TUMKUR UNIVERSITY, TUMAKURU

B.Sc. (Physics)

Course Structure & Syllabus

With Effect from 2024-25

DISCIPLINE SPECIFIC CORE COURSE (DSC)

FOR SEMESTER I & II

TUMKUR UNIVERSITY, TUMAKURU

B.Sc. (Physics)

Effective from 2024-25

Sem	Type of Course	Theory/ Practical	Course Code	Course Title	Instruction Hour/week	Duration of Exam	MARKS			Credits
							Formative	Summative	Total	
I	DSC 1	**Theory**	PHY101	Mechanics and Properties of Matter	4-Hrs	3-Hrs	20	80	100	4
	DSC 2	**Practical**	PHY102	Mechanics and Properties of Matter	4-Hrs	3-Hrs	10	40	50	2
II	DSC 3	**Theory**	PHY201	Oscillations, Waves, Heat and Thermodynamics	4-Hrs	3-Hrs	20	80	100	4
	DSC 4	**Practical**	PHY202	Oscillations, Waves, Heat and Thermodynamics	4-Hrs	3-Hrs	10	40	50	2

TUMKUR UNIVERSITY

B.Sc. Programme (PHYSICS): 2024-25

QUESTION PAPER PATTERN FOR DSC THEORY

Instruction to Candidates: Answer all the questions.
Time: 3-Hrs **Max. Marks = 80**

PART A

1. **Answer ALL the following questions.** (2 Marks each) **8 X 2 = 16**

a.
b.
c.
d.
e.
f.
g.
h.

PART B

Answer any FIVE questions. (8 Marks each) **8 X 5 =40**

2.
3.
4.
5.
6.
7.
8.
9.

PART C

Answer any SIX of the following. (Problems) (4 Marks each) **6 X 4 = 24**

10.
11.
12.
13.
14.
15.
16.
17.

NOTE: Equal weightage must be given to all units while setting the question paper.

TUMKUR UNIVERSITY

B.Sc. Programme (PHYSICS): 2024-25

SCHEME OF EVALUATION FOR DSC PRACTICAL

(40 Marks for semester end Practical Examination with 3-Hrs duration)

1.	Basic formula with unit and description, nature of graph	: 4 Marks
2.	Tracing of schematic ray/block/circuit diagram with description	: 4 Marks
3.	Tabulation	: 4 Marks
4.	Experimental skill (Performance including connections)	:10 Marks
5.	Calculations and drawing graph	: 6 Marks
6.	Accuracy of the result and unit	: 2 Marks
7.	Record	: 5 Marks
8.	Viva-voce	: 5 Marks

Total: 40 Marks

TUMKUR UNIVERSITY

B.Sc. Programme (PHYSICS): 2024-25

PROGRAM OUTCOMES (PO)

On the completion of three years B.Sc. degree programme, the student will be able to:

PO1	**Disciplinary Knowledge**	Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Communication skills**	Communicates effectively on physical activities with scientific community and with the society at large scale, and write effective reports on science events and design documentation, makes effective communication skills.
PO3	**Critical Thinking and Problem solving:**	Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO4	**Social competence**	Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO5	**Research-related skills and Scientific temper**	Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO6	**Co-operation/Team work/Leadership qualities**	Rendering co-operation and willing to work in team, leading the team with high expectations.
PO7	**Information/Digital Literacy/Modern tool usage**	Utilise the techniques and modern tools for solving complex problems with an understanding of limitations.
PO8	**Environment and Sustainability**	Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Multicultural competence**	Applying the basics of physics in multicultural fields with excellent competence.
PO10	**Multi-disciplinary knowledge**	Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO11	**Moral and ethical Awareness/Reasoning**	Apply ethical principles and commit to professional ethics and responsibilities and norms of scientific practices.
PO12	**Self-directed and Life-long learning**	Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	I
Course Title	Mechanics and Properties of Matter (Theory)		
Course Code	PHY101 (DSC)	No. of Credits	04
Contact Hours	60 Hours	Duration of SEP/Exam	3 Hours
Formative Assessment Marks	20	Summative Assessment Marks	80

COURSE LEARNING OUTCOMES (CO)

After the successful completion of the course, the student will	
CO1	Understand the basics of mechanics like units and measurement, motion of a point particle, Newtonian mechanics and conservation of energy
CO2	Enrich the knowledge of dynamics of system of particles and rigid body
CO3	Get the knowledge and importance of gravitation, elasticity and mechanics of composite materials
CO4	Understand the concepts in fluid mechanics i.e, behaviour of fluids, their viscous property and surface tension

MAPPING OF COURSE LEARNING OUTCOMES (CO) WITH PROGRAMME OUTCOMES (PO)

Course Outcomes (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	1	3	2	3	1				1	3	2
CO2	3	2	3	2	3	1	2		2	2		2
CO3	3	1	3	2	3	1		2	2	2	3	
CO4	3	2	3	2	3	1	2		2	1		3

Score indicators: High=3, Medium=2, Low=1

Pedagogy: Interactive lectures, inquiry based learning, blended learning, learning based on experiments.

I SEMESTER B.Sc. PHYSICS SYLLABUS

PHY101 (DSC)

MECHANICS AND PROPERTIES OF MATTER

Course duration: 16 weeks with 4 hours of instruction per week

UNIT I: BASICS OF MECHANICS

Units, Measurements: System of units (CGS and SI), Dimensional formulae of physical quantities. Measurement, errors and error analysis; Standard deviation. [3 hours]

Motion of a Point Particle: Review of scalars and vectors, Position vector $\vec{r}(t)$ of a moving point particle and its Cartesian, polar components. Velocity and acceleration as the vector derivatives. Derivative of the planar vector of a constant magnitude. Radial and transverse components of velocity and acceleration for arbitrary planar motion, Deduction of results for uniform circular motion, centripetal force, Numerical problems. [5 hours]

Review of Newtonian mechanics: Newton's laws of motion, Concepts of inertia, force, momentum and energy. [2 hours]

Conservation of Energy: Conservative force and non-conservative forces with examples. Conservation of energy in a conservative force field. Applications: (i) Vertical oscillations of a loaded light spiral spring - Derivation and (ii) Estimation of escape velocity in the gravitational field of the earth - Derivation. Conditions for a geostationary satellite. Numerical problems. [5 hours]

UNIT II: DYNAMICS OF SYSTEM OF PARTICLES AND RIGID BODY

Linear Momentum: Definition, Conservation of the linear momentum for a system of two particles. Expression for final velocity of a single-stage rocket - (i) with and (ii) without gravity. Multistage rocket - elementary ideas. Elastic and inelastic collisions – Theory of elastic head-on collision and elastic oblique collision in a lab frame and centre of mass frame. Numerical problems. [5 hours]

Angular Momentum: Review of angular momentum and Torque. Relation between angular momentum and torque. Law of conservation of angular momentum. Derivation of areal velocity expression. Central force: Physical insight into the nature of central forces. Derivations of Kepler's laws of planetary motion using Newton's laws. Numerical problems. [4 hours]

Rigid Body Dynamics: Moment of inertia and radius of gyration. Statements of the theorems of the parallel and perpendicular axes. Relation between torque and angular acceleration. Expression for the kinetic energy of a rigid body. Derivation of expressions of the moment of inertia of regular bodies like rectangular lamina, circular lamina, and a solid cylinder. Numerical problems. [5 hours]

UNIT III: GRAVITATION, ELASTICITY AND MECHANICS OF COMPOSITE MATERIALS

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). Numerical problems. [4 hours]

Elasticity: Concepts of moduli of elasticity, Hooke's Law, and Poisson's ratio σ. Relation between the elastic constants q, k, η and σ, limiting values for σ. Work done in stretching a wire. Elastic potential energy. Theory of bending moment. Theory of a single cantilever. I-section girders. Torsion – calculation of couple per unit twist. The torsional pendulum, Static torsion. Searle's double bar experiment. Numerical problems. [6 hours]

Mechanics of composite materials: Composite materials, Classification of composites: Fiber-Reinforced composites, Laminated composites, Particulate composites, Combination of composites, Mechanical behaviour of various materials, Laminae: Principle types, Stress-strain behaviour of various materials, Applications of composite materials. [5 hours]

UNIT IV: FLUID MECHANICS

Viscocity: Newton's law of viscous flow, Coefficient of viscosity, Streamline and turbulent flow, Equation of continuity, Energy of the fluid, Bernoulli's theorem, Applications of Bernoulli's equation: Curved flight of a spinning ball (Magnus effect), Lift of an Aircraft wing, Critical velocity; Reynolds number and its significance, Motion of a body in a viscous medium - Stoke's law, Stoke's method for coefficient of viscosity, Flow of liquid through a narrow horizontal tube - Poiseuille's formula, Experimental determination of coefficient of viscosity by Poiseuille's method, Variation of viscosity of liquids with temperature and pressure, Numerical problems. [9 hours]

Surface Tension: Surface Energy and Surface Tension – examples, Expression for excess pressure inside curved liquid surface and two special cases, Angle of contact, Surface tension and interfacial tension; theory of drop-weight method, Experimental determination of surface tension by Jaeger's method with relevant theory, Theory of surface tension of mercury by Quincke's method, Numerical problems. [6 hours]

REFERENCE BOOKS

1. Halliday D, Resnick R, and Walker J, Principles of Physics, Ninth edition, Wiley India Pvt. Ltd. (2013).
2. D. S. Mathur and P. S. Hemne, Mechanics, S Chand and Company, Revised Edition (2012).
3. Arora CL, and Hemne PS, Physics for Degree Students, Revised edition, S Chand and Company (2012).
4. Salma Alrasheed, Principles of Mechanics: Fundamental University Physics Advances in Science, Technology & Innovation, Springer Nature Switzerland (2019).

5. Vidvan Singh Soni, Mechanics, Fourth edition, PHI Learning Private Limited, Delhi (2019).
6. Charles Kittel, and Walter Knight, Berkeley Physics Course, Mechanics Vol. 1, Second edition, Tata McGraw Hill (2011).
7. Mathur D S, Elements of Properties of Matter, S Chand and Company (2007).
8. Brij Lal, and Subrahmanyam N, Properties of Matter, Sixth edition, S Chand and Company (2002).
9. Shankara Narayana S R, Mechanics and Properties of Matter, Second Revised edition, Sultan Chand and Sons (1998).
10. Daniel Kleppner, Robert Kolenkow, An Introduction to Mechanics, Second edition, Cambridge University Press (2014).
11. Mahendra K Verma, Introduction to Mechanics, Second edition, Universities Press (2016).
12. Sumit Sharma, Composite materials: Mechanics, Manufacturing and Modeling, CRC Press, First edition. (2021).
13. Autar Kaw, Mechanics of Composite Materials, Second edition, Taylor & Francis (2005).

FORMATIVE ASSESSMENT FOR THEORY	
Assessment Type	**Marks**
Assessment Test	10
Assignment	5
Quiz	5
Total	**20**

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	I
Course Title	Mechanics and Properties of Matter (Practicals)		
Course Code	PHY102 (DSC)	No. of Credits	02
Contact Hours	4 Hours/week	Duration of SEP/Exam	3 Hours
Formative Assessment Marks	10	Summative Assessment Marks	40

I SEMESTER B.Sc. PHYSICS PRACTICALS

PHY102 (DSC)

MECHANICS AND PROPERTIES OF MATTER

Course duration: 16 weeks with 4 hours of lab work per week. Minimum **EIGHT** of the following experiments are to be performed:

1. Estimation of errors (Average deviation, Standard deviation, standard error and Probable error) in the experimental determination of physical quantities like length, diameter, thickness, time, mass, temperature and resistance from the given data. And also fit the given data to a straight-line graph and calculate from the given observations Standard deviation, standard error and Probable error.
2. Drop weight method: Determination of surface tension of liquid and interfacial tension between two liquids.
3. Determination of the surface tension of water by Jaeger's method.
4. Determination of the surface tension of water by Quincke's method.
5. Young's modulus: Single cantilever method using a traveling microscope
6. Searle's double bar: Determination of Young's modulus, rigidity modulus and Poisson's ratio.
7. Study of the relationship between the longitudinal strain and lateral strain in the case of rubber tube and hence to find Poisson's ration for rubber.
8. Torsional pendulum: Determination of the rigidity modulus of the given wire.
9. Determination of Young's modulus by dynamic method (using graph).
10. Determination of radius of gyration and moment of inertia of a rectangular body in three different axes.
11. Stokes' method: Determination of the coefficient of viscosity of viscous liquid.
12. Determination of the co-efficient of viscosity of water by noting its flow through a capillary tube.
13. Determination of rigidity modulus by the static-torsion method.
14. Determination of Young's modulus by the method of uniform bending.
15. Verification of law of conservation of liner momentum by collision in two dimensions.
16. Study of one dimensional elastic collision using two hanging spheres.

REFERENCE BOOKS

1. C. L. Arora, B.Sc. Practical Physics, S. Chand & Co.
2. B. L. Flint and H. T. Worsnop, Advanced Practical Physics for students, Asia Publishing House.
3. Indu Prakash & Rama Krishna, A Text Book of Practical Physics, 11th Edition, Kitab Mahal.
4. D. P. Khandelwal, A Laboratory Manual of Physics for undergraduate classes, Vani Publications.
5. D. Chattopadhyay, P. C. Rakshit, B. Saha, An advanced course in practical physics, New Central Book Agency Pvt Ltd.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	II
Course Title	Oscillations, Waves, Heat And Thermodynamics (Theory)		
Course Code	PHY201 (DSC)	No. of Credits	04
Contact Hours	60 Hours	Duration of SEP/Exam	3 Hours
Formative Assessment Marks	20	Summative Assessment Marks	80

COURSE LEARNING OUTCOMES (CO)

After the successful completion of the course, the student will	
CO1	Understand the basics of oscillations, types of waves and propagation of waves
CO2	Enrich the knowledge of thermometry, kinetic theory and thermal conductivity
CO3	Get the knowledge and importance of thermodynamics, laws of thermodynamics and entropy as measure of disorderness
CO4	Understand the concepts of thermodynamic potentials and low temperature physics and vacuum technology

MAPPING OF COURSE LEARNING OUTCOMES (CO) WITH PROGRAMME OUTCOMES (PO)

Course Outcomes (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	3	1	3	1		1	1	1	1	
CO2	3	2	3	1	3	1	2		1	2		2
CO3	3	1	3	1	3	1				1	3	2
CO4	3	1	3	2	3	1	2	1		2		3

Score indicators: High=3, Medium=2, Low=1

Pedagogy: Interactive lectures, inquiry based learning, blended learning, learning based on experiments.

PHY201 (DSC)

OSCILLATIONS, WAVES, HEAT AND THERMODYNAMICS

UNIT I: OSCILLATIONS AND PROPAGATION OF WAVES

Free and forced oscillations: Equation for a harmonic oscillator. Free oscillations and damped oscillations (practical examples). Setting up of equation for forced oscillations and its solution, condition for resonance. Numerical problems. [3 hours]

Waves: Review of waves - Different types of waves (examples), Equation for a progressive wave in one dimension. Differential equation of wave motion, characterization of simple harmonic waves (frequency, wavelength, amplitude, phase, etc. both in graphical and mathematical method), Applications of waves. [4 hours]

Propagation of waves: a) Longitudinal waves: i) Through fluid - Expression for velocity of longitudinal waves (derivation) – examples - Newton`s formula for velocity of sound in air and Laplace correction. ii) Through solid -Vibrations in a rod. b) Transverse waves: Velocity of transverse vibrations in a string (derivation). Expression for fundamental frequency and overtones (examples). Numerical problems. [5 hours]

Fourier's theorem: Statement and explanation– expression for Fourier coefficients (exponential form). Limitations of Fourier theorem. Mathematical analysis of a square wave. Numerical problems. [3 hours]

UNIT II: THERMOMETRY, KINETIC THEORY AND THERMAL CONDUCTIVITY

Thermometry: Temperature scales (Centigrade, Fahrenheit and Kelvin scale), General theory of thermometry, Principle, construction and working of liquid glass thermometers, gas thermometers, resistive type thermometers, thermocouple as thermometer, pyrometers, Numerical problems. [4 hours]

Kinetic Theory: Maxwell's law of distribution of molecular velocity (no derivation); its interpretation. Derivation of expressions for mean velocity, most probable velocity, and RMS velocity. Degrees of freedom. Principle of equipartition of energy. Derivation of $U = (3/2)\,RT$. Mean free path, Derivation of expression for mean free path, probability of a particle having mean free path. Real gases, Andrew's isothermals, Vander Waals equations – derivation of expressions for critical constants, Numerical problems. [7 hours]

Thermal Conductivity: Equation for the flow of heat through a solid bar. Thermal conductivity of a good conductor by Forbe's method, Determination of thermal conductivity of a bad conductor by Lee and Charlton's method. Numerical problems. [4 hours]

UNIT III: THERMODYNAMICS AND ENTROPY

Thermodynamics: Review of basic concepts of heat and temperature - the Zeroth law of thermodynamics. Differential form of the first law of thermodynamics, Derivations of expression for work done in an isothermal and adiabatic process for an ideal gas. The

second law of thermodynamics - Kelvin's and Clausius' statements and their equivalence, Reversible and irreversible processes with examples. Carnot theorem - statement and proof. Carnot Cycle and derivation of expression for its efficiency. Carnot heat Engine. Refrigerator – Coefficient of performance. Clausius - Clapeyron's first latent heat equation. Otto engine (Internal combustion engine) and expression for its efficiency, Diesel engine and expression for its efficiency, Numerical problems.

[9 hours]

Entropy: Concept of entropy, Change of entropy in reversible cycle and irreversible process with examples. Temperature-entropy diagram, Physical significance of entropy, Entropy of a perfect gas. Second law of thermodynamics in terms of entropy. Entropy of the Universe. Third law of thermodynamics: Nernst's heat theorem statement. Numerical problems. [6 hours]

UNIT IV: THERMODYNAMIC POTENTIALS AND LOW TEMPERATURE PHYSICS

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz function, Gibbs function, relations among these functions, Gibbs - Helmholtz Equations. Derivation of Maxwell's thermodynamic relations using thermodynamic Potentials. Derivation of TdS equations for C, C_V and heat capacity equations. Derivation of $C_P - C_V = R$ using Maxwell's Relations. Internal Energy equations. Numerical problems. [5 hours]

Low Temperature Physics: Joule Kelvin effect – Liquefaction of gas using porous plug experiment. JouleThomson expansion - expression for the temperature of inversion, inversion curve. Relation between Boyle temperature, temperature of inversion and critical temperature of a gas. Principle of regenerative cooling. Liquefaction of helium, Kapitza's method. Adiabatic demagnetization. Numerical problems. [6 hours]

Vacuum Technology: Introduction with basic definitions and units, Exhaust pump and their characteristics, Measurement of low pressure, Pirani gauge – construction and working. Numerical problems. [4 hours]

REFERENCE BOOKS

1. N. K. Bajaj, The Physics of Waves and Oscillations, Second edition, Tata McGraw-Hill publishing Company (1984).
2. N. Subramanyam and brij Lal, Waves and Oscillations, Second revised edition, Vikas Publishing House Pvt. Ltd. (2010).
3. Frank S Crawford Jr., Berkley Physics Course Waves, Special Indian edition, Tata McGraw-Hill publishing Company (2011).
4. Halliday and Resnick, Fundamentals of Physics, Ninth edition, Wiley India (2011).
5. R. H. Dittaman and M. W. Zemansky, Heat and Thermodynamics, Seventh edition, The McGraw-Hill Companies (2007).
6. S.J. Blundell and K.M. Blundell, Concepts in Thermal Physics, Second edition, Oxford University Press, 2006.
7. Brijlal, N. Subramanyam, P. S. Hemne, Heat Thermodynamics and Statistical Physics, First edition. S Chand Publishing (2007).

8. S.C. Gupta, Thermodynamics, First edition, Pearson (2005).
9. S.R. Shankara Narayana, Heat and Thermodynamics, Second edition, Sulthan Chand and Sons (1990).
10. A. K. Saxena and C. M. Tiwari, Heat and Thermodynamics, Alpha Science International Ltd., Oxford, U.K. (2014).
11. V. Ganesan, Thermodynamics: Basic and Applied, McGraw Hill Education (India) Private Limited (2018).
12. Anandamoy Manna, Heat and Thermodynamics, Pearson Education (2010).
13. P. B. Nagaraj and D. Venkatesh, Basic Thermodynamics, New Age International, New Delhi (2005).
14. Sensors and Transducers, D Patranabis, Second edition, Prentice-Hall of India Private Limited, New Delhi (2005).

FORMATIVE ASSESSMENT FOR THEORY	
Assessment Type	**Marks**
Assessment Test	10
Assignment	5
Quiz	5
Total	**20**

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	II
Course Title	Oscillations, Waves, Heat And Thermodynamics (Practicals)		
Course Code	PHY202 (DSC)	No. of Credits	02
Contact Hours	4 Hours/week	Duration of SEP/Exam	3 Hours
Formative Assessment Marks	10	Summative Assessment Marks	40

II SEMESTER B.Sc. PHYSICS PRACTICALS

PHY202 (DSC)

WAVES AND OSCILLATIONS, HEAT AND THERMODYNAMICS

Course duration: 16 weeks with 4 hours of lab work per week. Minimum **EIGHT** of the following experiments are to be performed:

1. Determination of velocity of sound through wire using sonometer.
2. Determination of frequency of tuning fork using Helmholtz resonator.
3. Verification of law of vibrating string by Melde's experiment.
4. Determination of frequency of AC by Melde's experiment.
5. Determination of specific heat capacity of liquid by Newton's law of cooling.
6. Determination of thermal conductivity of a bad conductor by Lee,s and Charlton method.
7. Determination of thermal conductivity of rubber by heating method.
8. Coefficient of thermal conductivity of copper by Searle's method.
9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Verification of Clausius – Clapeyron equation using pressure cooker.
11. Mechanical equivalent of Heat by Callender and Barne's method.
12. Determination of specific heat of materials using calorimeter.
13. The construction and calibration of a direct reading thermo-electric thermometer and its use in the measurement of: (a) room temperature, (b) body temperature, (c) boiling temperature of saturated brine solution, and (d) melting point of solder.
14. The use of resistance thermometer in the measurement of (a) room temperature, and (b) boiling point of a liquid.
15. Calibration of thermistor for temperature measurement.

REFERENCE BOOKS

1. C. L. Arora, B.Sc. Practical Physics, S Chand and Company Limited.
2. B. L. Flint and H. T. Worsnop, Advanced Practical Physics for students, Asia Publishing House.
3. Harman Singh and P.S. Hemne, B.Sc. Practical Physics, S Chand and Company Limited.
4. R. K. Shukla and Anchal Srivastava, Practical Physics, New Age International (P) Limited, Publishers.