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- **Topic 2** Modulation and Propagation of Electromagnetic Waves

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Note : *Solutions of the Examination Paper are given within the book in their respective chapters / topics.*

PREFACE

Malcolm Forbes said ***"Education's purpose is to replace an empty mind with an open one"*** *and this is something which is always followed by* ***Maharashtra State Board of Secondary & Higher Education (MSBSHSE).*** *The aim of the Board is not just to let learners obtain basic knowledge but to make them life-long learners.*

The purpose of this book is to nurture individuality and thus enhance one's innate potentials which help in increasing the self-study mode for students. This book strengthens knowledge and attitude related to subject. This book is designed in such a way that students can set their own goals and can improve their problem solving and thinking skills.

This book is strictly as per the latest ***Maharashtra Board Curriculum for HSC Exams.*** *It contains variety of questions from latest textbooks. It contains all types of questions like VSA Questions (Very Short Answer), SA Questions (Short Answer), MCQs (Multiple Choice Questions) and LA Questions (Long Answer). A synopsis is given for every chapter which contains important points from that chapter. Each chapter has high quality figures wherever required for better, fast and clear understanding.*

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–Publisher

Why Topic Wise Question Banks Are A Better Choice than Previous Year's Papers ?

Question Bank	Previous Years' Paper
1. Chapter-wise and Topic –wise resentation in Question Banks facilitates systematic study. 2. Question Banks can be referred to by the students throughout the year as well as at the completion of each chapter in school. 3. Question Banks, take into account any changes in syllabus or layout and hence are fully updated and aligned as per the latest specifications by the Board.	1. Year Wise presentation restricts methodical flow of learning. 2. These can be referred to only after the completion of the full syllabus in school. 3. Previous Years' questions cannot be changed and hence fail to be adept with the latest Board specifications

LATEST SYLLABUS

1. Circular motion

Angular displacement, Angular velocity and angular acceleration, Relation between linear velocity and angular velocity, Uniform circular motion, Radial acceleration, Centripetal and centrifugal forces, Banking of roads, Vertical circular motion due to earth's gravitation, Equation for velocity and energy at different positions of vertical circular motion. Kinematical equations for circular motion in analogy with linear motion.

2. Gravitation

Newton's law of gravitation, Projection of satellite, Periodic time, Statement of Kepler's laws of motion, Binding energy and escape velocity of a satellite, Weightlessness condition in orbit, Variation of 'g' due to altitude, lattitude, depth and motion, Communication satellite and its uses.

3. Rotational motion

Definition of M.I., K.E. of rotating body, Rolling motion, Physical significance of M.I., Radius of gyration, Torque, Principle of parallel and perpendicular axes, M.I. of some regular shaped bodies about specific axes, Angular momentum and its conservation.

4. Oscillations

Explanation of periodic motion, S.H.M., Differential equation of linear S.H.M. Projection of U.C.M. on any diameter, Phase of S.H.M., K.E. and P.E. in S.H.M., Composition of two S.H.M.'s having same period and along same line, Simple pendulum, Damped S.H.M.

5. Elasticity

General explanation of elastic property, Plasticity, Deformation, Definition of stress and strain, Hooke's law, Poisson's ratio, Elastic energy, Elastic constants and their relation, Determination of 'Y', Behaviour of metal wire under increasing load, Applications of elastic behaviour of materials.

6. Surface tension

Surface tension on the basis of molecular theory, Surface energy, Surface tension, Angle of contact, Capillarity and capillary action, Effect of impurity and temperature on surface tension.

7. Wave motion

Simple harmonic progressive waves, Reflection of transverse and longitudinal waves, Change of phase, Superposition of waves, Formation of beats, Doppler effect in sound.

8. Stationary waves

Study of vibrations in a finite medium, Formation of stationary waves on string, Study of vibrations of air columns, Free and Forced vibrations, Resonance.

9. Kinetic theory of gases and Radiation

Concept of an ideal gas, Assumptions of kinetic theory, Mean free path, Derivation for pressure of a gas, Degrees of freedom, Derivation of Boyle's law, Thermodynamics- Thermal equilibrium and definition of temperature, 1st law of thermodynamics, 2nd law of thermodynamics, Heat engines and refrigerators, Qualitative idea of black body radiation,Wein's displacement law, Green house effect, Stefan's law, Maxwell distribution, Law of equipartition of energy and application to Specific heat capacities of gases.

10. Wave theory of light

Wave theory of light, Huygens' Principle, Construction of plane and spherical wave front, Wave front and wave normal, Reflection at plane surface, Refraction at plane surface, Polarisation, Polaroids, Plane polarised light, Brewster's law, Doppler effect in light.

11. Interference and diffraction

Interference of light, Conditions for producing steady interference pattern, Young's experiment, Analytical treatment of interference bands, Measurement of wavelength by biprism experiment, Diffraction due to single slit, Rayleigh's criterion, Resolving power of a microscope and telescope, Difference between interference and diffraction.

12. Electrostatics

Gauss' theorem proof and applications, Mechanical force on unit area of a charged conductor, Energy density of a medium, Dielectrics and electric polarisation, Concept of condenser, Capacity of parallel plate condenser, Effect of dielectric on capacity, Energy of charged condenser, Condensers in series and parallel, van-de- Graaff generator.

13. Current electricity

Kirchhoff's law, Wheatstone's bridge, Meter bridge, Potentiometer.

14. Magnetic effects of electric current

Ampere's law and its applications, Moving coil galvanometer, Ammeter, Voltmeter, Sensitivity of moving coil galvanometer, Cyclotron.

15. Magnetism

Circular current loop as a magnetic dipole, Magnetic dipole moment of revolving electron, Magnetisation and magnetic intensity, Diamagnetism, Paramagnetism, Ferromagnetism on the basis of domain theory, Curie temperature.

16. Electromagnetic inductions

Laws of electromagnetic induction, proof of, $e = -\frac{d\varnothing}{dt}$ Eddy currents, Self induction and mutual induction,

Need for displacement current, Transformer, Coil rotating in uniform magnetic induction, Alternating currents, Reactance and impedance, LC oscillations (qualitative treatment only) Power in a.c circuit with resistance, inductance and capacitance, Resonant circuit, Wattless current, AC generator.

17. Electrons and photons

Photoelectric effect, Hertz and Lenard's observations, Einstein's equation, Particle nature of light.

18. Atoms, Molecules and Nuclei

Alpha particle scattering experiment, Rutherford's model of atom. Bohr's model, Hydrogen spectrum, Composition and size of nucleus, Radioactivity, Decay law, massenergy relation, mass defect, B.E. per nucleon and its variation with mass number, Nuclear fission and fusion, de Broglie hypothesis, Matter waves – wave nature of particles, Wavelength of an electron, Davisson and Germer experiment, Continuous and characteristics X-rays.

19. Semiconductors

Energy bands in solids, Intrinsic and extrinsic semiconductors, P-type and Ntype semiconductor, P-N junction diode, I-V characteristics in forward and reverse bias, Rectifiers, Zener diode as a voltage regulator, Photodiode, Solar cell, I-V characteristics of LED, Transistor action and its characteristics, Transistor as an amplifier (CE mode), Transistor as a switch, Oscillators and Logic gates (OR, AND, NOT, NAND, NOR)

20. Communication systems

Elements of communication system, bandwidth of signals, bandwidth of transmission medium, Need for modulation, Production and detection of an amplitude modulated wave, space communication, Propagation of electromagnetic waves in atmosphere.

List of Practicals

1. To determine Young's modulus of elasticity of the material of a given wire.
2. To find the force constant and effective mass of helical spring by plotting T^2--m graph using method of oscillations.
3. To determine the surface tension of water by capillary rise method.
4. To study the relationship between the temperature of a hot body and time by plotting a cooling curve.
5. To study the relation between frequency and length of a given wire under constant tension using sonometer.
6. To study the relation between the length of a given wire and tension for constant frequency using sonometer.

7. To find the speed of sound in air at room temperature using a resonance tube.
8. To find resistance of given wire using metre bridge and hence determine the specific resistance of its material.
9. To verify the laws of combination (series/ parallel) of resistances using a metre bridge.
10. To compare the emf of two given cells using potentiometer.
11. To determine the internal resistance of given cell using potentiometer.
12. To determine resistance of galvanometer using metre bridge.
13. To draw the I-V characteristic curves of a p-n junction diode in forward bias and reverse bias.
14. To study the characteristics of a commonemitter npn or pnp transistor and to find out the values of current and voltage gains.
15. To draw the characteristic curve of a zener diode and to determine its reverse break down voltage.

List of Activities

1. To study dissipation of energy of a simple pendulum by plotting a graph between square of amplitude and time.
2. To study the effect of detergent on surface tension by observing capillary rise.
3. To study the factors affecting the rate of loss of heat of a liquid.
4. To study the effect of load on depression of a suitably clamped meter scale loaded
   (i) at its end (ii) in the middle.
5. To measure the resistance and impedance of an inductor with or without iron core.
6. To study the variation in potential drop with length of a wire for a steady current.
7. To draw the diagram of a given open circuit comprising at least a battery, resistor/ rheostat, key, ammeter and voltmeter. Mark the components that are not connected in proper order and correct the circuit and also the circuit diagram.
8. To study effect of intensity of light (by varying distance of the source) on an L.D.R.
9. To identify a diode, an LED, a transistor, and 1C, a resistor and a capacitor from mixed collection of such items.
10. Use of multimeter to
    (i) identify base of transistor
    (ii) distinguish between npn and pnp type transistors,
    (iii) see the unidirectional flow of current in case of a diode and an LED
    (iv) check whether a given electronic component (e.g. diode, transistor or IC) is in working order.
11. To observe polarization of light using two polaroids.
12. To assemble a household circuit comprising three bulbs, three (on/off) switches, a fuse and a power source.

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Examination Paper	Maharashtra HSC Exam March 2016 Set No. J-731	Physics

Time : 3 Hours **Max. Marks : 70**

General Instructions :

(i) *All questions are compulsory.*
(ii) *Neat diagrams must be drawn wherever necessary.*
(iii) *Figures to the right indicate full marks.*
(iv) *Use of only logarithmic table is allowed.*
(v) *All symbols have their usual meaning unless otherwise stated.*
(vi) *Answers to both sections must be written in the same answer book.*
(vii) *Answer to every question must be written on a new page.*

SECTION – I

Q. 1. Attempt any six : **[12]**

(i) In U.C.M. (Uniform circular motion), prove the relation $\vec{v} = \vec{w} \times \vec{r}$, where symbols have their usual meanings.

(ii) Derive an expression for critical velocity of a satellite revolving around the earth in a circular orbit.

(iii) Obtain an expression for total kinetic energy of a rolling body in the form $\frac{1}{2}MV^2\left[1+\frac{K^2}{R^2}\right]$.

(iv) Define 'emissive power' and 'coefficient of emission of a body'.

(v) A coin kept at a distance of 5 cm from the centre of a turntable of radius 1.5 m just begins to slip when the turntable rotates at a speed of 90 r.p.m. Calculate the coefficient of static friction between the coin and the turntable. [g = 9.8 m/s^2].

(vi) The fundamental frequency of an air column in a pipe closed at one end is in unison with the third overtone of an open pipe. Calculate the ratio of lengths of their air columns.

(vii) A particle performing linear S.H.M. has a period of 6.28 seconds and a path length of 20 cm. What is the velocity when its displacement is 6 cm from mean position ?

(viii) The energy of the free surface of a liquid drop is 5π times the surface tension of the liquid. Find the diameter of the drop in C.G.S. system.

Q. 2. Select and write the most appropriate answer from the given alternatives for each sub–question :

(i) A particle rotates in U.C. M. with tangential velocity 'v' along a horizontal circle of diameter 'D'. Total angular displacement of the particle in time 't' is .....

(a) vt **(b)** $\left(\frac{v}{D}\right)-t$

(c) $\frac{vt}{2D}$ **(d)** $\frac{2vt}{D}$

(ii) Two springs of force constants K_1 and K_2 ($K_1 > K_2$) are stretched by same force. If W_1 and W_2 be the work done stretching the springs then .....

(a) $W_1 = W_2$ **(b)** $W_1 < W_2$

(c) $W_1 > W_2$ **(d)** $W_1 = W_2 = 0$

(iii) A and B are two steel wires and the radius of A is twice that of B. If they are stretched by the same load, then the stress on B is .....

(a) Four times that of A. **(b)** Two times that of A.

(c) Three times that of A. **(d)** Same as that of A.

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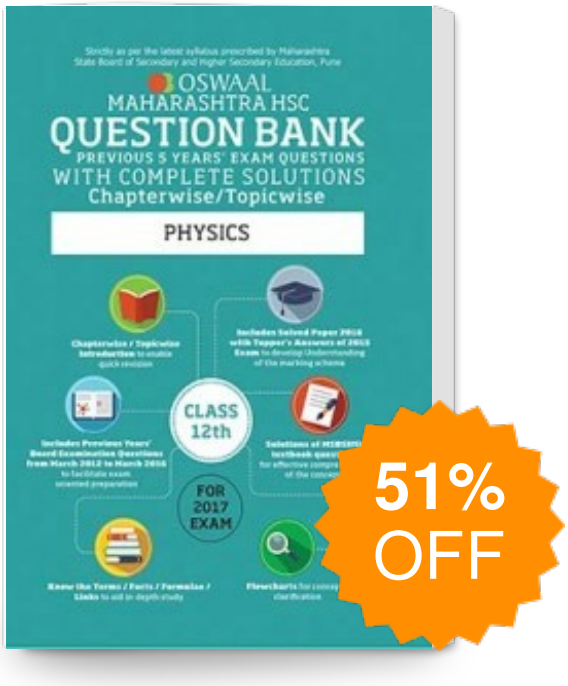

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