit III:	**Physics of Radiotherapy** Clinical aspects of radiation therapy: Biological basis of radiotherapy, radiation sources, radiation dose, time dose fractionation. External beam radiation therapy, radiation therapy modalities, production of radioisotopes, use of radioisotopes in therapy, particle and ion beam radiotherapy. Brachytherapy - principle of brachytherapy and classification of brachytherapy techniques.	(13 hours)
	Class Room Activities Unit I: Students can demonstrate the shape, size, positions and functions of different organs in the body with the help of models. Unit II: The use of X-rays in the diagnosis of the fractured bone can be demonstrated with the help of a gamma source and a gamma ray survey meter. As the density of materials between the source and the detector changes the reading on the meter (or intensity of the beefing sound) changes. Unit III: (i) Students can be asked to list out different type of cancers and possible causative factors. They can be asked to list out the healthy practices to reduce the risk of cancers. (ii) As there will be students from different disciplines in the OE course, group discussion can be arranged to discuss about their programme and outcome. This will be an opportunity for the students to know about other disciplines. **Other related activities/projects:** 1. Visit to nearby hospitals/diagnostic centers to study the working of X-ray machines. 2. Visit to ultrasound diagnostic centers to study the principle and use of ultrasound in diagnosis. 3. Project on principle and use of X-ray films in imaging. 4. Visit to radiotherapy centers to study the modalities of radiotherapy.	

Text Books

1. C. H. Best and N. B. Taylor. A Test in Applied Physiology. Williams and Wilkins Company, Baltimore, 1999.

2. C. K. Warrick. Anatomy and Physiology for Radiographers. Oxford University Press, 2001.

3. Jerrold T. Bushberg. The Essential Physics for Medical Imaging (2nd Edition). Lippincott Williams & Wilkins, 2002.

4. Jean A. Pope. Medical Physics: Imaging. Heinemann Publishers, 2012.

5. Faiz M. Khan and Roger A. Potish. Treatment Planning in Radiation Oncology. Williams and Wilkins, USA, 2003.

6. D. Baltas. The physics of modern brachytherapy for oncology. Taylor and Francis, 2007.

Reference Books

1. J. R. Brobek. Physiological Basis of Medical Practice. Williams and Wilkins, London, 1995.

2. Edward Alcamo, Barbara Krumhardt. Barron's Anatomy and Physiology the Easy Way. Barron's Educational Series, 2004.

3. Lippincott, Anatomy and Physiology. Lippincott Williams & Wilkins, 2002.

4. W. E. Arnould Taylor. A textbook of anatomy and physiology, Nelson Thornes, 1998.

5. G. S. Pant. Advances in Diagnositc Medical Physics. Himalaya Publishing House, 2006.

6. Sabbahaga, Diagnositc Ultrasound applied to OBG. Maryland, 1980.

7. Faiz M Khan. The Physics of Radiation Therapy (3rd edition). Lippincott Williams & Wilkins, USA, 2003.

8. Jatinder R. Palta and T. Rockwell Mackie. Intensity Modulation Radiation Therapy. Medical Physics publishing, Madison, Wisconsin, 2003.

9. AAPM Report No. 72. Basic Applications of Multileaf collimators, AAPM, USA, 2001.

10. AAPM Report No. 91. Management of Respiratory motion in radiation oncology, 2006.

11. CA Joslin, A. Flynn, E. J. hall. Principles and Practice of Brachytherapy. Arnold publications, 2001.

12. Peter Hoskin, Catherine Coyle. Radiotherapy in Practice. Oxford University Press, 2011.

13. W. R. Handee. Medical Radiation Physics. Year Book Medical Publishers Inc., London, 2003.

14. Donald T. Graham, Paul J. Cloke. Principles of Radiological Physics. Churchill Livingstone, 2003.

15. Thomas S. Curry. Christensen',s Physics of Diagnostic Radiology (4th Edition). Lippincott Williams & Wilkins, 1990.

16. Madison. MRI – Perry Sprawls – Medical Physics Publishing. Wisconsin, 2000.

	17. Steve Webb. The Physics of Three–Dimensional Radiotherapy. Institute of Physics Publishing, Bristol and Philadelphia, 2002. 18. Radiation oncology physics: A Handbook for teachers and students. IAEA publications, 2005. 19. F. M. Khan. The Physics of Radiation Therapy (3rd Edition), Lippincott Williams and Wilkins, U.S.A., 2003.	

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OPTICAL INSTRUMENTS

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit 1.	**Basics of Optics** Scope of optics, optical path, laws of reflection and refraction as per Fermat's principle, magnifying glass, Lenses (thick and thin), convex and concave lenses, Lens makers formulae for double concave and convex lenses, lens equation. Focal and nodal points, focal length, image formation, combination of lenses, dispersion of light: Newton's experiment, angular dispersion and dispersion power. Dispersion without deviation. (Expressions need not be derived, but have to be discussed qualitatively).	13
Unit 2.	**Camera and microscopes** Human eye (constitution and working), Photographic camera (principle, construction and working), construction, working and utilities of Simple microscopes, Compound microscope, Electron microscopes, Binocular microscopes **Self study** Experimental determination of magnifying power of a microscope. (Construction part can be discussed through block diagrams)	14
Unit 3.	**Telescopes and Spectrometer** Construction, working and utilities of Astronomical telescopes Terrestrial telescopes Reflecting telescopes, Construction, working and utilities of Eyepieces or Oculars (Huygen, Ramsden's, Gauss) Spectrometer - Construction, working and utilities, measurement of refractive index. **Self study** Telescopes used at different observatories in and outside India.	13
	Activities: Find position and size of the image in a magnifying glass and magnification. Observe rain bows and understand optics. Create a rainbow. Find out what makes a camera to be of good quality. Observe the dispersion of light through prism. Make a simple telescope using magnifying glass and lenses. Learn principle of refraction using prisms. Check bending of light in different substances and find out what matters here. Learn about different telescopes used to see galaxies and their ranges. Many more activities can be tried to learn optics by going through you tubes and webistes such as https://spark.iop.org, http://www.yenka.com, https://publiclab.org etc.	

Sports Science

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Content (Use maths of 10th Std only – Only qualitative discussion)		Hrs
Unit - 1		
Chapter No. 1	**Measurement**: Physical quantities. Standards and Units. International system of Units. Standards of time, length and mass. Precision and significant figures.	o4
Chapter No. 2	**Newton's laws of motion**: Newton's first law. Force, mass. Newton's second law. Newton's third law. Mass and weight. Applications of Newton's laws.	03
Chapter No. 3	**Projectile motion**: Shooting a falling target. Physics behind Shooting, Javelin throw and Discus throw.	03
Topics for self study (If any)	**https://www.real-world-physics-problems.com/physics-of-sports.html**	
Unit - 2		
Chapter No. 4.	**Conservation laws**: Conservation of linear momentum, collisions – elastic and inelastic. Angular momentum. (Physics behind Carom, Billiards, Racing)	04
Chapter No. 5.	**Centre of mass**: Physics behind Cycling, rock climbing, Skating,	02
Chapter No. 6.	**Gravitation**: Origin, Newton's law of gravitation. Archimedes's principle, Buoyancy (Physics behind swimming)	04
Topics for self study (If any)	Archimedes' Principle: Made EASY | Physics in You tube	
Unit - 3		
Chapter No.7	**Food and Nutrition:** Proteins, Vitamins, Fat, Blood pressure. Problems due to the deficiency of vitamins.	04
Chapter No. 8	**Energy:** Different forms of Energy, Conservation of mass-energy.	03
Chapter No . 9	**Physical exercises:** Walking, Jogging and Running, Weight management.	03
Topics for self study (If any)	10 Best Exercises for Everyone – Healthline	
	Suggested Activities	
Activity No. 1	Identify the methods of measurement of time, length and mass from ancient time and build models for them.	02
	Reference : History of measurement - Wikipedia *https://en.wikipedia.org › wiki › History_of_measurem*	

Activity No. 2	Identify Physics principles behind various Sports activities.	01
	https://www.real-world-physics-problems.com/physics-of-sports.html	
Activity No. 3	List the difficulties experienced in Gymnastics, Cycling and weight lifting.	02
Activity No. 4	List the difficulties experienced in swimming.	01
Activity No. 3	List the difficulties experienced in Gymnastics, Cycling and weight lifting.	02
Activity No. 4	List the difficulties experienced in swimming.	01
Activity No. 5	Learn breathing exercises.	02
	Reference : 1)Simple Breathing Exercise for Beginners | Swami Ramdev *2) https://www.yogajournal.com*	
Activity No.6	Write an essay on Physical health v/s Mental health or conduct a debate on Physical health v/s Mental health.	01

Text Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics for Entertainment	Yakov Perelman	Createspace Independent Pub.	
2	Physics Everywhere	Yakov Perelman	Prodinnova	2014
3	Mechanics for Entertainment	Yakov Perelman	Prodinnova	2014
4	Handbook of Food and Nutrition	M.Swaminathan	Bangalore Press 2012	2012
5	Food Science	B. Srilakshmi	New Age International Pub	2015

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics	Resnick, Halliday and Krane, Vol 1	Wiley Student Edition.	
2	For the love of Physics	Walter Lewin	Taxmann Publications Private Limited	2012
3	An Introduction to the Physics of Sports	VassiliosMcInnesSpathopoulos	CreateSpace Independent Publishing Platform	2013

Internet resources

https://www.topendsports.com/biomechanics/physics.htm

https://www.real-world-physics-problems.com/physics-of-sports.html

https://www.healthline.com/
https://www.mayoclinic.org/
https://www.who.int/news-room/

NANOTECHNOLOGY

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit 1:	Introduction to nanomaterials Length scales in physics, Nanostructures: 1D, 2D and 3Dnanostructures (nano dots, thin films,nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equationInfinite potential well, potential step, potential box, quantum confinement of carriers in 3D,2D, 1D nanostructures and its consequences.	(13hours)
Unit 2:	Synthesis and Characterization of nanostructure materials Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation.Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beamevaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electrodeposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods.MBE growth of quantum dots. X-Ray Diffraction. Optical Microscopy. Scanning ElectronMicroscopy. Transmission Electron Microscopy. Atomic Force Microscopy. ScanningTunneling Microscopy.	(13 hours)
Unit 3:	Properties and applications of nanomaterials Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures andcharging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect bandgap semiconductor nanocrystals. Quantitative treatment of quasiparticles and excitons,charging effects. Radiative processes: General formalization-absorption, emission andluminescence. Optical properties of heterostrctures and nanostructures. Applications ofnanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solarcells). Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching andoptical data storage. Magnetic quantum well; magnetic dots - magnetic data storage.	(13 hours)
References Books: ➢ C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.). ➢ S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company) ➢ K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology(PHI Learning Private Limited). ➢ Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons). ➢ M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook(Elsevier, 2007). ➢ Introduction to Nanoelectronics, V.V. Mitin, V.A. Kochelap and M.A. Stroscio, 2011,Cambridge University Press. ➢ Bharat Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004).		

Student Activities: 1. Synthesis of metal nanoparticles by chemical route. 2. Synthesis of semiconductor nanoparticles. 3. XRD pattern of nanomaterials and estimation of particle size. 4. To study the effect of size on color of nanomaterials. 5. Growth of quantum dots by thermal evaporation. 6. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD. 7. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region. 8. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency. 9. Visit to nearby research labs to study the working of XRD, SEM, UV-Visible Spectrophotometer instruments 10. Visit to nearby research labs for project work and interaction with scientists at IISC, JNCSR, Universities etc.	

ELECTRICAL INSTRUMENTS

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Content		Hrs
Unit - 1		
Chapter No. 1	Voltage and current sources, Kirchoff's current and voltage laws, loop and nodal analysis of simple circuits with dc excitation. Ammeters,voltmeters: (DC/AC)	03
Chapter No. 2	Representation of sinusoidal waveforms, peak and rms values, power factor. Analysis of single-phase series and parallel R-L-C ac circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections. Wattmeters: Induction type, single phase and three phase wattmeter, Energy meters: AC. Induction type single phase and three phase energy meter	05
Chapter No. 3	Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications.	05
Topics for self study (If any)	Types of switches and Circuits, Safety precautions and rules in handling electrical appliances, Electric shock, first aid for electrical shocks, Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED	
	Suggested Activities	
Activity No. 1	Identify variety of electrical switches and note down their applications/utility.	
	Reference: Weblink/Youtube/Book	
Activity No. 2	Identify the hazards involved in handling electrical circuits and instruments, make a list of safety precautions as well as first aid for electrical shocks.	
	Reference : Weblink/Youtube/Book	
Unit - 2		
Chapter No. 4.	Galvanometers: General principle and performance equations of D'ArsonvalGalvanometers, Vibration Galva nometer and Ballistic Galvanometer.	03
Chapter No. 5.	Potentiometers: DCPotentiometer, Crompton potentio meter, construction, standardization, application. AC Potentio meter, Drysdalepolar potentio meter; standardization, application.	03
Chapter No. 6.	DC/AC Bridges: General equations for bridge balance, measurement of self inductance by Maxwell's bridge (with variable inductance & variable capacitance), Hay's bridge, Owen's bridge, measurement of capacitance by Schearing bridge, errors, Wagner's earthing device, Kelvin's double bridge.	07
Topics for self study (If any)	Importance of grounding and Earthing, Methods for Earthing,	

	Suggested Activities	
Activity No. 3	Make a study of importance of grounding in electrical circuits.	
	Reference : Weblink/Youtube/Book	
Activity No. 4	Prepare a detailed account of various methods of earthing and their utility/applications	
	Reference : Weblink/Youtube/Book	
Unit - 3		
Chapter No.7	Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer (LVDT), Capacitive Transducers, Peizo-Electric transducers, Optical Transducer, Hall Effect Transducer	06
Chapter No. 8	CRO: Block diagram, Sweep generation, vertical amplifiers, use of CRO in measurement of frequency,phase, Amplitude and rise time of a pulse. Digital Multi-meter: Block diagram, principle of operation	03
Chapter No. 9	Basics of lead acid batteries, Lithium Ion Battery , Battery storage capacity, Coulomb efficiency, Numerical of high and low charging rates, Battery sizing.	04
Topics for self study (If any)	Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED	
	Suggested Activities	
Activity No. 5	Prepare a document on evolution of incandescent bulbs to the present day LED lights	
	Reference : Weblink/Youtube/Book	
Activity No.6	Make a comparative study of Fuses, MCB, ELCB and Relays highlighting their use and applications	
	Reference : Weblink/Youtube/Book	

Text Books

AK.Sawhney, ACourse inElec.&Electronics Measurements&Instrumentation **,Dhanpatrai& Co. 1978**
A.D. Helfrick& W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques **PHI,2016**

References Books

1. D C Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications,**2019**
2. David G Alciatore and Michel B Histand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata McGraw Hill Education Private Limited, New Delhi., 2005
3. Vincent Del Toro, Electrical Engineering Fundamentals Prentice Hall India**2009**

List of Experiments to be performed in the Laboratory

Sl No	Experiment
1	Introduction to Lab Equipment
2	Voltmeter Design
3	Ammeter Design
4	Ohmmeter Design
5	Multimeter Design
6	Measurement of Resistance using Wheatstone Bridge
7	Measurement of Capacitance using Schering Bridge
8	Measurement of Inductance using Maxwell Bridge
9	Measurement of Light Intensity
10	Measurement of Temperature
	Reference Book for Laboratory Experiments
	AK.Sawhney ACourse inElec.&Electronics Measurements&Instrumentation:
	Helfrick& Cooper, Modern Electronic Instrumentation and Measurement Techniques:

PHYSICS FOR ALL

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit I	**Energy and Power** Explosions and energy; Energy, heat and its units; Energy table and discussions; Discussion of cost of energy; Measuring energy; Power; Different power sources; Kinetic energy.	(13 Hours)
Unit II	**Gravity, Force and Space** The force of Gravity; Newton's third law; Weightlessness; Low earth orbit; Geosynchronous satellites; Spy satellites; Medium Earth Orbit satellite; Circular Acceleration; momentum; Rockets; Airplanes, helicopters and fans; Hot air and helium balloons; angular momentum and torque.	(13 Hours)
Unit III	**Nuclei and radioactivity** Radioactivity; Elements and isotopes; Radiation and rays; Seeing radiation; The REM – The radiation poisoning; Radiation and cancer; The linear hypothesis; Different types of radiation; The half-life rule; Smoke detectors; measuring age from radioactivity; Environmental radioactivity; Glow of radioactivity; Nuclear fusion.	(13 Hours)
Unit IV	**Climate change** Global warming; IPCC; A brief history of climate; carbon dioxide; The greenhouse effect; Enhancement of Greenhouse effect; Hurricane and tornadoes; Antarctica; Fluctuations; Paleoclimate; Global warming vs Human caused global warming; Can we stop global warming?, Fossil Fuel Resources; Energy security; Energy efficiency and conservation; Bio-fuels; Nuclear, Wind and Solar power.	(13 Hours)
	References This course is extracted from the book titled "Physics and Technology for Future Presidents: An Introduction to the Essential Physics Every World Leader Needs to Know" by Richard A Muller, WW Norton and Company, 2007. (Unit-1 to 4 are from chapters 1, 3, 4 and 10, respectively).	

SPACE MISSIONS

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit 1:	**Introduction to Space Missions :** Rockets, types and their applications, Different types of orbits, Artificial satellites – basic idea and their applications, Introduction to Space Missions, Beginning of Space Missions - World and India, Applications of Space Research, Space crafts, Launching Vehicles.	**13 Hours**
Unit 2:	**National Aeronautics and Space Administration (NASA)** About NASA and its Goals, History of Creation. Foundational human spaceflight: X-15 program (1954–1968), Project Mercury (1958–1963), Project Gemini (1961–1966), Project Apollo (1960–1972), Skylab (1965–1979), Apollo-Soyuz (1972–1975). Modern human spaceflight programs: Space Shuttle program (1972–2011), International Space Station (1993–present), Constellation program (2005–2010), Commercial Crew Program (2011–present), Journey to Mars (2010–2017), Artemis program (2017–present).	**13 Hours**
Unit 3:	**Indian Space Research Organisation (ISRO)** About ISRO and its Goals, History of Creation. General Satellite Programmes: The IRS series, The INSAT series. Gagan Satellite Navigation System, Navigation with Indian Constellation (NavIC), Other satellites. Launch vehicles: Satellite Launch Vehicle (SLV), Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV). Experimental Satellites: Details and applications (Any Five) Earth Observation Satellites: Details and applications (Any Five) Communication satellites: Details and applications (Any Five)	**13 Hours**
	Self Study: Major Space Centres in the World (at least 10) – brief idea about their location, establishment, capabilities and achievements. People behind space programs – at least 2 from India. Successful Missions (Any Five). **Activities*:** • Design of working model of Rocket launching. • Preparation of report and presentation on application of satellites in agriculture, communication, weather forecasting, exploration of natural resources and Global positioning system (GPS). * Faculty may suggest any other relevant activity as well. Preparation of report and presentation onApollo 11: A Success story	

	Activities: • Preparation of report and presentation on the recent space missions of NASA. • Preparation of report on any one proposed space programmeof NASA. * Faculty may suggest any other relevant activity as well. Chandrayaan 1: Details and applications. Mars Orbiter Mission: Details and applications. **Activities:** • Preparation of report and presentation on the recent space missions of ISRO. • Preparation of report and presentation on any one proposed space programmeof ISRO. • Preparation of report and presentation on the contributions of Scientists from Karnataka to Indian Space Program and use of space technology in the local district. * Faculty may suggest any other relevant activity as well.	

Activity Based Pedagogy:

(Design, Activity and Assessment)

Conducting activity based teaching-leaning experience for students empower students with several graduate attributes by addressing several Outcomes at different levels of the Cognitive Blooms Taxanomy of Learning: like Clarity of Concept, ability to apply knowledge, evaluate and analyse the results, while they are also learn through the Affective and Psycho-motor domains of Learning through self-learning, group dynamics and team work, communication and presentation skills, ethics, life-long learning, etc. These experiments must be ones that do not involve sophisticated instrumentation and should be able to be performed outside laboratories.

Example 1: Elastic Properties of Solids:

The most important concept of studying elastic properties of solids is the Hooke's Law, which defines the stress-strain relationship.

Class 1: Defining problems, forming groups and giving instructions:

- The students should be made into forced groups of 6 to 8 members, depending on the class strength, consisting of diverse kinds of students in cognition, cultural, sex, behaviour, etc.
- Different materials of varying elastic properties should be given to each group, and should be asked to plot a graph of stress-strain of these materials in 8-10 days.
- Give clear instructions and clarify doubts, but not giving the procedure for the experiments. Students should discuss among themselves and consult books and internet to identify the procedure to obtain the Stress-strain graph. They should use only house-hold items or other commonly available tools to perform all the experiments.

Class 2: Presentation and discussion by students (max 8-10 mins each)

- Each group will be asked to make a presentation of 2 power point slides, where the first one explains the process they went through to arrive at the results and the second one shows their measured graph and an ideal text book plots. This slide should also contain two or three explanations of why both the plots differ.
- The student who will make the presentation on behalf of the group will be randomly selected just before the presentations. This will ensure that all group members will be mutually train each other for the presentation.
- The teacher should give equal marks to each member of a group depending on the methods adopted and clarity of concepts and results obtained and ability to analyse.

The following Program Outcomes will be attained by the students in such an activity based learning:

P.O. 1 : Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
P.O. 3 : Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
P.O. 5 : Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
P.O. 6 : Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Example 2: Periodic and Non-Periodic Motions

Most important aspect of understanding this topic is to distinguish them with the amplitude versus distance and amplitude versus time plots.

Class 1: Defining problems and giving instructions

- Each student will be asked to list as many observations as possible, under the two types of motion as they observe in the external world (home, market, college, etc) in 8-10 days.
- The student will be asked to identify any one motion in each of the lists and plot graphs of amplitude versus distance and amplitude versus time for each of them in the 8-10 days.

Class 2: Peer evaluation by students and defending self

- Each student is asked to submit the lists of periodic and non-periodic motions observed in everyday life.
- Each student is also asked to submit the amplitude versus distance and amplitude versus time of one periodic motion and one non-periodic motion of his/her choice among his/her list.
- The submissions are randomly distributed among other students. Teacher now discusses the two types of motions in the lists of students and shows how the graphs will ideally look like.
- Now students are asked to evaluate and mark the submissions of other students they have with them and then the marked papers are returned to the respective students.
- Each student should be given an opportunity to question the marks he has got and each student who has given the marks should be able to defend his choice or marks.
- While observing the lists, marks obtained and the plots made, the teacher can assign marks to each student.

The following Program Outcomes will be attained by the students in such an activity based learning:

P.O. 1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
P.O. 4. Ethics: Apply the professional ethics and norms in respective discipline.
P.O. 6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Continuous Formative Evaluation/ Internal Assessment:

Total marks for each course shall be based on continuous assessments and semester end examinations. The pattern of 40 : 60 for IA and Semester End theory examinations respectively and 50 : 50 for IA and Semester End practical examinations respectively.

Total Marks for each Course = 100 marks
Continuous assessment (C1) = 20 marks
Continuous assessment (C2) = 20 marks
Semester End Examination (C3) = 60 marks

Evaluation process of IA marks shall be as follows:

a) The first component (C1) of assessment is for 20% marks. This shall be based on test, assignment, seminar, case study, field work, project work etc. This assessment and score process should be completed after completing 50% of syllabus of the course/s and within 45 working days of semester program
b) The second component (C2) of assessment is for 20% marks. This shall be based on test, assignment, seminar, case study, field work, internship / industrial practicum / project work etc. This assessment and score process should be based on completion of remaining 50 percent of syllabus of the courses of the semester.
c) During the 17th – 19th week of the semester, a semester end examination shall be conducted by the University for each Course. This forms the third and final component of assessment (C3) and the maximum marks for the final component will be 60%.
d) In case of a student who has failed to attend the C1 or C2 on a scheduled date, it shall be deemed that the student has dropped the test. However, in case of a student who could not take the test on scheduled date due to genuine reasons, such a candidate may appeal to the Program Coordinator / Principal. The Program Coordinator / Principal in consultation with the concerned teacher shall decide about the genuineness of the case and decide to conduct special test to such candidate on the date fixed by the concerned teacher but before commencement of the concerned semester end examinations.
e) For assignments, tests, case study analysis etc., of C1 and C2, the students should bring their own answer scripts (A4 size), graph sheets etc., required for such tests/assignments and these be stamped by the concerned department using their department seal at the time of conducting tests / assignment / work etc.
f) The outline for continuous assessment activities for Component-I (C1) and Component-II (C2) of a course shall be as under.
g)

Activities	**C1**	**C2**	**Total Marks**
Session Test	10 marks	10 marks	20
Seminars/Presentations/Activity	10 marks		10
Case study /Assignment / Field work / Project work etc.		10 marks	10
Total	20 marks	20 marks	40

- For practical course of full credits, Seminar shall not be compulsory. In its place, marks shall be awarded for Practical Record Maintenance.(the ratio is 50 (25 + 25) : 50)
- Conduct of Seminar, Case study / Assignment, etc. can be either in C1 or in C2 component at the convenience of the concerned teacher.
- The teachers concerned shall conduct test / seminar / case study, etc. The students should be informed about the modalities well in advance. The evaluated courses / 29 assignments during component I (C1) and component II (C2) of assessment are immediately provided to the candidates after obtaining acknowledgement in the register by the concerned teachers(s) and maintained by the Chairman in the case of a University Post-Graduate Department and the Principal / Director in the case of affiliated institutions. Before commencement of the semester end examination, the evaluated test, assignment etc. of C1 and C2 shall be obtained back to maintain them till the announcement of the results of the examination of the concerned semester.

h) The marks of the internal assessment shall be published on the notice board of the department / college for information of the students.

i) The Internal assessment marks shall be communicated to the Registrar (Evaluation) at least 10 days before the commencement of the University examinations and the Registrar (E) shall have access to the records of such periodical assessments.

j) There shall be no minimum in respect of internal assessment marks.

k) Internal assessment marks may be recorded separately. A candidate who has failed or rejected the result, shall retain the internal assessment marks.

Scheme of Valuation for Practical's

C1 and C2 are internal tests to be conducted during 8th and 16th weeks respectively of the semester. C3 is the semester-end examination conducted for 3 hours. The student will be evaluated on the basis of skill, comprehension and recording the results. The student has to compulsorily submit the practical record for evaluation during C1 and C2. For C3, the record has to be certified by the Head of the Department.

• The student is evaluated for 25 marks in C1 and C2 as per the following scheme:

Experiment: 20, Record: 05 for C1 (25 marks)

Experiment: 20, Record: 05 for C2 (25 marks)

• The student is evaluated for 50 marks in C3 as per the following scheme:

Experiment: 35, Viva: 15 for C3 (50 marks)

The experimental portion of evaluation (C3) is carried out as per the following scheme:

Formula with proper units and explanation	08
Setting up the apparatus / circuit connections	07
Taking readings and tabulating	10
Calculations and Graph	10
Viva	15
Total	50

QUESTION PAPER PATTERN

DSC Courses and similar courses

Max Marks: Time: 3 hours

Unit 1

Long answer questions; Answer 1 out of 2 $1 \times 10 = 10$

Unit 2

Long answer questions; Answer 1 out of 2 $1 \times 10 = 10$

Unit 3

Long answer questions; Answer 1 out of 2 $1 \times 10 = 10$

Unit 4

Long answer questions; Answer 1 out of 2 $1 \times 10 = 10$

Numerical problems: Six numerical problems (one each from unit); 4 to be answered $4 \times 5 = 20$