Detailed Syllabus for Semesters I & II of
B.Sc (Honours) Physics

Semester I
DSC-A1: 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: 30	Summative Assessment Marks: 70

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)

Course Outcomes (COs) *(UGC guidelines)*	Programme Outcomes (POs)					
	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.

DSC A1: Mechanics & Properties of Matter (Credits 4+2)		52 Hrs
Unit 1		
Chapter 1	**Units and measurements:** Fundamental and Derived units, Principal system of units (CGS & SI), measurement of length, mass & time; Dimensions- dimensional formulae & equations- use of dimensions, conversion of one system of units into another, errors.	(13)
Chapter 2	**Momentum and Energy**: Concept of Work, Energy and Linear momentum, Conversion of linear momentum and examples, Conversion of energy and examples. Motion of rockets (single stage): system of variable mass.	
Chapter 3	**Special Theory of Relativity:** Einstein's concept of special theory of relativity, basic postulates of special theory of relativity, Lorentz transformation of space and time, Length contraction and Time dilation.	
Topics for 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 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 4significant figures. Ask them to mention the precession of the measurement. v). 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, centre of mass of system of two and many particles.	(13)
Chapter 5	**Dynamics of Rigid bodies**: Rigid body- translational and rotational motion. Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. Moment of inertia- Theorem of parallel and perpendicular axis (only statement), Moment of inertia of a rectangular lamina and solid cylinders. Moment of inertia of flywheel. Theory of compound pendulum and determination of g.	
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.	
Self study	Geosynchronous orbits. Basic idea of global positioning system (GPS).	

		Ref: 1-4,9,10
	Suggested Activities	
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.	
	Reference: www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn	
Activity 4	Activity: Prepare suitable charts and give seminar talks in the class.	
	Unit 3	
Chapter 7	**Elasticity:** Load, stress and strain, Hook's law and elastic limit, stress-strain diagram, Elastic moduli- relation between elastic constants, Poison's ratio- expression for Poison's ratio in terms of elastic constants, work done in stretching a wire, twisting couple on a cylinder, Torsional pendulum, determination of rigidity modulus by torsional pendulum, Young's modulus by uniform bending Problems.	(13)
	Suggested Activities	
Activity 5	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 6	Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	
	Unit 4	
Chapter 8	**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 9	**Viscosity:** Laminar or viscous flow, co-efficient of viscosity, streamline flow and turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's and Stoke's method, Problems.	
Self study	Capillarity determination of surface tension by drop weight method.	
		Ref: 6,7,9,10
	Suggested Activities	

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	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. iv) List the applications where viscosity plays a dominant role	

Note: 1. Activities have to be carried out compulsorily. In addition to the suggested activities, teacher has to encourage students to carry out many possible activities under every unit. 2. Enough number of numerical/analytical problems must be solved in every chapter.

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,		

DSC A1: Practical - I (2 credits)

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.

Note: Minimum EIGHT experiments have to be carried out.

Reference Books 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 UG 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

Open Elective theory course for Semester I
(OE-I: Sports Science)

PROGRAMME OUTCOME

1. Students will come to know about physical quantities their units used internationally.
2. Students will learn about Newton's laws their applications in day to day life.
3. Students will learn about projectile motion.
4. Students will learn about conservation laws associated with momentum and energy, centre of mass and gravitation which are very useful in sports.
5. Students will realize science around Food and nutrition.
6. Students will learn the Physics that is associated with physical exercises.

OE – I : Sports Science (3 credits)		**39 Hrs**
Unit 1		
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**	
Unit 2		
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	
Unit 3		
Chapter 7	**Food and Nutrition:** Proteins, Vitamins, Fat, Blood pressure. Problems due to the deficiency of vitamins.	

Chapter 8	**Energy:** Different forms of Energy, Conservation of mass-energy.	(13)
Chapter 9	**Physical exercises:** Walking, Jogging and Running, Weight management.	
self study	10 Best Exercises for Everyone – Health line	
	Suggested Activities	
Activity 1	Identify the methods of measurement of time, length and mass from ancient time and build models for them.	
	Reference : History of measurement - Wikipedia https://en.wikipedia.org › wiki › History_of_measurement	
Activity 2	Identify Physics principles behind various Sports activities.	
	Reference : https://www.real-world-physics-problems.com/physics-of-sports.html	
Activity 3	List the difficulties experienced in Gymnastics, Cycling and weight lifting.	
Activity 4	List the difficulties experienced in swimming.	
Activity 5	Learn breathing exercises.	
	Reference : 1)Simple Breathing Exercise for Beginners | Swami Ramdev 2) https://www.yogajournal.com	
Activity 6	Write an essay on Physical health v/s Mental health or conduct a debate on Physical health v/s Mental health.	

Note: Activities have to be carried out compulsorily. In addition to the suggested activities, teacher has to encourage students to carry out many possible activities under every unit.

Text Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Pub.
1	Physics for Entertainment	Yakov Perelman	Create space Ind 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 Int. Pub.	2015

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Pub.
1	Physics	Resnick, Halliday and Krane, Vol 1	Wiley Student Edition.	
2	For the love of Physics	Walter Lewin	Taxmann Pub. Pvt. Ltd	2012
3	An Introduction to the Physics of Sports	Vassilios McInnesSpathopoulos	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/				