TUMKUR UNIVERSITY

TUMAKURU

Course Structure and Content

Multi-Disciplinary program as per National Educational Policy

B. Sc., Physics (Honours)

B. Sc., / M. Sc., (Physics)

September 25, 2021, Tumakuru

Board of Studies

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Proposed Curriculum Framework for Multidisciplinary Four-year Undergraduate Programme

Year	Objective	Nature of Courses	Outcome	No. of courses
I-year (Semester 1 and 2)	Understanding and Exploration	1. Major/Minor Discipline specific Core Courses 2. Languages 3. Ability Enhancement Compulsory Courses 4. Skill Enhancement Courses	Understanding of Disciplines Language Competency Gaining perspective of context/Generic skills Basic skills sets to pursue any vocation	2+2 2+2 1+1 1+1
Exit option with certification				
II-year (Semester 3 and 4)	Focus and Immersion	1. Major/Minor Discipline specific Core Courses 2. Languages 3. Ability Enhancement Compulsory Courses 4. Skill Enhancement Courses	Understanding of disciplines Gaining perspective of context Skill sets to pursue vocation Development of various Domains of mind &Personality	2+2 2+2 1+1 1+1
Exit option with Diploma				
III-year (Semester 5 and 6)	Real time learning	1. Major/Minor Discipline specific Core Courses 2. Major/Minor Discipline specific Elective Courses 3. Skill Enhancement courses	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				
IV-year (Semester 7 and 8)	Deeper concentration	1. Major Discipline specific Core Courses 2. Major Discipline specific Elective Courses 3. Research methodology and research project	Deeper and Advanced Learning of Major Discipline Foundation to pursue Doctoral Studies & Developing Research competencies	4+4
Exit option with Degree with Honours				
V-year (Semester 9 and 10)	Masters of the Subject	1. Major Discipline specific Core Courses 2. Major Discipline specific Elective Courses 3. Research methodology and research project	Deeper and Advanced Learning of the Major Discipline towards gaining proficiency over the subject	4+4/ 6+6
Master's Degree				

Curriculum Structure for Physics as Major Discipline

Semester- I to Semester – X

Discipline Specific Core (DSC)

Sem	Code	Course titles	Credits
1	PHYDSC01	Mechanics and Properties of Matter	4+2
2	PHYDSC02	Electricity and Magnetism	4+2
3	PHYDSC03	Wave Motion and Optics	4+2
4	PHYDSC04	Thermal Physics and Electronics	4+2
5	PHYDSC05	Classical Mechanics and Quantum Mechanics – I	3+2
	PHYDSC06	Elements of Atomic and Molecular Physics	3+2
6	PHYDSC07	Elements of Nuclear Physics and Nuclear Instruments	3+2
	PHYDSC08	Elements of Condensed Matter Physics and Devices	3+2
7	PHYDSC09	Mathematical Methods of Physics – I	4
	PHYDSC10	Classical Electrodynamics	3+2
	PHYDSC11	Experimental Methods of Physics	3+2
		Research Methodology	3
8	PHYDSC12	Classical Mechanics and Quantum Mechanics – II	3
	PHYDSC13	Statistical Mechanics	3+2
	PHYDSC14	Astrophysics and Astronomy	3
		Research Project	6
9	PHYDSC15	Mathematical Methods of Physics – II	3
		Research Project	***
10	PHYDSC16	Quantum Mechanics – III	3
		Research Project	***

Open Electives (OE)

Sl. No.	Code	Course Titles	Credits
Sub Pool for Semester I			
1	PHYOEC01	Mechanics, Elasticity and Fluid Dynamics	3
2	PHYOEC02	Energy Sources	3
3	PHYOEC03	Physics in Daily Life	3
4	PHYOEC04	Electrical Instruments	3
5	PHYOEC05	Sports Science	3
Sub Pool for Semester II			
6	PHYOEC06	Electromagnetism	3
7	PHYOEC07	Climate Science	3
8	PHYOEC08	Optical Instruments	3
9	PHYOEC09	Physics for All	3
10	PHYOEC10	Space Missions	3

Note: Students with core papers other than Physics who would like to make Physics as minor subject in third year by changing one of the core subjects are advised to take PHYOE01 and PHYOE06 as open electives in I and II semesters respectively.

Discipline Specific Electives (DSE)

Sl. No.	Code	Course Title	Credits
Discipline Specific Electives for semester VII			
1	PHYDSE01	Condensed Matter Physics – 1	
2	PHYDSE02	Nuclear and Particle Physics – 1	
3	PHYDSE03	Theoretical and Computational Physics	
4	PHYDSE04	Biophysics	
5	PHYDSE05	Astrophysics and Astronomy	
Discipline Specific Electives for semester VIII			
7	PHYDSE06	Atomic and Molecular Physics – 1	
8	PHYDSE07	Material Science and Nano Materials	
9	PHYDSE08	Lasers and Non-linear Optics	
10	PHYDSE09	Plasma Physics	
11	PHYDSE10	Physics of Semiconductor Devices	
12	PHYDSE11	Radiation and Accelerator Physics	
Discipline Specific Electives for Semester IX (Specialization papers)			
13	PHYDSE12	Condensed Matter Physics – 2	
14	PHYDSE13	Nuclear and Particle Physics – 2	
15	PHYDSE14	Atomic and Molecular Spectroscopy – 1	
16	PHYDSE15	Material Physics and Nanophysics – 1	
17	PHYDSE16	Theoretical and Computational Physics – 1	
18	PHYDSE17	Astronomy and Astrophysics – 1	
Discipline Specific Electives for Semester X (Specialization papers)			
19	PHYDSE18	Condensed Matter Physics – 3	
20	PHYDSE19	Nuclear and Particle Physics – 3	
21	PHYDSE20	Atomic and Molecular Spectroscopy – 2	
22	PHYDSE21	Material Physics and Nanophysics – 2	
23	PHYDSE22	Theoretical and Computational Physics – 2	
24	PHYDSE23	Astronomy and Astrophysics – 2	

Note:

- Students who wish to study courses PHYDSE13, PHYDSE14, PHYDSE21, PHYDSE22, PHYDSE23 and PHYDSE24 must have studied PHYDSE01, PHYDSE02, PHYDSE15, PHYDSE16, PHYDSE17, PHYDSE18 respectively.
- Students who wish to study PHYDSE19 must have studied both PHYDSE01 and PHYDSE13.
- Students who wish to study PHYDSE20 must have studied both PHYDSE02 and PHYDSE14.

Skill Enhancement Courses (SEC)

Sl. No.	Code	Course Title	Credits
For Semester I			
1	PHYSEC01	Domestic and industrial electrical networking	1+1
2	PHYSEC02	Instrumentation and measurement	1+1
3	PHYSEC03	Mathematical ability for competitive examinations – 1	1+1
4	PHYSEC04	Science Communication	1+1

Detailed Syllabus of Discipline Specific Core Courses for Semester-I and II

Course Content for Semester – I

PHYDSC01: Mechanics and Properties of Matter

Course Title	**Mechanics and Properties of Matter**
Course code	**PHYDSC01**
Course credits	**4+2**
Total Contact Hours	**52+52**
Model Syllabus Authors	**State Physics Expert Committee**

Chapter Number	Topics to be covered	Contact hours
Unit - 1		
Chapter-1	**Units and Measurements**: System of units (CGS and SI), dimensional formulae of physical quantities. Measurement, errors and error analysis; Standard deviation. Problems	3
Chapter-2	**Momentum and Energy**: Momentum, Work and energy, Conservation of linear momentum (statement and proof). Conservation of energy (statement and proof) with examples. Motion of rockets (Equation of motion for variable mass system, expression for velocity and acceleration of single stage rockets). Problems	5
Chapter-3	**Special Theory of Relativity:** Frames of References, Constancy of speed of light. Postulates of Special Theory of Relativity. Lorentz transformations, Length contraction and Time dilation illustrations. Relativistic addition of velocities. Problems	5
Topics for self-study		
	Measurement of length, mass, time and other fundamental physical quantities.	
Suggested Activities for students		
Activity-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. students can estimate standard deviations wherever possible.	
Activity-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-4	**Laws of Motion:** Newton's Laws of motion. Dynamics of single and a system of particles (Conservation of momentum and energy). Centre of mass. Problems	2
Chapter-5	**Dynamics of Rigid bodies**: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. moment of inertia: Parallel and perpendicular axes theorem (statement only), M I of a rectangular Lamina and solid cylinders. Flywheel, Theory of compound pendulum and determination of g. Problems	6
Chapter-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 (Expression for orbital velocity, period of revolution). Problems	5
Topics for self-study		
	Geosynchronous orbits. Basic idea of global positioning system (GPS). Escape velocity, Problems	
Suggested Activities for students		
Activity-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	
Activity-4	Activity: Prepare suitable charts and give seminar talks in the class	
Unit - 3		
Chapter-7	**Oscillations:** Simple harmonic oscillations, kinetic, potential and total energies of particle executing SHM, Forced oscillations and damped oscillations (qualitative), resonance. Problems	4
Chapter-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-	9

	Twisting couple on a cylinder. Torsional pendulum- Determination of rigidity modulus and moment of inertia - q, η and σ by Searle's method. Problems	
Topics for self-study		
	Yield point stress and elastic limit; Plastic deformations	
Suggested Activities for students		
Activity-5	**Activity:** Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale alongside. 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-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-9	**Surface tension:** Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface, excess pressure inside spherical liquid drops and bubble, angle of contact. Variation of surface tension with temperature and impurities. Problems.	7
Chapter-10	**Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poiseuille's method, Stoke's method. Variation of viscosity with temperature. Lubrication and lubricants. Problems.	6
Topics for self-study		
	Capillarity determination of surface tension by drop weight method. Problems	
Suggested Activities for students		
Activity-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-8	Activity: 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	D. S. Mathur	S. Chand and co	2000
2.	Mechanics and Relativity	Vidwan Singh Soni	PHI Learning Pvt. Ltd	2013
3	Mechanics: Berkeley Physics Course	Charles Kittel	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal and Subramanyam	S. Chand and co	2002
5	Concepts of Physics	H. C. Verma	Bharathi Bhawan	2017

Reference Books:

Sl. No.	Title of the book	Authors name	Publisher	Year of publication
1	An introduction to Error analysis	John R. Taylor	University Science Books	1997
2	Physics	Resnick, Halliday and Walter	Wiley	2010
3	Physics Vol-I	Halliday and Resnick	John Wiley & sons	2013

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

Formative assessment should be based on continuous evaluation of student's performance. It should include internal test, assignments, seminars, performing activities and any other component as necessary.

Students should be given multiple chances to improve his or her formative assessment marks.

Course Content for Semester – II

PHYDSC02: Electricity and Magnetism

Course Title	**Electricity and Magnetism**
Course code	**PHYDSC02**
Course credits	**4+2**
Total Contact Hours	**52+52**
Model Syllabus Authors	**State Physics Expert Committee**

Chapter Number	Topics to be covered	Contact hours
Unit-I		
Chapter-1	Electric charge and field, Coulomb's law, electric field strength, electric field lines and flux, point charge and electric dipole in an electric field; Problems.	2
Chapter-2	Gauss's law and its applications, Electric fields of a spherical charge distribution, line charge and infinite flat sheet of charge. Problems.	2
Chapter-3	Electric potential: Definition of electric potential; Relation between electric field strength and potential - Electric potential as line integral for electric field and electric field as gradient of potential; Work done by a charge, derivation of the expression for potential energy; 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 an electric dipole. Potential due to electric quadrupole (qualitative). Problems.	9
Topics for self-study		
	Vector Calculus: Vector differentiation - Gradient, divergence and curl; Line, Surface and Volume integral.	
Suggested Activities for students		
Activity-1	Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries.	

	A small project report on production of electricity as a source of energy: Different methods.	
Activity-2	Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
Unit-II		
Chapter-4	Conductors and insulators in electric field; Atomic view of dielectric materials; Capacitance and capacitors; Calculation of capacitance in a parallel plate capacitor (with and without dielectric); Energy stored in a capacitor; Guass's law in dielectrics. Problems.	5
Chapter-5	Electric currents and current density; Derivation for the expression for electrical conductivity and Ohm's law; Physics of electrical conduction (conduction in metals and semiconductors); Circuits and circuit elements – resistors, capacitors and inductors; Variable currents in capacitor circuits; Combination of resistor, inductor and capacitors. Problems.	8
Topics for self-study		
	Types of resistors and capacitors; Capacitance of earth	
Suggested Activities for students		
Activity-3	Learn about electrical appliances which work with AC and DC electricity Learn about types of resistors and their colour codes and types of capacitors (electrolytic and non-electrolytic)	
Activity-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-III		
Chapter-6	Magnetism: Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux); Magnetic field due to straight conductor and a circular coil; Magnetic force on a moving point charge and a current carrying conductor. Electromagnetic induction: Emf induced in a conducting rod moving in a magnetic field; Laws of induction; Self	6

	inductance and mutual inductance; Energy stored in a magnetic field. Problems.	
Chapter-7	Alternating current circuits: Theories of RL circuit (growth and decay), RC circuit (charging and discharging), LC circuit (charging and discharging) and LCR circuit (charging and discharging); Resonance, quality factor, admittance and impedance; power and energy in AC circuits. Problems.	7
Topics for self-study		
	Hall Effect and problems.	
Suggested Activities for students		
Activity-5	Prepare a small project report on street lighting and types of electrical bulbs. Learn the measurement of electric current using tangent galvanometer.	
Activity-6	Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
Unit-IV		
Chapter-8	Electromagnetic waves: Equation of continuity; Maxwell's equations (in free space and material medium); Displacement current; Expression for velocity of electromagnetic waves (in free space and material medium); Transverse nature of electromagnetic waves; Energy transported by electromagnetic waves – Poynting theory and Poynting vector. Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility. Problems	10
Chapter-9	Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves. Problems.	3
Topics for self-study		
	B-H curves and its characteristics Ferrites	
Suggested Activities for students		
Activity-7	1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. Learn the principle of working of a Gauss meter to measure magnetic field	
Activity-8	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 Tangent 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.
13.	Determination of magnetic field along the axis of a current carrying circular coil

(Minimum EIGHT experiments have to be carried out)

Formative assessment should be based on continuous evaluation of student's performance. It should include internal test, assignments, seminars, performing activities and any other component as necessary.

Students should be given multiple chances to improve his or her formative assessment marks.

Detailed Syllabus of Open Elective Courses in Physics

PHYOEC01: Mechanics, Elasticity and Fluid Dynamics

Course Title	**Mechanics, Elasticity and Fluid Dynamics**
Course code	**PHYOE01**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**BoS, Tumkur University**

Chapter Number	Topics to be covered	Contact hours
Unit - 1		
Chapter-1	**Units and Measurements**: System of units (CGS and SI), dimensions of physical quantities, dimensional formulae.	2
Chapter-2	**Momentum and Energy**: Work and energy, Conservation of linear momentum. Conservation of energy with examples. Newton's Laws of motion. Dynamics of single and a system of particles.	5
Chapter-3	**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 circular ring.	6
Topics for self-study		
	Centre of mass, Kinetic energy and potential energy, Newtons laws for rotational motion	-
Suggested Activities for students		
Activity-1	3. i). Students can measure diameters of small balls of different size and estimate their volumes. 4. 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. students can estimate standard deviations wherever possible.	-
Activity-2	Students can try and understand conservation of energy in every day examples. For example: iv) What happens in solar conservation panels v) Pushing an object on the table it moves	-

	vi) 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-4	**Gravitation:** Law of Gravitation. Acceleration due to gravity, Weightlessness, Satellite in a circular orbit: Orbital velocity, escape velocity, time period of revolution	6
Chapter-5	**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 twisting a wire, Torsional Pendulum-Determination of rigidity modulus and moment of inertia	7
Topics for self-study		
	Variation of g with height and depth, Elastic constants of different materials and comparison, Methods to measure elastic constants.	
Suggested Activities for students		
Activity-3	**Activity:** Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale alongside. 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.	
Unit - 3		
Chapter-6	**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.	7
Chapter-7	**Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method	6
Suggested Activities for students		
Activity-4	Surface tension dependence on temperature and impurities, viscosity of liquids dependence on temperature	

Activity-5	2. 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-7	Activity: 3. 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. 1. List the applications where concept of Viscosity plays a dominant role	

Reference books

Sl. No.	Title of the book	Authors name	Publisher	Year of publication
1	Mechanics	D. S. Mathur	S. Chand and co	2000
2.	Mechanics and Relativity	Vidwan Singh Soni	PHI Learning Pvt. Ltd	2013
3	Mechanics: Berkeley Physics Course	Charles Kittel	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal and Subramanyam	S. Chand and co	2002

PHYOEC02: Energy Sources

Course Title	**Energy Sources**
Course code	**PHYOE02**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**State Physics Expert Committee**

Unit	Content	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.	13
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.	
Unit-II: Renewable energy sources		
Chapter-3	**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.	13
Chapter-4	**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.	

Unit-III: Wind and Tidal Energy Harvesting		
Chapter-5	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.	13
Chapter-6	Geothermal Resources, Geothermal Technologies. Hydropower resources, hydropower technologies, environmental impact of hydropower sources. Carbon captured technologies, cell, batteries, power consumption.	
	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). http://en.wikipedia.org/wiki/Renewable_energy	

PHYOEC03: Physics in Daily Life

Course Title	**Physics in Daily Life**
Course code	**PHYOE03**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**BoS, Tumkur University**

Chapter Number	Topics to be covered	Contact hours
Unit - I		
Chapter-1	**Motion**: Motion and its properties; Concept of inertia; Jerking when accelerated or decelerated as examples, importance of car seat belts. Relative motion and addition of velocities. Conservation laws (Linear momentum, angular momentum and energy). Balancing of bicycle, rolling of solid and hallow cylinders as examples.	13
Chapter-2	**Oscillations and Waves**: Simple harmonic oscillations, pendulums as examples; Waves-types of waves and their propagation; Sound-velocity of sound in air, its variation as function of temperature and humidity; Musical notes and resonance; Doppler effect.	
Topics for self-study		
	Centripetal force, Coriolis force and banking of roads	
Suggested Activities for students		
Activity-1	Drop two objects of different masses and find out the time taken by them to reach the ground-justify. Try to balance the bicycle when it is at rest. Explain why it is easy to balance bicycle when it is moving fast. Take bouncy ball drop from a height and check what height it can reach after getting reflected by ground. Repeat the experiment with different balls and explain the result.	
Unit-II		
Chapter-3	**Light:** Theories of light; reflection, refraction and total internal reflection. Formation of rainbow. Diffraction and interference (definitions and types only). Formation of	13

	halos around moon. Scattering of light: Blue colour of sky and red colour of rising or setting sun.	
Chapter-4	**Heat:** Heat and temperature; Good and bad conductors and their applications; Law of cooling and applications; Thermodynamic processes – examples; Phase transitions – effect of impurities on melting and boiling points (Addition of salt to frost);	
Topics for self-study		
	Formation of mirage; Specific heat and heat capacities.	
	Suggested Activities for students	
Activity-2	Observe the edge of shadows and find out whether the edge is sharp as the object and explain what you see. Take two glasses of filled to half with boiling water. Add room temperature water to one of the glasses to fill it completely. Leave for five minutes and then add the room temperature water to the other glass. Now measure the temperature of water in both the glasses and explain what you find out. Take ice and add some salt on to it. Observe what happens.	
Unit-III		
Chapter-5	**Radiation:** Electromagnetic spectrum, common sources of various types of radiation and their properties. Radio communication, working of microwave oven, IR thermometer and pulse oximeter; Visible light-basic and complementary colours; Ultra-violet radiation and its hazard, importance of Ozone layer; X-rays, principle and application.	13
Chapter-6	**Radioactivity**: Types of radioactivity, radiation hazard; Application of radiations in medicine; Radiation level detection and radiation safety.	
Topics for self-study		
	Electromagnetic shielding	-
Suggested Activities for students		
Activity-3	Measure the temperature of various systems like hot pan, red charcoal, candle fire, gas stove flame etc, using IR thermometer. Explain the results. Combine different colours and find out what colour you get. Compare the colours based on their frequency or wavelength from the electromagnetic spectrum.	-

	Visit a nearby hospital where radiation therapy is being administered for cancer patients. Find out what kind of radiations are employed.	
	Reference Books 1. The Physics Behind: Discover the Physics of Everyday Life, Russ Swan, Firefly books, 2018 2. Physics in Daily Life, Nibu A George, Lilly Publishing House, 2019 3. Physics in Daily Life-I, Murat Uhrayoglu, Lulu.com, 2011 4. Physics in Daily Life-II, Murat Uhrayoglu, Lulu.com, 2012	

PHYOEC04: Electrical Instruments

Course Title	**Electrical Instruments**
Course code	**PHYOE04**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**State Physics Expert Committee**

Chapter Number	Topics to be covered	Contact hours
Unit - I		
Chapter-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)	13
Chapter-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.	
Chapter-3	Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications.	
Topics for self-study		
	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 for students		
Activity-1	Identify variety of electrical switches and note down their applications/utility. Identify the hazards involved in handling electrical circuits and instruments, make a list of safety precautions as well as first aid for electrical shocks.	
Unit-II		

Chapter-4	Galvanometers: General principle and performance equations of D'Arsonval Galvanometers, Vibration Galvanometer and Ballistic Galvanometer.	13
Chapter-5	Potentiometers: DC Potentiometer, Crompton potentiometer, construction, standardization, application. AC Potentiometer, Drysdale polar potentiometer; standardization, application.	
Chapter-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 Schering bridge, errors, Wagner's earthing device, Kelvin's double bridge.	
Topics for self-study		
	Importance of grounding and Earthing, Methods for Earthing	
Suggested Activities for students		
	Make a study of importance of grounding in electrical circuits. Prepare a detailed account of various methods of earthing and their utility/applications	
Unit-III		
Chapter-7	Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer (LVDT), Capacitive Transducers, Peizo-Electric transducers, Optical Transducer, Hall Effect Transducer	13
Chapter-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	
Chapter-9	Basics of lead acid batteries, Lithium Ion Battery, Battery storage capacity, Coulomb efficiency, Numerical of high and low charging rates, Battery sizing.	
Topics for self-study		
	Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED	
Suggested Activities for students		
	Prepare a document on evolution of incandescent bulbs to the present-day LED lights Make a comparative study of Fuses, MCB, ELCB and Relays highlighting their use and applications	
	Reference Books	

	1. AK.Sawhney, A Course in Elec. & Electronics Measurements & Instrumentation, Dhanpatrai & Co. 1978 2. A.D. Helfrick & W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques PHI,2016 3. D C Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications,2019 4. David G Alciatore and Michel B Histand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata McGraw Hill Education Private Limited, New Delhi., 2005 5. Vincent Del Toro, Electrical Engineering Fundamentals Prentice Hall India2009	

PHYOEC05: Sports Science

Course Title	**Sports Science**
Course code	**PHYOE05**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**State Physics Expert Committee**

Chapter Number	Topics to be covered	Contact hours
Unit - I		
Chapter-1	**Measurement**: Physical quantities. Standards and Units. International system of Units. Standards of time, length and mass. Precision and significant figures.	13
Chapter-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.	
Chapter-3	**Projectile motion**: Shooting a falling target. Physics behind Shooting, Javelin throw and Discus throw.	
Topics for self-study		
	https://www.real-world-physics-problems.com/physics-of-sports.html	-
Suggested Activities for students		
Activity-1	Identify variety of electrical switches and note down their applications/utility. Identify the hazards involved in handling electrical circuits and instruments, make a list of safety precautions as well as first aid for electrical shocks.	
Unit-II		
Chapter-4	**Conservation laws**: Conservation of linear momentum, collisions – elastic and inelastic. Angular momentum. (Physics behind Carom, Billiards, Racing)	13
Chapter-5	**Centre of mass**: Physics behind Cycling, rock climbing, Skating,	
Chapter-6	**Gravitation**: Origin, Newton's law of gravitation. Archimedes's principle, Buoyancy (Physics behind swimming)	
Topics for self-study		

	Archimedes' Principle: Made EASY | Physics in You tube	
Suggested Activities for students		
	Make a study of importance of grounding in electrical circuits. Prepare a detailed account of various methods of earthing and their utility/applications	
Unit-III		
Chapter-7	**Food and Nutrition:** Proteins, Vitamins, Fat, Blood pressure. Problems due to the deficiency of vitamins.	13
Chapter-8	**Energy:** Different forms of Energy, Conservation of mass-energy.	
Chapter-9	**Physical exercises:** Walking, Jogging and Running, Weight management.	
Topics for self-study		
	10 Best Exercises for Everyone – Healthline	
Suggested Activities for students		
	Prepare a document on evolution of incandescent bulbs to the present day LED lights Make a comparative study of Fuses, MCB, ELCB and Relays highlighting their use and applications	
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

PHYOEC06: Electromagnetism

Course Title	**Electromagnetism**
Course code	**PHYOE06**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**BoS, Tumkur University**

Chapter Number	Topics to be covered	Contact hours
Unit-I		
Chapter-1	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.	4
Chapter-2	Gauss's law and its applications, Electric fields of a spherical charge distribution, line charge and infinite flat sheet of charge.	4
Chapter-3	Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges	5
Topics for self-study		
	Constant potential surfaces, Electric potential due to line charge, spherical charge distribution	
Suggested Activities for students		
Activity-1	Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries. A small project report on production of electricity as a source of energy: Different methods	
Activity-2	Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
Unit-II		
Chapter-4	Conductors in electrostatic field: Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate	6

	capacitor, parallel plate capacitor with dielectric, Energy stored in a capacitor, Dielectrics and Guass's law	
Chapter-5	Magnetism: Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor. 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
Topics for self-study		
	Types of resistors and capacitors; Capacitance of earth, AC dynamo	
Suggested Activities for students		
Activity-3	Learn about types of resistors and their colour codes and types of capacitors (electrolytic and non-electrolytic)	
Activity-4	4. Learn about power transmission: 3-phase electricity, voltage and phase 5. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? 6. Prepare a small project report on street lighting and types of electrical bulbs.	
	7. Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
Unit-III		
Chapter-6	Electromagnetic waves: Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility	13
Chapter-7	Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves.	
Topics for self-study		
	Hall Effect	
Suggested Activities for students		
Activity-5	Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets	

	and superconducting magnets. Learn the principle of working of a Gauss meter to measure magnetic field	
Activity-6	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.	

Reference 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

PHYOEC07: Climate Science

Course Title	**Climate Science**
Course code	**PHYOE07**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**State Physics Expert Committee**

Chapter Number	Topics to be covered	Contact hours
Unit-I		
Chapter-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. Greenhouse gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere.	13
Topics for self-study		
	Distribution of winds; Indian monsoon and its importance	
Unit-II		
Chapter-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
Topics for self-study		

	Contribution of remote sensing and GPS to climate science	
Unit-III		
Chapter-3:	**Global Climate Change** Greenhouse effect and global warming, Enhancement in concentration of carbon dioxide and other greenhouse 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
	Activities to be carried out on Climate Science: 1. Try to find answer to the following questions: (a) Imagine you are going in an 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. 4. Design your own rain gauge for rainfall measurement at your place. 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 3. (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.	

PHYOEC08: Optical Instruments

Course Title	**Optical Instruments**
Course code	**PHYOE08**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**State Physics Expert Committee**

Chapter Number	Topics to be covered	Contact hours
	Unit-I	
Chapter -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
	Topics for self-study	
	Normal shift and lateral shift	
	Unit-II	
Chapter - 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 (Construction part can be discussed through block diagrams)	13
	Topics for self-study	
	Experimental determination of magnifying power of a microscope.	
	Unit-III	
Chapter - 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.	13
	Topics for self-study	

	Telescopes used at different observatories in and outside India.	
	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.	

PHYOEC09: Physics for All

Course Title	**Physics for all**
Course code	**PHYOE09**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**State Physics Expert Committee**

Chapter Number	Topics to be covered	Contact hours
Unit-I		
Chapter 1	**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
Chapter-2	**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; angular momentum and torque.	
Topics for self-study		
	Working of Hot air and helium balloons	
Unit-II		
Chapter - 3	**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
Topics for self-study		
	Nuclear fission and nuclear reactors	
Unit - III		
Chapter-4	**Climate change** Global warming; IPCC; A brief history of climate; carbon dioxide; The greenhouse effect; Enhancement of Greenhouse effect; Hurricane	13

	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.	
Topics for self-study		
	Initiations and laws around the world to fight against global warming.	
	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).	

PHYOEC10: Space Missions

Course Title	**Space Missions**
Course code	**PHYOE10**
Course credits	**3**
Total Contact Hours	**39**
Model Syllabus Authors	**State Physics Expert Committee**

Chapter Number	Topics to be covered	Contact hours
Unit I:	**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**
Unit II:	**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**
Unit III:	**Indian Space Research Organization (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**
Topics for 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		
	Activities - 1 • 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 on Apollo 11: A Success story **Activities - 2** • Preparation of report and presentation on the recent space missions of NASA. • Preparation of report on any one proposed space programme of NASA. * Faculty may suggest any other relevant activity as well. Chandrayaan 1: Details and applications. Mars Orbiter Mission: Details and applications. **Activities - 3** • Preparation of report and presentation on the recent space missions of ISRO. • Preparation of report and presentation on any one proposed space programme of 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.	

Detailed Syllabus of Skill Enhancement Courses in Physics

PHYSEC01: Domestic and Industrial Electrical Networking

Course Title	**Domestic and Industrial Electrical Networking**
Course code	**PHYSEC01**
Course credits	**1+1**
Total Contact Hours	**13+26**
Model Syllabus Authors	**BoS, Tumkur University**

Chapter Number	Topics to be covered	Contact hours
Chapter-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).	13
Chapter-2	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 meters.	
Chapter-3	Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications.	
Chapter-4	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 for students		
Activity-1	Identify variety of electrical switches and note down their applications/utility. Identify the hazards involved in handling electrical circuits and instruments, make a list of safety precautions as well as first aid for electrical shocks. Make a study of importance of grounding in electrical circuits. Prepare a detailed account of various methods of earthing and their utility/applications	

	Make a comparative study of Fuses, MCB, ELCB and Relays highlighting their use and applications	
List of Experiments to be performed in the Laboratory		
1	Preparing a three-pin extension box.	
2	Design and construction of ammeter.	
3	Design and construction of voltmeter.	
4	Setting up of a model household electrical network.	
5	A model earthing setup.	
6	Setting up and analysis of single-phase motor starter box.	
7	Setting up and analysis of three phase motor starter box.	
8	Determination and verification of household electrical load.	
9	Design and setting up of automatic water level indicator system.	
Books for reference		
	1. AK.Sawhney, A Course in Elec. & Electronics Measurements & Instrumentation, Dhanpatrai & Co. 1978 2. A.D. Helfrick & W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques PHI,2016 3. D C Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications,2019 4. David G Alciatore and Michel B Histand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata McGraw Hill Education Private Limited, New Delhi., 2005 5. Vincent Del Toro, Electrical Engineering Fundamentals Prentice Hall India2009	

PHYSEC02: Instrumentation and Measurement

Course Title	**Instrumentation and Measurement**
Course code	**PHYSEC02**
Course credits	**1+1**
Total Contact Hours	**13+26**
Model Syllabus Authors	**BoS, Tumkur University**

Chapter Number	Topics to be covered	Contact hours
Chapter-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)	13
Chapter-2	AC and DC power sources. Conversion of AC to DC, rectifiers and regulators. Current limiting networks; DC regulated power supply. Audio oscillators: Principle of oscillators, barkhausen criteria, fixed frequency and variable frequency oscillators, IC-555 and its applications	
Chapter-3	Sensors: Temperature sensors (thermostat), Light sensors (IR and visible), moisture sensors, motion sensers, smoke detectors,	
Chapter-4	Types of switches and Circuits, Safety precautions and rules in handling electrical appliances, earthing, Electric shock Fuses, MCB, ELCB and Relays. Design of simple circuits for lighting, heating and security applications.	
Suggested Activities for students		
Activity-1	Design simple electrical networks and determine the current through and voltages across various branches. Find out various types of voltage regulations and learn their advantages and disadvantages. Take an electrical appliance and enlist the components used in that. Visit an electrical appliance repair shop and prepare a chart of frequently used components and their applications. Design and prepare a printed circuit board (PCB)	
List of Experiments to be performed in the Laboratory		
1	Preparation of a printed circuit board (PCB) and	

	construction of related instrument.	
2	Design and construction of a regulated DC power supply	
3	Design and construction of fixed/variable frequency audio oscillator	
4	Construction of an incubator with temperature control	
5	Setting up of modern lighting system using light and motion sensors.	
6	Setting up of irrigation system using moisture sensor.	
7	Setting up of automatic water level controller system.	
8	Design and construction of ammeter.	
9	Design and construction of voltmeter.	
Books for Reference		
	1. AK.Sawhney, A Course in Elec. & Electronics Measurements & Instrumentation, Dhanpatrai & Co. 1978 2. A.D. Helfrick & W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques PHI,2016 3. D C Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications,2019 4. David G Alciatore and Michel B Histand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata McGraw Hill Education Private Limited, New Delhi., 2005 5. Vincent Del Toro, Electrical Engineering Fundamentals Prentice Hall India2009	

PHYSEC03: Mathematical ability for competitive examinations – 1

Course Title	**Mathematical ability for competitive examinations – 1**
Course code	**PHYSEC03**
Course credits	**2+0**
Total Contact Hours	**26**
Model Syllabus Authors	**BoS, Tumkur University**

Chapter Number	Topics to be covered	Contact hours
Unit-I	Arithmetical Ability: Problems on HCF and LCM; simplification of decimal fractions; problems on ages; percentage; profit and loss; Ratio proportion; Partnership; chain rule; pipes and cisterns; Time and work	13
Unit-II	Time and distance; Boats and streams; Problems on trains; Volume and surface area; Calendars and clocks; Permutations and combination; Probability; Heights and distances; Races and games of skill.	13
Suggested Activities for students		
Activity-1	Collect various problems related to mathematical ability from different competitive exams and solve them.	
Books for Reference		
	1. Quantitative Aptitude, R. S. Agarwal, S. Chand pub, 2017 2. Quantitative Aptitude – Quantum CAT, Sarvesh K. Verma, Arihant pub, 2020	

PHYSEC04: Science Communication

Course Title	**Science Communication**
Course code	**PHYSEC04**
Course credits	**1+1**
Total Contact Hours	**13+26**
Model Syllabus Authors	**BoS, Tumkur University**

Chapter Number	Topics to be covered	Contact hours
Unit-I	Science writing- introduction to science writing, why science communication, types of science writing-news, news articles, blogs, websites, newsletters, popular science books etc. Use of storytelling crafts in science writing, understanding the elements of a story Understanding what makes for a good science story, picking out a story from a research paper, identifying sources. Key principles for effective writing. Difference between popular science writing and research article-change of register (in language) avoiding equations, familiarising the audience with terms and concepts Identifying the story-what to communicate-choosing a topic, reviewing the sections of a scientific manuscript. Understanding tables and figures. Writing results, methods, introduction, and discussion sections. Components of a popular science article- title, opening paragraph, body, conclusion Language and length, style, describing methods and results identifying audience's language Reporting a story-presentation-making it effective, critically evaluating a research paper, interviewing scientists, background research Outlining and creating a narrative flow, crafting quality leads and headlines Writing with strong, active verbs, writing in the active voice, avoiding turning verbs into nouns; choosing strong verbs etc. A catchy title, the subjective element, relevance, the myth of complex topics Writing draft, self-editing and revising draft, sealing with the curse of jargon, importance of checking facts	13
Activities for students		
Activity	1. Student will be asked to study at least two sources from each category of science writing.	26

	2. Student will be asked to identify different forms of science writing 3. Student will be asked to identify a topic and collect proper resources 4. Student will asked to identify a research publication and to examine the factors to consider while preparing his/her own story. 5. Student will be asked to structure a narrative based on his/her study 6. Student will be asked to prepare a) 3 news articles, b) 3 press releases, c) 3 blog articles d) 1 book chapter with suitable headlines based his/her study of research publications chosen	
References		
	Visit this website:https://thewire.in/culture/science-communication -desiraju-twitter Visit this website: https://questproject.eu/how-to-improve-science-communication-consider-these-12-guiding-principles/ Visit the website: https://science.thewire.in/the-sciences/a -beginners -guide-to-writing-a-popular-science-article-by-a-teacher/ Visit this website: https://www.americanscientist.org/blog/from-the -staff/12-tips-for-scientists-writing-for-the-general-public Visit this website: https://www.nytimes.com/2021/04/29/learning/star- polymers-space-origami-and-singing-finches-the-winners -of-our-2nd- annual-stem-writing-contest.html Visit this website: https://www.nytimes.com/2020/12/23/learning/our-2nd-annual-stem-writing-contest.html#link-323f5ccc Visit this website: https://www.nytimes.com/2020/01/23/learning/informational-writing-unit.html Visit this website: https://www.nytimes.com/2021/04/29/learning/star-polymers-space-origami-and-singing-finches-the-winners-of-our-2nd- annual-stem-writing-contest.html#:~:text=Star%20Polymers%2C%20Space%20Origami% 20and,Contest%20%2D%20The%20New%20York%20Times Visit this website: https://en.wikipedia.org/wiki/Popular_science Visit this website: https://en.wikipedia.org/wiki/List_of_science_magazines Visit this website: https://en.wikipedia.org/wiki/Science_book#Notable_examples	