Secondary Education Curriculum

2076

Physics

Grades: 11 and 12 **Subject code: Phy. 101 (Grade 11), Phy. 102 (Grade 12)**

Credit hrs: 5 **Working hrs: 160**

1. Introduction

This curriculum presumes that the students joining grade 11 and 12 science stream come with diverse aspirations, some may continue to higher level studies in specific areas of science, others may join technical and vocational areas or even other streams. The curriculum is designed to provide students with general understanding of the fundamental scientific laws and principles that govern the scientific phenomena in the world. It focuses to develop scientific knowledge, skill competences and attitudes required at secondary level (grade 11-12) irrespective of what they do beyond this level, as envisioned by national goals. Understanding of scientific concepts and their application, in day to day context as well as the process of obtaining new knowledge through holistic approach of learning in the spirit of national qualification framework is emphasized in the curriculum.

In particular, this curriculum aims to provide sufficient knowledge and understanding of science for all learners to become confident citizens in the technological world. It helps the students to recognize the usefulness and limitations of laws and principles of physics and use them in solving problems encountered in their daily lives along a sound foundation for students who wish to study physics or related professional or vocational courses in higher education. It also helps to develop science related attitudes such as a concern for safety and efficiency, concern for accuracy and precision, objectivity, a spirit of enquiry, inventiveness, appreciation of ethno-science, and willingness to use technology for effective communication. It also promotes awareness of the principles and laws of science that are often the result of cumulative efforts and their studies and applications are subject to economic and technological limitations and social, cultural and ethical perceptions/acceptance.

The curriculum prepared in accordance with National Curriculum Framework is structured for two academic years in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Level-wise competencies

In completion of this course, students are expected to demonstrate the following competencies:

1. relate the phenomena and processes of the world around them to the knowledge and understanding of physical laws, principles and theories and describe them using appropriate scientific vocabulary, terminology and conventions
2. use scientific instruments, apparatus and methods to collect, evaluate and communicate information accurately and precisely
3. design simple experiment to develop relations among physical quantities,
4. carryout simple scientific research on issues related to physics and
5. construct simple models to illustrate physical concepts

6. use the knowledge of physics to promote care for the environment, indigenous knowledge, social values and ethics

3. Grade wise learning Outcomes

Grade 11	Grade 12
Content Area: Mechanics	
1. Physical Quantities 1.1 Demonstrate the meaning, importance and applications of precision in the measurements 1.2 Understand the meaning and importance of significant figures in measurements 1.3 Explain the meaning of dimensions of a physical quantity 1.4 Workout the dimensions of derived physical quantities applicable to this syllabus 1.5 Apply dimensional analysis method to check the homogeneity of physical equations	**1. Rotational dynamics** 1.1 Recall equations of angular motion and compare them with equations of linear motion 1.2 Derive the expression for rotational kinetic energy 1.3 Describe the term moment of inertia and radius of gyration 1.4 Find the moment of inertia of thin uniform rod rotating about its center and its one end 1.5 Establish the relation between torque and angular acceleration of a rigid body 1.6 Describe the work and power in rotational motion with expression 1.7 Define angular momentum and prove the principle of conservation of angular momentum 1.8 Solve numerical problems and conceptual questions regarding the rotational dynamics
2. Vectors 2.1 Distinguish between scalar and vector quantities 2.2 Add or subtract coplanar vectors by drawing scale diagram (vector triangle, parallelogram or polygon method) 2.3 Understand the meaning and importance of unit vectors 2.4 Represent a vector as two perpendicular components 2.5 Resolve co-planer vectors using component method	**2. Periodic motion** 2.1 Define simple harmonic motion and state its equation. 2.2 Derive the expressions for energy in simple harmonic motion 2.3 Derive the expression for period for vertical oscillation of a mass suspended from coiled spring 2.4 Describe angular simple harmonic motion and find its period 2.5 Derive expression for period of simple pendulum

2.6 Describe scalar and vector products 2.7 Understand the meaning and applications of scalar and vector product with examples 2.8 Solve related problems.	2.6 Explain the damped oscillation 2.7 Describe forced oscillation and resonance with suitable examples 2.8 Solve the numerical problems and conceptual questions regarding the periodic motion
3. Kinematics 3.1 Define displacement, instantaneous velocity and acceleration with relevant examples 3.2 Explain and use the concept of relative velocity 3.3 Draw displacement-time and velocity-time graph to represent motion, and determine velocity from the gradient of displacement-time graph, acceleration from the gradient of velocity-time graph and displacement from the area under a velocity-time graph 3.4 Establish equations for a uniformly accelerated motion in a straight line from graphical representation of such motion and use them to solve related numerical problems 3.5 Write the equations of motion under the action of gravity and solve numerical problem related to it 3.6 Understand projectile motion as motion due to a uniform velocity in one direction and a uniform acceleration in a perpendicular direction, derive the equations for various physical quantities (maximum height, time of flight, time taken to reach maximum height, horizontal range, resultant velocity) and use them to solve mathematical problems related to projectile motion	**3. Fluid statics** 3.1 State and explain Archimedes principle and Pascal's law 3.2 Define up-thrust, pressure in fluid, buoyancy, center of buoyancy and meta center 3.3 State and use the law of floatation, 3.4 Describe surface tension and explain its principle 3.5 Establish the relation between surface energy and surface tension 3.6 Define angle of contact and capillarity with examples 3.7 State the Newton's Formula for viscosity of a liquid and define coefficient of viscosity 3.8 Differentiate between laminar and turbulent flow & describe Reynolds number 3.9 Recall and use the Poiseuille's formula 3.10 State Stoke's law and use it to determine the coefficient of viscosity of given liquid 3.11 Explain equation of continuity and its application 3.12 Recall the Bernoulli's equation and explain its uses 3.13 Solve the numerical problems and conceptual questions regarding the fluid statics
4. Dynamics: 4.1 Define linear momentum, impulse, and establish the relation between them	-

4.2 Define and use force as rate of change of momentum 4.3 State and prove the principle of conservation of linear momentum using Newton's second and Newton's third of motion 4.4 Define and apply moment of a force and torque of a couple 4.5 State and apply the principle of moments 4.6 State and apply the conditions necessary for a particle to be in equilibrium 4.7 State and explain the laws of solid friction 4.8 Show the coefficient of friction is equal to the tangent of angle of repose and use the concept to solve problems. 4.9 Solve the numerical problem and conceptual question on dynamics	
5. Work, energy and power: 5.1 Explain work done by a constant force and a variable force 5.2 State and prove work-energy theorem 5.3 Distinguish between kinetic energy and potential energy and establish their formulae 5.4 State and prove the principle of conservation of energy 5.5 Differentiate between conservative and non-conservative force 5.6 Differentiate between elastic and inelastic collision and hence explain the elastic collision in one dimension 5.7 Solve the numerical problems and conceptual questions regarding work, energy, power and collision	-
6. Circular motion 6.1 Define angular displacement, angular velocity and angular acceleration 6.2 Establish the relation between angular and linear velocity & acceleration 6.3 Define centripetal force	-

6.4 Derive the expression for centripetal acceleration and use it to solve problems related to centripetal force 6.5 Describe the motion in vertical circle, motion of vehicles on banked surface 6.6 Derive the period for conical pendulum 6.7 Solve the numerical problem and conceptual question on circular motion	
7. Gravitation 7.1 Explain Newton's law of gravitation 7.2 Define gravitational field strength 7.3 Define and derive formula of gravitational potential and gravitational potential energy 7.4 Describe the variation in value of 'g' due to altitude and depth 7.5 Define center of mass and center of gravity 7.6 Derive the formula for orbital velocity and time period of satellite 7.7 Define escape velocity and derive the expression of escape velocity 7.8 Find the potential and kinetic energy of the satellite 7.9 Define geostationary satellite and state the necessary conditions for it 7.10 Describe briefly the working principle of Global Position -System (GPS) 7.11 Solve the numerical problems and conceptual questions regarding related to the gravitation	-
8. Elasticity 8.1 State and explain Hooke's law 8.2 Define the terms stress, strain, elasticity and plasticity 8.3 Define the types of elastic modulus such as young modulus, bulk modulus and shear modulus 8.4 Define Poisson's ratio 8.5 Derive the expression for energy stored in	-

a stretched wire 8.6 Solve the numerical problems and conceptual questions regarding elasticity	
Content Area: Heat and thermodynamics	
9. Heat and temperature 9.1 Explain the molecular concept of thermal energy, heat and temperature, and cause and direction of heat flow 9.2 Explain the meaning of thermal equilibrium and Zeroth law of thermodynamics. 9.3 Explain thermal equilibrium as a working principle of mercury thermometer.	**4. First Law of Thermodynamics** 4.1 Clarify the concept of thermodynamic system. 4.2 Explain the meaning of work done by the system and work done on the system, and describe how work done by gas during expansion can be calculated from indicator (P – V) diagram. 4.3 Explain the concept of latent heat and internal energy. 4.4 State and explain first law of thermodynamics - increase of internal energy (dU) = heat into the system (dQ) + work done on the system (PdV) realizing its limitations and necessity of second law of thermodynamics. 4.5 Define and explain two specific heat capacities of gas appreciating the relation Cp – Cv = R and cp – cv = r. 4.6 Explain various thermodynamic process (isothermal, isobaric, isochoric and adiabatic) with good concept of their P – V diagram. 4.7 Derive adiabatic equation $PV\gamma$ = constant. 4.8 Derive expression for work done during isothermal and adiabatic process. 4.9 Give concept of reversible and irreversible process with examples. 4.10 Solve mathematical problems related to first law of thermodynamics and thermodynamic process.
10. Thermal Expansion 10.1 Explain some examples and applications of thermal expansion, and	**5. Second Law of Thermodynamics** 5.1 State and explain second law of thermodynamics (Kelvin's and

demonstrate it with simple experiments. 10.2 Explain linear, superficial, cubical expansion and define their corresponding coefficients with physical meaning. 10.3 Establish a relation between coefficients of thermal expansion. 10.4 Describe Pullinger's method to determine coefficient of linear expansion. 10.5 Explain force set up due to expansion and contraction. 10.6 Explain differential expansion and its applications. 10.7 Explain the variation of density with temperature. 10.8 Explain real and apparent expansion of liquid appreciating the relation $\gamma r = \gamma g + \gamma a$. 10.9 Describe Dulong and Petit's experiment to determine absolute expansivity of liquid. 10.10 Solve mathematical problems related to thermal expansion.	Clausius's statement). 5.2 Compare second and first law of thermodynamics considering indication of direction of flow of heat. 5.3 Explain heat engine as a device to convert heat energy into mechanical energy appreciating that its efficiency is less than 100%. 5.4 Discuss Carnot's cycle with the concept of P – V diagram and calculate the work done of each step and corresponding efficiency. 5.5 Describe internal combustion engines, Otto engine and diesel engine with the help of P – V diagram to compare their efficiencies. 5.6 Explain refrigerator as heat engine working in reverse direction 5.7 Introduce entropy as a measure of disorder appreciating its roles in thermodynamic process. 5.8 Solve mathematical problems related to heat engine.
11. Quantity of Heat 11.1 Define heat capacity and specific heat capacity and explain application of high specific heat capacity of water and low specific heat capacity of cooking oil and massage oil 11.2 Describe Newton's law of cooling with some suitable daily life examples. 11.3 Explain the principle of calorimetry and describe any one standard process of determining specific heat capacity of a solid 11.4 Explain the meaning of latent heat of substance appreciating the graph between heat and temperature and define specific latent heat of fusion and vaporization. 11.5 Describe any one standard method of	-

measurement of specific latent heat of fusion and explain briefly the effect of external pressure on boiling and melting point. 11.6 Distinguish evaporation and boiling. 11.7 Define triple point. 11.8 Solve mathematical problems related to heat	
12. Rate of heat flow 12.1 Explain the transfer of heat by conduction, convection and radiation with examples and state their applications in daily life. 12.2 Define temperature gradient and relate it with rate of heat transfer along a conductor. 12.3 Define coefficient of thermal conductivity and describe Searl's method for its determination. 12.4 Relate coefficient of reflection (r), coefficient of transmission (t) and coefficient of absorption (r + a + t = 1). 12.5 Explain ideal radiator (e= 1, a =1) and black body radiation. 12.6 State and explain Stefan's law of black body radiation using terms; emissive power and emissivity. 12.7 Describe idea to estimate apparent temperature of sun. 12.8 Solve mathematical problems related to thermal conduction and black body radiations.	-
13. Ideal gas 13.1 Relate pressure coefficient and volume coefficient of gas using Charles's law and Boyle's law. 13.2 Define absolute zero temperature with the support of P - V, V- T graph. 13.3 Combine Charles's law and Boyle's law to obtain ideal gas equation. 13.4 Explain molecules, inter molecular	-

forces, moles and Avogadro's number. 13.5 Explain the assumptions of kinetic – molecular model of an ideal gas. 13.6 Derive expression for pressure exerted by gas due to collisions with wall of the container appreciating the use of Newton's law of motion. 13.7 Explain the root mean square speed of gas and its relationship with temperature and molecular mass. 13.8 Relate the pressure and kinetic energy. 13.9 Calculate the average translational kinetic energy of gas for 1 molecule and Avogadro's number of molecules. 13.10 Solve mathematical problems related ideal gas.	
Content Area : Wave and Optics	
14. Reflection at curved mirrors 14.1 State the relation between object distance, image distance and focal length of curved mirrors 14.2 State the relation between object size and image size 14.3 Know the difference between the real and virtual image in geometrical optics 14.4 Calculate the focal length of curved mirrors and its applications	**6. Wave motion** 6.1 Define and understand progressive wave 6.2 Write progressive wave in mathematical form 6.3 Discuss the condition under which stationary waves can be formed 6.4 Write stationary wave in mathematical form 6.5 Calculate frequency, amplitude, velocity, time period, etc of progressive wave 6.6 Find expression for stationary wave using two progressive waves
15. Refraction at plane surfaces 15.1 Recall the laws of refraction 15.2 Understand the meaning of lateral shift 15.3 Understand the meaning of refractive index of a medium 15.4 Calculate refractive index of a medium using angle of incidence and angle of refraction	**7. Mechanical waves** 7.1 Calculate Speed of wave motion 7.2 Understand and write expression for the Velocity of sound in solid and liquid 7.3 Describe Velocity of sound in gas 7.4 Describe Laplace correction 7.5 Formulate the effect of temperature, pressure, humidity on velocity of sound

15.5 Learn the relation between the refractive indices 15.6 Know the meaning of total internal reflection and the condition for it 15.7 Understand critical angle and learn the applications of total internal reflection 15.8 Explain the working principle of optical fiber	and their physical meaning 7.6 Solve numerical problems related to velocity of sound in the given medium and condition
16. Refraction through prisms: 16.1 Understand minimum deviation condition 16.2 Discuss relation between angle of prism, angle of minimum deviation and refractive index 16.3 Use above relations to find the values of refractive index of the prism 16.4 Understand deviation in small angle prism and learn its importance in real life	**8. Wave in pipes and strings** 8.1 Understand the formation of stationery waves in closed and open pipes 8.2 Define and understand harmonics and overtones 8.3 Discuss harmonics and overtones in closed and open organ pipes 8.4 Understand end correction in pipes 8.5 State and use the formula for velocity of transverse waves along a stretched string 8.6 Understand Vibration of string and overtones 8.7 Know the laws of vibration of fixed string.
17. Lenses 17.1 State properties of Spherical lenses 17.2 State the relation between object distance, image distance and focal length of a convex lens 17.3 Define visual angle and angular magnification 17.4 Derive Lens maker's formula and use it to find focal length	**9. Acoustic phenomena:** 9.1 Describe sound waves as pressure waves in a medium 9.2 Characterize the sound using its intensity, loudness, quality and pitch 9.3 Discuss Doppler's effect 9.4 Apply Doppler effect in realistic case where source and observers are in relative motion.
18. Dispersion 18.1 Understand pure spectrum 18.2 Learn the meaning of dispersive power 18.3 Discuss chromatic and spherical aberration 18.4 Discuss achromatism in lens and its applications	**10. Nature and propagation of Light:** 10.1 Use Huygen's principle to explain reflection and refraction of light

-	**11. Interference** 11.1 Explain the Phenomenon of Interferences 11.2 Understand the meaning of coherent sources 11.3 Describe Young's double slit experiment and obtain the expression fro nth order maxima
-	**12. Diffraction** 12.1 Describe diffraction at a single slit 12.2 Understand diffraction pattern of image and derive the expression for the position of nth order minima 12.3 Explain diffraction through transmission/diffraction grating and use the formula d sinqn = nl for maxima 12.4 Explain resolving power of optical instruments
-	**13. Polarization** 13.1 Describe phenomenon of polarization 13.2 Explain how polarization of light explains the transverse nature of light 13.3 State and use Brewster's law 13.4 Show the understanding of construction, working principle and uses of Potentiometer for comparing emfs and measuring internal resistance of cells
Content Area: Electricity and Magnetism	
19. Electric charges 19.1 Understand the concept of electric charge and charge carriers 19.2 Understand the process of charging by friction and use the concept to explain related day to day observations 19.3 Understand that, for any point outside a spherical conductor, the charge on the sphere may be considered to act as a point charge at its centre	**14. Electrical circuits:** 14.1 Understand Kirchhoff's law as well as use it to calculate unknown parameters in electrical circuits 14.2 Describe the circuit diagram and working of Wheatstone bridge circuit and understand its importance in real situation 14.3 Describe Meter bridge and understand it

19.4 State Coulomb's law 19.5 Recall and use $F = \frac{Qq}{4\pi\varepsilon_o r^2}$ for the force between two point charges in free space or air 19.6 Compute the magnitude and direction of the net force acting at a point due to multiple charges	14.4 Know construction, working and importance of Potentiometer 14.5 Understand the concept of super conductors 14.6 Know the meaning of perfect conductors and distinguish it from superconductor 14.7 Learn the technique to convert galvanometer into voltmeter and ammeter
20. Electric field: 20.1 Describe an electric field as a region in which an electric charge experiences a force 20.2 Define electric field strength as force per unit positive charge acting on a stationary point charge 20.3 Calculate forces on charges in uniform electric fields of known strength 20.4 Use $E = \frac{Q}{4\pi\varepsilon_o r^2}$ strength of a point charge in free space or air 20.5 Illustrate graphically the changes in electric field strength with respect distance from a point charge 20.6 Represent an electric field by means of field lines 20.7 Describe the effect of a uniform electric field on the motion of charged particles 20.8 Understand the concept of electric flux of a surface 20.9 State Gauss law and apply it for a field of a charged sphere and for line charge 20.10 Understand that uniform field exists between charged parallel plates and sketch the field lines	**15. Thermoelectric effects:** 15.1 Explain Seebeck effect and its application in Thermocouples 15.2 Show understanding of the construction and working principle of thermocouple as a temperature measuring device 15.3 Explain Peltier effect 15.4 Understand the construction and working of Thermopile
21. Potential, potential difference and potential energy 21.1 Define potential at a point as the work done per unit positive charge in bringing a small test charge from infinity to the point	**16. Magnetic field:** 16.1 Show understanding of the concept of magnetic field lines and magnetic flux and sketch magnetic field lines around a straight current carrying conductor and long solenoid

21.2 Use electron volt as a unit of electric potential energy 21.3 Recall and use $V = \frac{Q}{4\pi\varepsilon_o r}$ for the potential in the field of a point charge 21.4 Illustrate graphically the variation in potential along a straight line from the source charge and understand that the field strength of the field at a point is equal to the negative of potential gradient at that point 21.5 Understand the concept of equipotential lines and surfaces and relate it to potential difference between two points 21.6 Recall and use $E = \frac{\Delta V}{\Delta x}$ to calculate the field strength of the uniform field between charged parallel plates in terms of potential difference and separation	16.2 Explain Oersted's experiment, its outcome and limitations 16.3 Discuss force on moving charge in uniform magnetic field 16.4 Discuss force on a current carrying conductor placed in uniform magnetic field 16.5 Describe force and Torque on rectangular coil placed in uniform magnetic field 16.6 Describe moving coil galvanometer and know its applications 16.7 Explain Hall effect and derive the expression VH=BI/ntq where t is thickness 16.8 Use Hall probe to measure flux density of a uniform magnetic field 16.9 State Biot and Savart law and know its application on (i) a circular coil (ii) a long straight conductor (iii) a long solenoid 16.10 State Ampere's law and know its applications to (i) a long straight conductor (ii) a straight solenoid (ii) a toroidal solenoid 16.11 Discuss force between two parallel conductors carrying current- definition of ampere
22. Capacitor **22.1 capacitance and capacitor** a. Show understanding of the uses of capacitors in simple electrical circuits b. Define capacitance as the ratio of the change in an electric charge in a system to the corresponding change in its electric potential and associate it to the ability of a system to store charge c. Use $C = \frac{Q}{V}$ d. Relate capacitance to the gradient of potential-charge graph	**17. Magnetic properties of materials:** 17.1 Define relative permeability and relative susceptibility of a magnetic material 17.2 Discuss relationship between relative permeability and susceptibility 17.3 Discuss Hysteresis of ferromagnetism 17.4 Understand Dia,-para- and ferro-magnetic materials

22.2 Parallel plate capacitor a. Derive $C = \frac{\varepsilon_o A}{d}$, using Gauss law and $C = \frac{Q}{V}$, for parallel plate capacitor b. Explain the effect on the capacitance of parallel plate capacitor of changing the surface area and separation of the plates c. Explain the effect of a dielectric in a parallel plate capacitor in **22.3 Combination of capacitors** a. Derive formula for combined capacitance for capacitors in series combinations b. Solve problems related to capacitors in series combinations c. Derive formula for combined capacitance for capacitors in parallel combinations d. Solve problems related to capacitors in parallel combinations **22.4 Energy stored in a charged capacitor** a. Deduce, from the area under the potential-charge graph, the equations $E = \frac{1}{2}QV$ and hence $E = \frac{1}{2}CV^2$ for the average electrical energy of charged capacitor **22.5 Effect of dielectric** b. Show understanding of a dielectric as a material that polarizes when subjected to electric field c. Explain the effect of inserting dielectric between the plates of a parallel plate capacitor on its capacitance	
23. DC Circuits **23.1 Electric Currents; Drift velocity and its relation with current** a. Understand the concept that potential difference between two points in a	**18. Electromagnetic Induction:** 18.1 State and show understanding of Faraday's law of electromagnetic induction 18.2 State and show understanding of

conductor makes the charge carriers drift

b. Define electric current as the rate of flow of positive charge, $Q = It$

c. Derive, using $Q=It$ and the definition of average drift velocity, the expression $I=nAvq$ where n is the number density of free charge carriers

23.2 Ohm's law Ohm's law; Electrical Resistance: resistivity and conductivity

a. Define and apply electric resistance as the ratio of potential difference to current

b. Define *ohm* , *resistivity* and *conductivity*

c. Use $R = \rho l$ /A for a conductor

d. Explain, using $R = \rho l$ /A, how changes in dimensions of a conducting wire works as a variable resistor

e. Show an understanding of the structure of strain gauge (pressure sensor) and relate change in pressure to change in in resistance of the gauge

f. Show an understanding of change of resistance with light intensity of a light-dependent resistor (the light sensor)

g. Show an understanding of change of resistance of *n-type* thermistor to change in temperature (electronic temperature sensor)

23.3 Current-voltage relations: ohmic and non-ohmic

a. Sketch and discuss the I–V characteristics of a metallic conductor at constant temperature, a semiconductor diode and a filament lamp d) state Ohm's law

b. State Ohm's law and identify ohmic and non-ohmic resistors

Lenz's law

18.3 Discuss construction and working of A.C. generators

18.4 Define eddy currents, explain how they arise and give a few examples where eddy currents are useful and where they are nuisance

18.5 Describe self-inductance and mutual inductance and understand their uses

18.6 State the expression for energy stored in an inductor and use it wherever needed

18.7 Discuss the construction, working principle and importance of transformer

18.8 Discuss the sources of energy loss in practical transformer

19. Alternating Currents:

19.1 Understand peak and rms value of AC current and voltage

19.2 Discuss AC through a resistor, a capacitor and an inductor

19.3 Understand Phasor diagram in RC and RL circuits

19.4 Discuss series circuits containing combination of resistance, capacitance and inductance

19.5 Describe series resonance condition and know its applications

19.6 Understand the meaning of quality factor

19.7 Discuss power in AC circuits and know the term power factor

23.4 Resistances in series and parallel a. Derive, using laws of conservation of charge and conservation of energy, a formula for the combined resistance of two or more resistors in parallel b. Solve problems using the formula for the combined resistance of two or more resistors in series c. Derive, using laws of conservation of charge and conservation of energy, a formula for the combined resistance of two or more resistors in parallel d. Solve problems using the formula for the combined resistance of two or more resistors in series and parallel to solve simple circuit problems **23.5 Potential divider** a. Understand the principle of a potential divider circuit as a source of variable p.d. and use it in simple circuits b. Explain the use of sensors (thermistors, light-dependent resistors and strain gauges) in potential divider circuit as a source of potential difference that is dependent on temperature, illumination and strain respectively **23.6 Electromotive force of a source, internal resistance** a. Define electromotive force (e.m.f.) in terms of the energy transferred by a source in driving unit charge round a complete circuit b. Distinguish between e.m.f. and potential difference (p.d.) in terms of energy considerations c. Understand the effects of the internal resistance of a source of e.m.f. on the terminal potential difference **23.7 Work and power in electrical circuit** *a.* Derive from the definition of V and I, the relation $P=IV$ for power in	

electric circuit *b.* Use $P=IV$ *c.* Derive $P=I^2R$ for power dissipated in a resistor of resistance R and use the formula for solving the problems of heating effects of electric current	
Content Area: Modern Physics	
24. Nuclear physics 24.1 Explain how nucleus was discovered 24.2 Convey the meaning of mass number, atomic number 24.3 Calculate the expression of nuclear density 24.4 Explain the existence of different isotopes of the same element 24.5 Describe main theme of Einstein's mass energy relation and state the relation 24.6 Explain the meaning of mass defect and cause of it 24.7 Describe the terms creation and annihilation 24.8 Derive the relation of binding energy and binding energy per unit nucleon of different nuclei 24.9 Plot a graph between BE per nucleon and mass number of different nuclei 24.10 Define nuclear fusion and fission and explain the mechanism of energy release 24.11 Solve numerical problems related to nuclear physics	**20. Electrons** 20.1 Describe Millikan's oil drop experiment and explain how it suggests quantization of charge 20.2 Describe the motion of electrons in electric and magnetic fields and derive appropriate mathematical expressions 20.3 Describe J.J Thomson's experiment with suitable diagrams to explain the discovery of electron and its characters 20.4 Solve numerical problems related to above topics
25. Solids 25.1 Distinguish between energy level and energy band along with the formation of energy band in solids 25.2 Differentiate metals, semiconductors, and conductors on the basis of energy band 25.3 Explain the meaning of intrinsic and	**21. Photons** 21.1 Describe quantum nature of radiation 21.2 Explain properties of photons 21.3 Describe work function and photoelectric effect 21.4 Derive Einstein's photoelectric

extrinsic semiconductors with examples 25.4 Explain how p and n type semiconductors are formed 25.5 Interpret unit related conceptual questions clearly	equation 21.5 Describe Millikan's experiment for the verification of Einstein's photoelectric equation and calculate Planck's constant 21.6 Solve some related problems
26. Recent Trends in Physics 26.1 Explain elementary particles and antiparticles 26.2 Classify the particles with examples 26.3 Name different quarks with their charges and symbols 26.4 Write quark combination of few mesons and baryons particles 26.5 Describe leptons with examples 26.6 Explain Big Bang and Hubble's law and justify the expansion of the universe 26.7 Briefly describe dark matter, black hole and gravitational wave	**22. Semiconductor devices** 22.1 Describe the formation of PN junction and semiconductor diode 22.2 Plot forward and reverse characteristics of semiconductor diode including the concept of Zener diode 22.3 Define rectifier 22.4 Describe full wave rectification using semiconductor diodes 22.5 Define logic gates and explain operation of different logic gates OR, AND, NOT, NAND and NOR gates with their symbol , Boolean algebra and truth table
-	**23. Quantization of energy** 23.1 Write the postulates of Bohr's model 23.2 Derive the expression of radius of nth orbit, velocity of electron in nth orbit and total energy of electron in nth orbit of H-atom 23.3 Obtain the expression of wavelength of a spectral line 23.4 Obtain mathematical expressions different spectral series of H-atom 23.5 Differentiate excitation and ionization potentials 23.6 Explain emission and absorption spectra 23.7 Describe de Broglie hypothesis 23.8 Define x-rays 23.9 Describe modern Coolidge tube method for the production of x-rays with quality and quantity 23.10 Illustrate different properties of x-rays

	along with their applications 23.11 Solve numerical problems related to quantization of energy
-	**24. Radioactivity and nuclear reaction** 24.1 Explain the meaning of Radioactivity – natural and artificial 24.2 Differentiate types of radiations coming from radioactive sources – alpha, beta particles and gamma rays and state their properties 24.3 Explain radioactive disintegration law 24.4 Obtain the expressions of half-life, decay constant and mean life 24.5 Explain the working of Geiger-Muller Tube 24.6 Analyze some medical uses and health hazard of nuclear radiation 24.7 Work out some related numerical problems **24.8** Reason conceptual questions
-	**25. Recent trends in physics** **25.1 Seismology** a. Briefly explain the origin of earthquakes b. Explain different types of surface waves: Rayleigh and Love waves c. Explain different types of internal waves: S and P-waves d. Give brief introduction to the wave patterns of Gorkha Earthquake 2015 **25.2** Demonstrate basic ideas on a. Gravitational Wave b. Nanotechnology c. Higgs Boson

4. Scope and Sequence of Contents

Grade 11		Grade 12	
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Content Area: Mechanics			
1. Physical Quantities **1.1.** Precision and significant figures. Dimensions and uses of dimensional analysis.	**3**	**1. Rotational dynamics** 1.1 Equation of angular motion, Relation between linear and angular kinematics 1.2 Kinetic energy of rotation of rigid body 1.3 Moment of inertia; Radius of gyration 1.4 Moment of inertia of a uniform rod 1.5 Torque and angular acceleration for a rigid body 1.6 Work and power in rotational motion 1.7 Angular momentum, conservation of angular momentum.	**7**
2. Vectors 2.1. Triangle, parallelogram and polygon laws of vectors 2.2. Resolution of vectors; Unit vectors 2.3. Scalar and vector products.	**4**	2. **Periodic motion** 2.1 Equation of simple harmonic motion (SHM) 2.2 Energy in SHM 2.3 Application of SHM: vertical oscillation of mass suspended from coiled spring 2.4 Angular SHM, simple pendulum 2.5 Oscillatory motion: Damped oscillation, Forced oscillation and resonance.	**6**
3. Kinematics 3.1 Instantaneous velocity and acceleration	**5**	**3. Fluid statics** 3.1 Fluid statics: Pressure in a fluid; Buoyancy 3.2 Surface tension: Theory of	**9**

3.2 Relative velocity 3.3 Equation of motion (graphical treatment) 3.4 Motion of a freely falling body 3.5 Projectile motion and its applications.		surface tension; Surface energy 3.3 Angle of contact, capillarity and its applications 3.4 Fluid Dynamics: Newton's formula for viscosity in a liquid; Coefficient of viscosity 3.5 Poiseuille's formula and its application 3.6 Stokes law and its applications 3.7 Equation of continuity and its applications 3.8 Bernoulli's equation and its applications.	
4. Dynamics 4.1 Linear momentum, Impulse 4.2 Conservation of linear momentum 4.3 Application of Newton's laws 4.4 Moment, torque and equilibrium 4.5 Solid friction: Laws of solid friction and their verifications.	**6**	-	
5. Work, energy and power 5.1 Work done by a constant force and a variable force 5.2 Power 5.3 Work-energy theorem; Kinetic and potential energy 5.4 Conservation of Energy 5.5 Conservative and non-conservative forces 5.6 Elastic and inelastic collisions.	**6**	-	
6. Circular Motion 6.1 Angular displacement, velocity and acceleration 6.2 Relation between angular and linear velocity and acceleration 6.3 Centripetal acceleration 6.4 Centripetal force	**6**	-	

6.7 Conical pendulum 6.8 Motion in a vertical circle 6.9 Applications of banking.			
7. Gravitation 7.1 Newton's law of gravitation 7.2 Gravitational field strength 7.3 Gravitational potential; Gravitational potential energy 7.4 Variation in value of 'g' due to altitude and depth 7.5 Centre of mass and center of gravity 7.6 Motion of a satellite: Orbital velocity and time period of the satellite 7.7 Escape velocity 7.8 Potential and kinetic energy of the satellite 7.9 Geostationary satellite 7.10 GPS	**10**	-	
8. Elasticity 8.1 Hooke's law: Force constant 8.2 Stress; Strain; Elasticity and plasticity 8.3 Elastic modulus: Young modulus, bulk modulus, shear modulus 8.4 Poisson's ratio 8.5 Elastic potential energy.	**5**	-	
Content Area: Heat and Thermodynamics			
9. Heat and Temperature 9.1 Molecular concept of thermal energy, heat and temperature, and cause and direction of heat flow 9.2 Meaning of thermal equilibrium and Zeroth law of thermodynamics. 9.3 Thermal equilibrium as a working principle of mercury thermometer.	**3**	**4. First Law of Thermodynamics** 4.1 Thermodynamic systems 4.2 Work done during volume change 4.3 Heat and work; Internal energy and First law of thermodynamics 4.4 Thermodynamic processes: Adiabatic, isochoric, isothermal	**6**

10. Thermal Expansion 10.1 Linear expansion and its measurement 10.2 Cubical expansion, superficial expansion and its relation with linear expansion 10.3 Liquid Expansion: Absolute and apparent 10.4 Dulong and Petit method of determining expansivity of liquid	**4**	and isobaric 4.5 Heat capacities of an ideal gas at constant pressure and volume and relation between them 4.6 Isothermal and Adiabatic processes for an ideal gas.	
11. Quantity of Heat 11.1 Newton's law of cooling 11.2 Measurement of specific heat capacity of solids and liquids 11.3 Change of phases: Latent heat 11.4 Specific latent heat of fusion and vaporization 11.5 Measurement of specific latent heat of fusion and vaporization 11.6 Triple point	**6**	**5. Second Law of Thermodynamics** 5.1 Thermodynamic systems and direction of thermodynamic processes 5.2 Second law of thermodynamics 5.3 Heat engines 5.4 Internal combustion engines: Otto cycle, Diesel cycle; Carnot cycle 5.5 Refrigerator 5.6 Entropy and disorder (introduction only)	**6**
12. Rate of heat flow 12.1 Conduction: Thermal conductivity and measurement 12.2 Convection 12.3 Radiation: Ideal radiator 12.4 Black- body radiation 12.5 Stefan – Boltzmann law.	**5**	-	
13. Ideal gas 13.1 Ideal gas equation 13.2 Molecular properties of matter 13.3 Kinetic-molecular model of an ideal gas 13.4 Derivation of pressure exerted by gas, 13.5 Average translational kinetic	**8**	-	

energy of gas molecule 13.6 Boltzmann constant, root mean square speed 13.7 Heat capacities: gases and solids.			
Content Area: Waves & Optics			
14. Reflection at curved mirror 14.1 Real and Virtual images. 14.2 Mirror formula	**2**	**6. Wave motion** 6.1 Progressive waves 6.2 Mathematical description of a wave 6.3 Stationary waves	**2**
15. Refraction at plane surfaces 15.1 Laws of refraction: Refractive index 15.2 Relation between refractive indices 15.3 Lateral shift 15.4 Total internal reflection.	**4**	**7. Mechanical waves** 7.1 Speed of wave motion; Velocity of sound in solid and liquid 7.2 Velocity of sound in gas 7.3 Laplace's correction 7.4 Effect of temperature, pressure, humidity on velocity of sound.	**4**
16. Refraction through prisms 16.1 Minimum deviation condition 16.2 Relation between Angle of prism, minimum deviation and refractive index 16.3 Deviation in small angle prism.	**3**	**8. Wave in pipes and strings** 8.1 Stationary waves in closed and open pipes 8.2 Harmonics and overtones in closed and open organ pipes 8.3 End correction in pipes 8.4 Velocity of transverse waves along a stretched string 8.5 Vibration of string and overtones 8.6 Laws of vibration of fixed string.	**4**
17. Lenses 17.1 Spherical lenses, angular magnification 17.2 Lens maker's formula 17.3 Power of a lens	**3**	**9. Acoustic phenomena** 9.1 Sound waves: Pressure amplitude 9.2 Characteristics of sound: Intensity; loudness, quality and pitch 9.3 Doppler's effect.	**5**
18. Dispersion 18.1 Pure spectrum and dispersive	**3**	**10. Nature and propagation of light**	**3**

power 18.2 Chromatic and spherical aberration 18.3 Achromatism and its applications		10.1 Huygen's principle 10.2 Reflection and Refraction according to wave theory	
-		**11. Interference** 11.1 Phenomenon of Interferences: Coherent sources 11.2 Young's double slit experiment.	**2**
-		**12. Diffraction** 12.1 Diffraction from a single slit 12.2 Diffraction pattern of image; Diffraction grating 12.3 Resolving power of optical instruments.	**3**
-		**13. Polarization** 13.1 Phenomenon of polarization 13.2 Brewster's law; transverse nature of light 13.3 Polaroid.	**3**
Content Area: Electricity & Magnetism			
19. Electric Charges 19.1 Electric charges 19.2 Charging by induction 19.3 Coulomb's law- Force between two point charges 19.4 Force between multiple electric charges.	**3**	**14. Electrical circuits** 14.1 Kirchhoff's law 14.2 Wheatstone bridge circuit; Meter bridge 14.3 Potentiometer: Comparison of e.m.f., measurement of internal resistances of a cell 14.4 Super conductors; Perfect conductors 14.5 Conversion of galvanometer into voltmeter and ammeter; Ohmmeter 14.6 Joule's law	**6**
20. Electric field 20.1 Electric field due to point charges; Field lines	**3**	**15. Thermoelectric effects:** 15.1 Seebeck effect; Thermocouples 15.2 Peltier effect: Variation of	**3**

20.2 Gauss Law: Electric Flux 20.3 Application of Gauss law: Field of a charge sphere, line charge, charged plane conductor		thermoelectric e.m.f. with temperature; Thermopile	
21. Potential, potential difference and potential energy 21.1 Potential difference, Potential due to a point, Charge, potential energy, electron volt 21.2 Equipotential lines and surfaces 21.3 Potential gradient	**4**	**16. Magnetic field** 16.1 Magnetic field lines and magnetic flux; Oersted's experiment 16.2 Force on moving charge; Force on a conductor 16.3 Force and Torque on rectangular coil, Moving coil galvanometer 16.4 Hall effect 16.5 Magnetic field of a moving charge 16.6 Biot and Savart law and its application to (i) a circular coil (ii) a long straight conductor (iii) a long solenoid 16.7 Ampere's law and its applications to (i) a long straight conductor (ii) a straight solenoid (ii) a toroidal solenoid 16.8 Force between two parallel conductors carrying current- definition of ampere	**9**
22. Capacitor 22.1 Capacitance and capacitor 22.2 Parallel plate capacitor 22.3 Combination of capacitors 22.4 Energy of charged capacitor 22.5 Effect of a dielectric Polarization and displacement.	**7**	**17. Magnetic properties of materials:** 17.1 Magnetic field lines and magnetic flux 17.2 Flux density in magnetic material; Relative permeability; Susceptibility 17.3 Hysteresis 17.4 Dia,-para- and ferro-magnetic	**5**

		materials.	
23. DC Circuits 23.1 Electric Currents; Drift velocity and its relation with current 23.2 Ohm's law; Electrical Resistance; Resistivity; Conductivity 23.3 Current-voltage relations; Ohmic and Non-Ohmic resistance 23.4 Resistances in series and parallel, 23.5 Potential divider 23.6 Electromotive force of a source, internal resistance 23.7 Work and power in electrical circuits	**10**	**18. Electromagnetic Induction:** 18.1 Faraday's laws; Induced electric fields 18.2 Lenz's law, Motional electromotive force 18.3 A.C. generators; Eddy currents 18.4 Self-inductance and mutual inductance 18.5 Energy stored in an inductor 18.6 Transformer.	**6**
-		**19. Alternating Currents** 19.1 Peak and rms value of AC current and voltage 19.2 AC through a resistor, a capacitor and an inductor 19.3 Phasor diagram 19.4 Series circuits containing combination of resistance, capacitance and inductance 19.5 Series resonance, quality factor 19.6 Power in AC circuits: power factor	**6**
Content Area : Modern Physics			
24. Nuclear physics 24.1 Nucleus: Discovery of nucleus 24.2 Nuclear density; Mass number; Atomic number 24.3 Atomic mass; Isotopes 24.4 Einstein's mass-energy relation 24.5 Mass Defect, packing fraction, BE per nucleon 24.6 Creation and annihilation	**6**	**20. Electrons** 20.1 Milikan's oil drop experiment, 20.2 Motion of electron beam in electric and magnetic fields 20.3 Thomson's experiment to determine specific charge of electrons	**4**

24.7 Nuclear fission and fusion, energy released			
25. Solids 25.1 Energy bands in solids (*qualitative ideas*) 25.2 Difference between metals, insulators and semi-conductors using band theory 25.3 Intrinsic and extrinsic semi-conductors	**3**	**21. Photons** 21.1 Quantum nature of radiation 21.2 Einstein's photoelectric equation; Stopping potential 21.3 Measurement of Plank's constant	**3**
26. Recent Trends in physics *26.1 Particle physics:* Particles and antiparticles, Quarks (baryons and meson) and leptons (neutrinos) *26.2 Universe:* Big Bang and Hubble law: expansion of the Universe, Dark matter, Black Hole and gravitational wave	**6**	**22. Semiconductor devices** 22.1 P-N Junction 22.2 Semiconductor diode: Characteristics in forward and reverse bias 22.3 Full wave rectification 22.4 Logic gates; NOT, OR, AND, NAND and NOR.	**6**
-		**23. Quantization of energy** 23.1 Bohr's theory of hydrogen atom 23.2 Spectral series; Excitation and ionization potentials 23.3 Energy level; Emission and absorption spectra 23.4 De Broglie Theory; Duality 23.5 Uncertainly principle 23.6 X-rays: Nature and production; uses 23.7 X-rays diffraction, Bragg's law.	**8**
-		**24. Radioactivity and nuclear reaction** 24.1 Alpha-particles; Beta-particles, Gamma rays 24.2 Laws of radioactive disintegration 24.3 Half-life, mean-life and decay	**6**

		constant 24.4 Geiger-Muller Tube 24.5 Carbon dating 24.6 Medical use of nuclear radiation and possible health hazard.	
-		**25. Recent trends in physics** *Seismology:* 25.1 Surface waves: Rayleigh and Love waves Internal waves: S and P-waves Wave patterns of Gorkha Earthquake 2015 25.2 Gravitational Wave Nanotechnology Higgs Boson	**6**
	128		**128**

5. Practical Courses **[32 Hours]**

The practical work that students do during their course is aimed at providing them learning opportunities to accomplish competency number 2 and 3 of the syllabus as well as reinforcing their learning of the theoretical subject content. This part of the syllabus focuses more on skill building than knowledge building. Students must be aware of the importance of precision, accuracy, significant figures, range and errors while collecting, processing, analyzing and communicating data. Likewise, graphical method of analysis and drawing conclusion should be encouraged wherever possible.

Students should

1. learn to use metre rule for measuring length, Vernier-calipers for measuring small thicknesses, internal and external diameters of cylindrical objects and depths of holes, spherometer for measuring radius of curvature of spherical surfaces and micrometer screw-gauge for measuring diameter of small spherical or cylindrical objects and very small thicknesses, traveling microscope with Vernier scale for measuring small distances, top-pan balance for measuring small masses, stop watch for measuring time interval, laboratory thermometer for measuring temperature, protractor for measuring angle), ammeter and milli-ammeter for measuring electric current and voltmeter for measuring electric potential difference.
2. learn to measure precisely up to the least count of the measuring instrument-

   metre rule – 0.001m or 1 mm

   Vernier calipers - 0.1 mm

Spherometer - 0.01 mm

micrometer screw gauge - 0.01 mm

stop watch - 0.01s

laboratory thermometer - 0.5^{o}C

protractor - 1^{o}

3. learn to repeat readings and take the average value
4. learn to draw a standard table, with appropriate heading and unit for every column for storing data
5. learn to plot a graph using standard format, draw suitable trend lines, determine gradient, intercepts and area and use them to draw appropriate conclusion
6. learn to estimate and handle uncertainties.

In each academic year, students should perform 10 experiments, either listed below or designed by teacher, so that no more than three experiments come from the same unit of this syllabus.

a) Practical Activities for Grade 11

I. Mechanics

1. Verify the law of moments by graphically analyzing the relation between clockwise moment and anticlockwise moment on a half metre rule suspended at the cerntre by a string.
2. Determination of the coefficient of friction for the two surfaces by graphically analyzing how minimum force needed to set a trolley resting on plan horizontal surface to motion varies with its mass.
3. Determination of young modulus of elasticity of the material of a given wire by graphically analyzing the variation of tensile force with respect to extension produced by it.

II. Heat

4. Use of Pullinger's apparatus for the Determination of the linear expansivity of a rod.
5. Use of Regnault's apparatus to determination of the specific heat capacity of a solid by the method of mixture.
6. Determination of the thermal conductivity of a good conductor by Searle's method.

III. Geometrical Optics

7. Use of rectangular glass slab to determine the thickness of the slab by graphically analyzing how lateral shift varies with the angle of incidence.
8. Use of Travelling Microscope for the determination of the refractive index of glass slab by graphically analyzing how apparent depth varies with the real depth for glass plates of different thicknesses.
9. Determination of the focal length of a concave mirror by graphically analyzing the variation of image distance with respect to object distance.

IV. Current electricity

10. Verification of Ohm's law and determination of resistance of a thin-film resistor by graphical analysis of variation of electric current in the resistor with respect to potential difference across it.
11. Determination of resistivity of a metal wire by graphical analysis of variation of electric current through a metal wire against its length.
1. Investigation of *I-V* characteristics of a heating coil by graphically analyzing the variation of electric current though a light bulb with respect to the potential difference across it.

b) Sample project works for grade 11

1. Study the variation in the range of a jet of water with angle of projection
2. Study the factors affecting the rate of loss of heat of a liquid
3. Study the nature and size of the image formed by a convex lens using a candle and a screen.
4. Study of uses of alternative energy sources in Nepal
5. Study of energy consumption patterns in the neighborhood.
6. Study of study of electricity consumption pattern in the neighborhood.
7. Study of application of laws and principle of physics in any indigenous technology.
8. Verification of the laws of solid friction.
9. Study the temperature dependence of refractive index of different liquids using a hollow prism and laser beam.
10. Study the frequency dependence of refractive index of glass using a glass prism and white light beam.

c) Some examples of innovative works for grade 11

1. Construct a hygrometer using dry and wet bulb thermometers and use it to measure relative humidity of a given place.
2. Design and construct a system to demonstrate the phenomenon of total internal reflection (TIR) of a laser beam through a jet of water.
3. Construct a digital Newton meter using the concept of potential divider.

d) Practical Activities for Grade 12

I. Mechanics

1. Use of Simple pendulum for the determination of the value of 'g' in the laboratory by graphically analyzing the variation of period of oscillations with length of the pendulum.
2. Determination of the surface tension of water by capillary tube method by graphically analyzing the variation of by graphically analyzing the variation of height of the liquid against the diameter of capillary tube for five capillaries of different diameters dipped in water simultaneously.

3. Determination of the coefficient of viscosity of liquid by Stoke's method by graphically analyzing the variation of time taken for six metal balls of different diameters to travel the same distance in the given liquid with respect to their diameters.

II. Wave and Optics

4. Determination of the wavelength of He-Ne laser light by passing a plane diffraction grating.
5. Determination of the frequency of A.C. Mains using sonometer and graphically analyzing the variation of the ratio of resonating lengths with respect to the frequency of tuning fork using tuning forks of different frequencies.
6. Determination of velocity of sound in air at NTP using resonance tube.

III. Electricity and magnetism

7. Use of potentiometer for the
   a) Comparison of emf's of two cells
   b) Determination of the internal resistance of a cell
8. Study the variation or resistance of a thermistor with temperature.
   1. Use of deflection magnetometer to determination of the pole strength and magnetic moment of a bar magnet
   2. Determine the magnetic field strength of a bar magnet stuck on table by graphically analyzing the period of torsional motion of a freely suspended bar magnet and its distance from the near pole of the fixed magnet along its long axis.

IV. Modern Physics

11. Study the I-V characteristics of a semiconductor diode.

e) Sample project works for grade 12

1. Study the traffic noise level in your town using a sound pressure level (SPL) meter.
2. Design and construct a step-up transformer.
3. Construct a simple device to measure angle of contact of a liquid with a solid surface and also calculate the surface free energy of some hydrophobic and hydrophilic surfaces.
4. Calculate the surface free energy of some hydrophobic and hydrophilic surfaces.
5. Construct a simple DC motor using a disk type magnet and a battery.
6. Construct a model of AC generator/dynamo.
7. Construct a current balance to measure magnetic flux density of a U-shaped magnet.
8. Construction of a step down transformer attached with a full wave rectifier made from semiconductor diodes.

f) Some examples of innovative works for grade 12

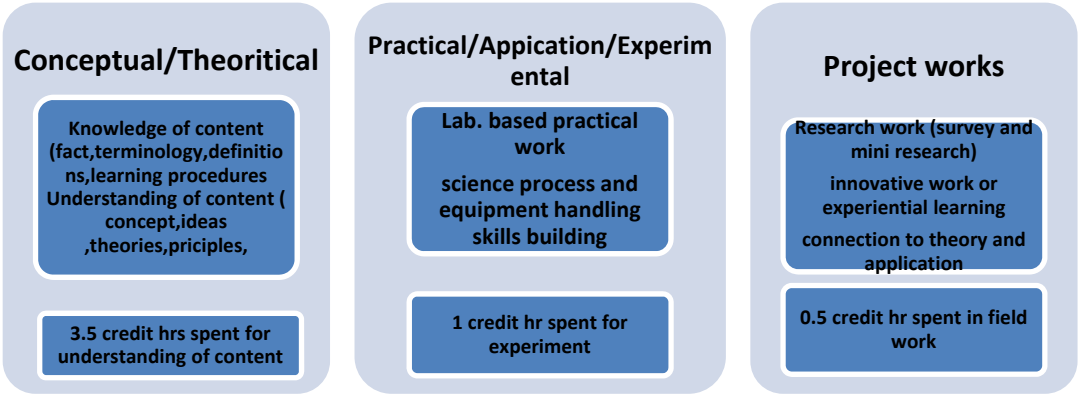
1. Construct a thermocouple thermometer and use it to investigate how temperature of a Bunsen burner flame changes with the height of the flame from the top of the burner.

2. Study of the status of hydroelectricity in Nepal.
3. Study of application of laws and principle of physics in any indigenous technology.
4. Verify Joule' law.
5. Investigation on Peltier effect.
6. History of space exploration
7. Study on history of nuclear power in Asia

6. Learning Facilitation Method and Process

Students should be facilitated to learn rather than just accumulation of information. Teacher plays vital role for delivering subject matters although others' role is also important. Student centered teaching-learning process is highly emphasized. Students are supposed to adopt multiple pathway of learning, such as online search, field visit, library work, laboratory work, individual and group work, research work etc. with the support of teacher. Self-study by students is highly encouraged and learning should not be confined to the scope of curriculum. Teacher should keep in mind intra and inter-disciplinary approach to teaching and learning, as opposed to compartmentalization of knowledge. Supportive role of parents/guardians in creating conducive environment for promoting the spirit of inquiry and creativity in students' learning i anticipated.

During the delivery process of science teaching in grade 11 and 12, basically following three approaches will be adopted;



a) Conceptual/Theoretical Approach

Possible theoretical methods of delivery may include the following;

- lecture
- interaction
- question answer
- demonstrations
- ICT based instructions
- cooperative learning
- group discussions (satellite learning group, peer group, small and large group)

- debate
- seminar presentation
- Journal publishing
- daily assignment

b) Practical/Application/Experimental approach

Practical work is the integral part of the learning science. The process of lab based practical work comprises as;

- familiarity with objective of practical work
- familiarity with materials, chemicals, apparatus
- familiarity with lab process (safety, working modality etc.)
- conduction of practical work (systematically following the given instruction)
- analysis, interpretation and drawing conclusion

c) Project work Approach

Project work is an integral part of the science learning. Students should be involved in project work to foster self-learning of students in the both theoretical and practical contents. Students will complete project work to have practical idea through learning by doing approach and able to connect the theory into the real world context. It is regarded as method/ process of learning rather than content itself. So use of project work method to facilitate any appropriate contents of this curriculum is highly encouraged.

In this approach student will conduct at least one **research work, or an innovative work** under the guidance of teacher, using the knowledge and skills learnt. It could include any of the followings;

(a) Mini research
(b) Survey
(c) Model construction
(d) Paper based work
(e) study of ethno-science

General process of research work embraces the following steps;

- Understanding the objective of the research
- Planning and designing
- Collecting information
- analysis and interpretation
- Reporting /communicating (presentation, via visual aids, written report, graphical etc.)

General process of innovative work embraces the following steps;

- identification of innovative task (either assigned by teacher or proposed by student)
- planning
- performing the task

- presentation of the work
- Record keeping of the work

Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the Curriculum. However, repetition of topic should be discouraged.

Learning process matrix

Knowledge and understanding	Scientific skills and process	Values, attitudes and application to daily life
• Scientific phenomenon, facts, definition, principles, theory, concepts and new discoveries • Scientific vocabulary, glossary and terminology • Scientific tools, devises, instruments apparatus • Techniques of uses of scientific instruments with safety • Scientific and technological applications	• Basic and integrated scientific process skills <u>Process</u> • Investigation • Creative thinking • problem solving	• Responsible • Spending time for investigation

Basic Science Process Skills includes,

1. Observing: using senses to gather information about an object or event. It is description of what was actually perceived.
2. Measuring: comparing unknown physical quantity with known quantity (standard unit) of same type.
3. Inferring: formulating assumptions or possible explanations based upon observations.
4. Classifying: grouping or ordering objects or events into categories based upon characteristics or defined criteria.
5. Predicting: guessing the most likely outcome of a future event based upon a pattern of evidence.
6. Communicating: using words, symbols, or graphics to describe an object, action or event.

Integrated Science Process Skills includes,

1. Formulating hypotheses: determination of the proposed solutions or expected outcomes for experiments. These proposed solutions to a problem must be testable.
2. Identifying of variables: Identification of the changeable factors (independent and dependent variables) that can affect an experiment.
3. Defining variables operationally: explaining how to measure a variable in an experiment.

4. Describing relationships between variables**:** explaining relationships between variables in an experiment such as between the independent and dependent variables.
5. Designing investigations: designing an experiment by identifying materials and describing appropriate steps in a procedure to test a hypothesis.
6. Experimenting: carrying out an experiment by carefully following directions of the procedure so the results can be verified by repeating the procedure several times.
7. Acquiring data: collecting qualitative and quantitative data as observations and measurements.
8. Organizing data in tables and graphs: presenting collected data in tables and graphs.
9. Analyzing investigations and their data: interpreting data, identifying errors, evaluating the hypothesis, formulating conclusions, and recommending further testing where necessary.
10. Understanding cause and effect relationships: understanding what caused what to happen and why.
11. Formulating models: recognizing patterns in data and making comparisons to familiar objects or ideas.

7. Student Assessment

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc. are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Out of 100 full marks Internal evaluation covers 25 marks. Internal evaluation consists of Practical work (16 marks), (b) Marks from trimester examinations (6 marks), and (c) Classroom participation (3 marks)

- **Practical Activities**

Practical work and project work should be based on list of activities mentioned in this curriculum or designed by the teacher. Mark distribution for practical work and project work will be as follows:

S. N.	Criteria	Elaboration of criteria	Marks
1.	Laboratory experiment	Correctness of apparatus setup/preparation	2
		Observation/Experimentation	2
		Tabulation	1
		Data processing and Analysis	1
		Conclusion (Value of constants or prediction with	1

		justification)	
		Handling of errors/precaution	1
2.	Viva-voce	Understanding of objective of the experiment	1
		Skills of the handling of apparatus in use	1
		Overall impression	1
3.	Practical work records and attendance	Records (number and quality)	2
4	Project work	Reports (background, objective, methodology, finding, conclusion	2
		Presentation	1
		Total	**16**

Note: (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of laboratory experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

- **Marks from trimester examinations**

Total of 6 marks; 3 marks from each trimester.

- **Classroom participation (3 marks)**

Classroom participation includes attendance (1) and participation in learning (2).

(b) External Evaluation

Out of 100 marks theoretical evaluation covers 75 marks. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (such as analyzing, evaluating, creating).

नेपाली

कक्षा : ११ र १२ **विषय सङ्केत :** Nep. 001 (कक्षा ११), Nep. 002 (कक्षा १२)

पाठ्यघण्टा : ३ **वार्षिक कार्यघण्टा : ९६**

१. परिचय

नेपाल बहुजातीय, बहुसांस्कृतिक एवम् बहुभाषिक मुलुक हो । बहुजातीय र बहुसांस्कृतिक विशेषता भएको राष्ट्रमा राष्ट्रिय एकता प्रवर्धन गर्न तथा सामाजिक, सांस्कृतिक सम्बन्ध र समन्वय कायम गर्न सम्पर्क भाषाको आवश्यकता पर्दछ । यसका लागि विद्यार्थीमा भाषिक सक्षमताको विकास हुनुपर्दछ । विद्यार्थीमा भाषिक सञ्चार एवम् बोध र अभिव्यक्तिगत सिपको विकास हुनु नै भाषिक सक्षमता हो । नेपाली भाषा विद्यालय तहको शिक्षणको प्रमुख माध्यम, सरकारी कामकाज र नेपाली समाजको साझा सम्पर्कको भाषा हो । पहिलो, दोस्रो एवम् विदेशी भाषाका रूपमा नेपाली भाषाको प्रयोग हुँदै आएको छ । यस दृष्टिले नेपाली भाषाको प्रयोगमा व्यापकता रहेको छ । नेपालमा नेपाली भाषा सामाजिकीकरण, अन्तरभाषिक व्यवहार, सञ्चार, प्रशासन, प्रविधि र मौखिक तथा लिखित व्यवहारको प्रमुख माध्यमका रूपमा रहिआएको छ । नेपाली समाजको बहुलतालाई दृष्टिगत गर्दै सबै प्रकारका ज्ञान र सिप प्राप्त गर्न तथा विभिन्न माध्यमबाट अन्तर्राष्ट्रिय स्तरका ज्ञानसमेत नेपाली भाषामा सिक्न सक्ने बनाउन विद्यालय तहमा नेपाली भाषाको शिक्षण अपरिहार्य छ । त्यसैले विद्यालय तहमा नेपाली भाषालाई अनिवार्य विषयका रूपमा शिक्षण गर्नुपरेको हो । नेपाली भाषा शिक्षणको मुख्य उद्देश्य विद्यार्थीमा नेपाली भाषासम्बद्ध भाषिक सिप एवम् व्यावहारिक र सिर्जनात्मक क्षमताको विकास गराउनु हो ।

प्रस्तुत पाठ्यक्रमको उद्देश्य विद्यार्थीमा भाषिक सक्षमता अभिवृद्धि गराउनु हो । (कक्षा ९-१०) पूरा गरेका विद्यार्थीको स्तरलाई ध्यान दिई विद्यालय तहको समाप्तिपछि अन्य क्षेत्रमा लाग्ने तथा उच्च शिक्षामा प्रवेश गर्नेहरूको आधारभूमिका रूपमा नेपाली भाषामा सक्षम बनाउने अभिप्रायले यो पाठ्यक्रम तयार पारिएको हो । माध्यमिक तह (कक्षा ११-१२) पूरा गर्दा विद्यार्थीहरूले नेपाली विषयमा प्राप्त गर्ने तहगत सक्षमता र कक्षागत सिकाइ उपलब्धिलाई यस पाठ्यक्रममा समावेश गरिएको छ । पाठ्यक्रममा विद्यार्थीमा बोध एवम् अभिव्यक्तिगत क्षमताको विकासका लागि उपयुक्त विधा र क्षेत्र निर्देश गरिएको छ । यसमा प्रयोजनपरक भाषिक सिप विकास र कार्यमूलक व्याकरणमा विशेष ध्यान दिइएको छ । तदनुरूपका सिकाइ सहजीकरण प्रक्रिया र मूल्याङ्कन विधि पनि समेटिएका छन् । यस पाठ्यक्रममा निम्नलिखित पक्षहरूलाई प्राथमिकतामा राखिएको छ :

- समयसापेक्ष जीवनोपयोगी एवम् सक्षमतामा आधारित भाषिक सिप
- पाठगत विविधताको प्रस्तुति र कार्यमूलक व्याकरण
- स्तरअनुरूपका पाठ्यवस्तुको छनोट एवम् स्तरण
- विद्यार्थीकेन्द्रित सिकाइमा आधारित सहजीकरण प्रक्रिया
- प्रयोजनपरक भाषिक सिप र सिकाइमा जोड
- खोजपरक, परियोजनामूलक तथा सिर्जनात्मक भाषिक अभ्यासमा जोड
- भाषिक सामर्थ्य र सम्पादनका रूपमा भाषिक सिपको विकासमा जोड
- व्याकरणलाई भाषा प्रयोगको आधारका रूपमा सैद्धान्तिकभन्दा रचनात्मक बनाउने प्रयत्न
- स्वतन्त्र पठन र रचना कौशलको विकासमा जोड
- सिपगत सक्षमता परीक्षणमा आधारित भाषिक मूल्याङ्कन

२. तहगत सक्षमता

यस तहका अन्त्यमा विद्यार्थीहरू निम्नलिखित सक्षमता प्राप्त गर्न समर्थ हुने छन् :

१. विविध विषयक्षेत्रका मौखिक सामग्रीको बोध र अभिव्यक्ति

२. विविध विषयक्षेत्रका लिखित सामग्रीको सुरुचिपूर्ण पठन र बोध

३. पाठगत सन्दर्भको अनुमान, घटना, चरित्र र परिवेशको पहिचान, बोध र प्रस्तुति

४. देखेसुनेका, पढेका र अनुभव गरेका विषयवस्तुको मौखिक र लिखित अभिव्यक्ति

५. सामाजिक, सांस्कृतिक, राष्ट्रिय एवम् मानवीय मूल्यअनुकूलको लेख्य अभिव्यक्ति

६. दैनिक व्यावहारिक लेखनमा दक्षता प्रदर्शन

७. सिर्जनात्मक र प्रतिक्रियापरक अभिव्यक्ति कौशल

८. अन्तरसांस्कृतिक एवम् भाषिक मूल्यप्रतिको सचेतता र सम्मानजनक भाषिक व्यवहार

९. तार्किक, अन्तरक्रियात्मक एवम् समस्या समाधानमूलक अभिव्यक्ति कौशल

१०. खोज तथा परियोजनामा आधारित लेख र रचनाको सिर्जना

११. समालोचनात्मक चिन्तनसहितको मौखिक र लिखित अभिव्यक्ति

३.कक्षागत सिकाइ उपलब्धि

	कक्षा : एघार	**कक्षा : बाह्र**
१. सुनाइ र बोलाइ सिप	१. उच्चरित हुने वर्णहरूको पहिचान गरी शुद्ध उच्चारण गर्न २. विविध पाठ, सञ्चार माध्यम र अन्य सामग्री सुनेर तार्किक प्रतिक्रिया व्यक्त गर्न ३. दिइएका विषय वा शीर्षकमा समूहगत छलफल एवम् प्रस्तुतीकरण गर्न ४. सन्दर्भअनुसार गति, यति र लय मिलाई मौखिक अभिव्यक्ति गर्न ५. देखेसुनेका, पढेका तथा अनुभव गरेका विषयलाई सिलसिला मिलाई प्रस्तुत गर्न ६. सामाजिक, सांस्कृतिक सन्दर्भ, वक्ताको अवस्था तथा संवेगका आधारमा प्रतिक्रिया दिन	१. शब्द सुनी अक्षरीकरणसहित शुद्ध उच्चारण गर्न २. विविध पाठ, सञ्चार माध्यम र अन्य क्षेत्रका अभिव्यक्ति सुनेर विश्लेषणात्मक प्रतिक्रिया व्यक्त गर्न ३. दिइएका विषय वा शीर्षकमा समूहगत छलफल एवम् प्रस्तुतीकरण गर्न ४. सन्दर्भअनुसार गति, यति र लय मिलाई मौखिक प्रतिक्रिया व्यक्त गर्न ५. देखेसुनेका तथा अनुभव गरेका विषयलाई सिलसिला मिलाई प्रस्तुत गर्न ६. सामाजिक सन्दर्भ, प्रसङ्ग, वक्ताको अवस्था, अभिवृद्धि र संवेग तथा भाषाको प्रयोजनपरक भेदका आधारमा शिष्टतापूर्वक प्रतिक्रिया व्यक्त गर्न ७. औपचारिक कार्यक्रममा सहभागी भई आफ्ना विचार प्रभावकारी रूपमा व्यक्त गर्न
२. पढाइ सिप	१. लिखित सामग्रीलाई गति, यति, लय मिलाई शुद्धसँग पढ्न	१. लिखित सामग्रीलाई गति, यति, लय मिलाई शुद्धसँग पढ्न

	२. साहित्यिक तथा प्रयोजनपरक पाठहरू पढी पारिभाषिक/प्राविधिक शब्दलाई वाक्यमा प्रयोग गर्न ३. पाठमा प्रयोग भएका शब्दको हिज्जे र अर्थबोधका लागि शब्दकोशको प्रयोग गर्न ४. लिखित सामग्रीको सस्वर तथा मौन पठनद्वारा पढाइको गति विकास गर्न ५. लिखित सामग्रीका आधारमा सन्दर्भको अनुमान, घटना, चरित्र र परिवेशको बोध गरी पढ्न ६. विभिन्न पाठ तथा तिनका विशिष्ट अंशको व्याख्या एवम् समीक्षा गर्न सक्ने गरी पढ्न ७. विविध क्षेत्रसँग सम्बन्धित पाठहरू पढी बोध गर्न ८. पूर्वानुमान, निष्कर्ष, सारांश, संश्लेषण, प्रतिक्रिया व्यक्त गर्न सक्ने गरी पाठहरू पढ्न	२. साहित्यिक तथा प्रयोजनपरक पाठहरू पढी पारिभाषिक/प्राविधिक शब्दको सन्दर्भअनुसार वाक्यमा प्रयोग गर्न ३. पाठमा प्रयोग भएका शब्दको हिज्जे, उच्चारण, स्रोत, शब्दवर्ग, बनोट र अर्थ पहिचानका लागि शब्दकोशको प्रयोग गर्न ४. लिखित सामग्रीको द्रुतपठन गर्न ५. लिखित सामग्री भाव विश्लेषण गर्न सक्ने गरी पढ्न ६. विभिन्न पाठ तथा तिनका विशिष्ट अंशको व्याख्या एवम् समीक्षा गर्न सक्ने गरी पढ्न ७. विविध क्षेत्रसँग सम्बन्धित पाठहरू पढी बोध गर्न ८. पूर्वानुमान, निष्कर्ष, सारांश, संश्लेषण, विश्लेषण, गरी प्रतिक्रिया व्यक्त गर्न सक्ने गरी पाठहरू पढ्न
३. लेखाइ सिप	१. नेपाली वर्णको पहिचान र वर्गीकरण गरी लेख्न २. वर्णविन्यास र लेख्य चिह्नहरूको शुद्ध प्रयोग गर्न ३. मौखिक एवम् लिखित अभिव्यक्तिको बुँदाटिपोट गर्न र सारांश लेख्न ४. व्यावहारिक लेखन (घरायसी पत्र, निमन्त्रणा, बधाई, शुभकामना, सम्मानपत्र, सूचना, विज्ञापन, श्रद्धाञ्जली, समवेदना) गर्न ५. देखेसुनेका, पढेका र अनुभव गरेका विषयवस्तुका बारेमा सिलसिला मिलाएर लिखित वर्णन गर्न ६. कुनै पनि विषय शीर्षकमा अर्थपूर्ण, क्रमबद्ध तथा प्रभावकारी रूपमा अनुच्छेद रचना गर्न ७. पाठको प्रकृतिअनुसार विषयक्षेत्र, संरचना (आदि, मध्य र अन्त्यको शृङ्खला), घटना, चरित्र, परिवेश, भाव, लयबोध गरी लेख्न ८. साहित्यिक विधा र पाठहरूको विश्लेषण गर्न र विशिष्ट अंशको व्याख्या गर्न ९. लिखित अभिव्यक्तिका क्रममा व्याकरणका आधारभूत नियम पालना गरी लेख्न १०. विभिन्न विधामा आधारित भई निर्देशित र स्वतन्त्र सिर्जना गर्न ११. कोशीय प्रविष्टिअनुसार शब्दक्रम मिलाई लेख्न	१. शब्दमा रहेका अक्षर संरचना छुट्याई लेख्न २. वर्णविन्यास र लेख्य चिह्नहरूको शुद्ध प्रयोग गर्न ३. विज्ञान, प्रविधि, सामाजिक शास्त्र, वाणिज्य कानुन आदि क्षेत्रसँग सम्बन्धित प्रयोजनपरक लेखन गर्न ४. व्यावहारिक लेखन गर्न (व्यावसायिक पत्र, भरपाई, तमसुक, करारनामा, मन्जुरीनामा, मुचुल्का, प्रशासनिक टिप्पणी तथा बैठक निर्णय, विज्ञप्ति, बोलपत्र र सम्पादकलाई चिठी लेखन) ५. सामाजिक, सांस्कृतिक, राष्ट्रिय एवम् मानवीय मूल्यमा आधारित भई लिखित अभिव्यक्ति दिन ६. देखेसुनेका, पढेका र अनुभव गरेका विषयवस्तुका बारेमा सिलसिला मिलाएर लिखित वर्णन गर्न ७. पाठको प्रकृतिअनुसार सन्दर्भको अनुमान, संरचना पहिचान, घटना वर्णन, भावबोध, तार्किक विश्लेषण गरी लेख्न ८. साहित्यिक विधा र पाठहरूको विश्लेषण गर्न र विशिष्ट अंशको व्याख्या गर्न ९. लिखित अभिव्यक्तिका क्रममा व्याकरणका आधारभूत नियम पालना गरी लेख्न १०. विभिन्न विधामा आधारित भई निर्देशित र

		स्वतन्त्र सिर्जना गर्न ११. विद्युतीय सञ्चार माध्यममा प्रकाशित सामग्री तथा पुस्तक र लेख रचना पढी प्रतिबिम्बात्मक लेखन गर्न १२. कोशीय प्रविष्टिअनुसार शब्दक्रम मिलाई लेख्न

४. विषयवस्तुको क्षेत्र र क्रम

(क) कक्षा : ११

क्र सं	विधा/ पाठ	क्षेत्र	बोध	अभिव्यक्ति	भाषातत्त्व	पाठ्यघण्टा
१.	कविता (पद्य)	देशभक्ति	•कविताको संरचना •विषयको क्रम, भाषा, लय आदिको बोध •देशभक्ति, संस्कृति र भाषासम्बन्धी पद्यांशको बोध	• कविताको लयबद्ध वाचन • कवितालाई गद्यमा रूपान्तरण • कविता सिर्जना (अनुकरणात्मक लेखन)	(अ) नेपाली कथ्य र लेख्य वर्ण (स्वर र व्यञ्जन) को पहिचान (आ) उच्चार्य व्यञ्जन वर्णको पहिचान र प्रयोग (स्थान, प्रयत्न, घोषत्व र प्राणत्व)	७
२.	कथा	सामाजिक	•कथाको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध	• कथाका घटनाहरूको टिपोट • कथाका पात्रहरूको चरित्र वर्णन • लघुकथा लेखन (अनुकरणात्मक)	(अ) मूल र व्युत्पन्न शब्दको पहिचान (आ) शब्द स्रोत : तत्सम, तद्भव र आगन्तुक शब्द (इ) शब्दकोशीय प्रयोग	८
३.	निबन्ध	सांस्कृतिक (आत्मपरक)	•निबन्धको संरचना (अनुच्छेद योजना, विषय प्रस्तुतिको क्रम, भाषाशैली आदि) को बोध •निबन्धमा प्रयुक्त कठिन शब्दको अर्थबोध	• निबन्धमा वर्णित मुख्य विषयको बुँदाटिपोट र सार लेखन • स्थानीय समाजमा प्रचलित चाडपर्वको वर्णन गरी निबन्ध लेखन • तार्किक, अन्तरक्रियात्मक एवम् समस्या	पदवर्ग (नाम, सर्वनाम, विशेषण र क्रियापद) को प्रयोगात्मक पहिचान	७

				समाधानमूलक लेखन		
४.	जीवनी	(राष्ट्रिय)	-जीवनीको संरचना (जीवन विषयक घटना शृङ्खला, अनुच्छेद योजना, भाषा आदि) को बोध	• जीवनीमा प्रस्तुत घटनाक्रमको वर्णन • आफ्नो समाजमा प्रतिष्ठित कुनै व्यक्तिको जीवनी लेखन • जीवनीबाट प्राप्त सन्देश/शिक्षाको अभिव्यक्ति	(अ) पदवर्ग (नामयोगी, क्रियायोगी, संयोजक, विस्मयादिबोधक र निपात) को प्रयोगात्मक पहिचान (आ) शब्द रूपायन	७
५.	पत्र लेखन	घरायसी	•पत्र लेखनको संरचना (विषय, प्रस्तुतिक्रम, ढाँचा, भाषाशैली आदि) को बोध -	• पत्र लेखनमा प्रस्तुत विषयवस्तु र ढाँचाको टिपोट • विषयको प्रस्तुति • निर्दिष्ट विषयमा पत्र लेखन • निमन्त्रणा, बधाई, शुभकामना, अभिनन्दनपत्र, सम्मानपत्र, सूचना, विज्ञापन, श्रद्धाञ्जली, समवेदनाको ढाँचा र शैलीको अध्ययन तथा लेखन अभ्यास	लेख्य चिह्न र तिनको प्रयोग (पूर्णविराम, अर्धविराम, अल्पविराम, कोष्ठक, विकल्पबोधक/ि तर्यक्, प्रश्नवाचक, उद्धरण, विस्मयसूचक/उ द्गार, निर्देशक, योजक, छुट चिह्न/कागपादे चिह्न,	८
६.	कथा	मनोवैज्ञानिक	•कथाको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध	• कथाका घटनाहरूको टिपोट • कथाका पात्रहरूको चरित्र वर्णन • पढेका नयाँ कथाका बारेमा प्रस्तुति • लघुकथा लेखन (अनुकरणात्मक)	(अ) वर्णविन्यासको पहिचान र प्रयोग (आ) भाषिक प्रयोगमा पदयोग र पदवियोगको पहिचान र प्रयोग	८
७.	निबन्ध	प्राकृतिक (वस्तुपरक)	•निबन्धको संरचना (विषय प्रस्तुतिको क्रम, अनुच्छेद योजना, भाषाशैली आदि)	• निबन्धमा वर्णित मुख्य विषयको बुँदाटिपोट, सारांश • प्रकृति तथा वातावरणको वर्णन	उपसर्गद्वारा शब्दनिर्माण (अ) अ, अन, कु, बि, बे, बद, गैर, ना (आ) अति, अधि, अनु,	७

			को बोध •निबन्धको शैली र ढाँचाको अध्ययन	गरी निबन्ध लेखन •खोज तथा परियोजनामा आधारित भई समालोचनात्मक चिन्तनसहितको लेखन	अप, अभि, अव, आ, उत्, उप, दुर्, दुस्, नि, निर्, निस्, परा, परि, प्र, प्रति, वि, सम्, सु	
८.	लघुनाटक	सामाजि/ मनोवैज्ञानिक	•नाटकको संरचना (विषय, प्रस्तुतिक्रम, हाउभाउ, मञ्चीयता, चरित्र, संवाद, भाषाशैली आदि) को बोध	•नाटकका प्रमुख पात्रको चरित्र वर्णन •नाटकका घटना तथा परिवेशको वर्णन •नाटकको संवादात्मक अभिनय (विषयको प्रस्तुति, हाउभाउ) •संवाद लेखन •प्रतिवेदन लेखन (कार्यक्रम, भ्रमण, घटना)	प्रत्ययद्वारा शब्द निर्माण: (क) अक्कड, अत, अन्त, आइ, आइँ/याइँ, आउ, आली, आलु, आवट, आहा/याहा, इया, (ख) इयार, इलो, ई, उवा, ए, एली, ओ, ओट, औली/यौली, पन/पना, ली, ले	११
९	रिपोर्ताजमूलक रचना	स्वास्थ्य, योग तथा चिकित्सा	•रिपोर्ताजको संरचना (विषय प्रस्तुतिको क्रम, अनुच्छेद योजना, भाषाशैली आदि) को बोध •रिपोर्ताजमा प्रयुक्त कठिन शब्दको अर्थबोध •रिपोर्ताजको ढाँचा र शैलीको अध्ययन	•रिपोर्ताजमा वर्णित मुख्य विषयको बुँदाटिपोट, टिप्पणी लेखन •स्वास्थ्य, योग र चिकित्साको वर्णन गरी रिपोर्ताज लेखन •रिपोर्ताजमा प्रयुक्त कठिन शब्दबाट वाक्य रचना •प्रतिवेदन लेखन ढाँचा र शैलीको अध्ययन र लेखन अभ्यास	प्रत्ययद्वारा शब्द निर्माण: अक, अन, अनीय, इक, इत, ई, ईन/ईण, ईय, क, तर, तम, तव्य, ता, ति, त्व, मय, मान्, वान्, य	८
१०.	संवादात्मक रचना	कृषि, वन तथा वातावरण	•संवादको संरचना (विषय, प्रस्तुतिक्रम, हाउभाउ, तर्क, संवाद, भाषाशैली	•संवादमा प्रस्तुत विषयवस्तुको टिपोट •विषयको प्रस्तुति, हाउभाउ	समास प्रक्रियाद्वारा शब्द निर्माण (अव्ययीभाव, कर्मधारय, तत्पुरुष, द्वन्द्व,	८

			आदि) को बोध	• निर्दिष्ट विषयमा संवाद लेखन तथा मौखिक अभिव्यक्ति र अभिनय • उद्घोषण, समाचार वाचन, प्रवचन आदिको अभ्यास	द्विगु, बहुव्रीहि (समास र विग्रहसमेत)	
११.	दैनिकी रचना	पर्यटन	• निर्दिष्ट पाठको बोध (अनुमान, संरचना पहिचान आदि) • निर्दिष्ट पाठमा प्रयुक्त प्राविधिक तथा पारिभाषिक शब्दको अर्थबोध	• निर्दिष्ट पाठसँग सम्बन्धित रचना • बुँदाटिपोट र सारांश लेखन • दैनिकी लेखन • अनुकरणात्मक लेखन	(अ) द्वित्व प्रक्रियाद्वारा शब्द निर्माण (पूर्ण, आंशिक र आपरिवर्तित द्वित्व) (आ) सन्धि र सन्धि भएका शब्दको पहिचान	८
१२.	वक्तृतात्मक रचना	जलस्रोत र ऊर्जा	• वक्तृताको संरचना (विषय, प्रस्तुतिक्रम, हाउभाउ, तर्क, संवाद, भाषाशैली आदि) को बोध	• वक्तृतामा प्रस्तुत विषयवस्तुको टिपोट • हाउभाउसहित विषयको प्रस्तुति • निर्दिष्ट विषयमा वक्तृता लेखन तथा मौखिक अभिव्यक्ति र अभिनय • उद्घोषण, समाचार वाचन, प्रवचन आदिको अभ्यास • वक्तृता/वादविवाद आयोजना • विभिन्न ढाँचामा प्रतिवेदन लेखन	(अ) उद्देश्य र उद्देश्य विस्तार तथा विधेय र विधेय विस्तार, पहिचान र प्रयोग (आ) व्याकरणात्मक कोटिका आधारमा वाक्य परिवर्तन (लिङ्ग, वचन, पुरुष, आदर) (इ) कथन (प्रत्यक्ष, अप्रत्यक्ष) (ई) ध्रुवीयता (करण, अकरण)	९
जम्मा						९६

(ख) कक्षा : १२

क्रम सङ्ख्या	पाठ	क्षेत्र	बोध	अभिव्यक्ति	भाषातत्त्व	पाठ्यघण्टा
१.	कविता (गद्य कविता)	सामाजिक	• कविताको संरचना (विषयको क्रम, भाषा, शैलीको बोध आदि) • गद्य कविताको लयबोध	• कवितालाई अनुच्छेदमा रूपान्तर • कविताको लयबद्ध वाचन • कविता सिर्जनाको अभ्यास	नेपाली अक्षरको पहिचान र उच्चारण अभ्यास	७
२.	कथा	ऐतिहासिक/ पौराणिक/ सांस्कृतिक	• कथाको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध	• कथामा प्रयुक्त घटनाहरूको सिलसिलाबद्ध टिपोट • निर्देशित वा स्वतन्त्र कथा लेखन अभ्यास • विद्युतीय तथा सञ्चार माध्यममा प्रकाशित कथाहरूको अध्ययन र प्रभावको प्रस्तुति	पदवर्ग (नाम, सर्वनाम, विशेषण र अव्यय) को पहिचान र प्रयोग	७
३.	निबन्ध	नियात्रा	• निबन्धको संरचना (विषय प्रस्तुतिको क्रम, अनुच्छेद योजना, भाषाशैली आदि) को बोध • निबन्धमा प्रयुक्त कठिन शब्दको अर्थबोध	• आफूले गरेको कुनै यात्राको वर्णन • निबन्ध लेखन • विद्युतीय सञ्चार माध्यम र प्रकाशित उपयोगी लेख रचनाहरूको अध्ययन र त्यसबाट प्राप्त विषयवस्तु, सन्देश आदिको प्रस्तुति • तार्किक, अन्तरक्रियात्मक एवम् समस्या समाधानमूलक लेखन	(अ) पदसङ्गति (क) लिङ्ग (ख) वचन (ग) पुरुष (घ) आदर (सामान्य, मध्यम, उच्च) (आ) शब्द रूपायन	७
४.	पत्र लेखन (व्यावसयिक)		• पत्र लेखनको संरचना (विषय,	• पत्र लेखनमा प्रस्तुत विषयवस्तुको	वाक्यको पहिचान र प्रयोग	८

			प्रस्तुतिक्रम, ढाँचा, भाषाशैली आदि) को बोध	टिपोट • विषयको प्रस्तुति • निर्दिष्ट विषयमा पत्र लेखन • भरपाई, तमसुक, करारनामा, मञ्जुरीनामा, मुचुल्का, प्रशासनिक टिप्पणी, बैठक निर्णय, विज्ञापन, सूचना, विज्ञप्ति, बोलपत्र, सम्पादकलाई चिठीको ढाँचा र शैलीको अध्ययन र लेखन अभ्यास • विद्युतीय सञ्चार माध्यममा उपलब्ध प्रयोजनपरक सामग्रीको अध्ययन र लेखन अभ्यास	(क) सरल, संयुक्त र मिश्र वाक्यको पहिचान र प्रयोग (ख) निर्धारित कथाबाट सरल, मिश्र र संयुक्त वाक्यको पहिचान र वाक्यान्तरण	
५.	उपन्याको अंश	सामाजिक	• उपन्यास अंशको संरचना (विषय, परिच्छेद योजना, घटना शृङ्खला, पात्र, संवाद, भाषाशैली आदि) को बोध • शब्दभण्डारको बोध	• उपन्यास अंशको विषयवस्तु वर्णन • उपन्यासको अंशका प्रमुख पात्रको चरित्र वर्णन • उपन्यासको अंशको घटना तथा परिवेशको वर्णन • आफूले अध्ययन गरेको कुनै एक उपन्यासको विषयवस्तु, पात्र, परिवेश, सन्देश आदि बारेमा मौखिक तथा लिखित अभिव्यक्ति	क्रियाका काल (भूत, अभूत) पक्ष : अपूर्ण, पूर्ण, अज्ञात, अभ्यस्त (आ) नेपाली वर्णविन्यासको प्रयोगात्मक अभ्यास	१४
६.	जीवनी	अन्तर्राष्ट्रिय	• जीवनीको संरचना (जीवन विषयक घटना शृङ्खला, अनुच्छेद योजना, भाषा आदि) को	• जीवनीमा प्रस्तुत घटनाक्रमको वर्णन • आफ्नो समाजमा प्रतिष्ठित कुनै व्यक्तिको जीवनी	क्रियाका भाव : सामान्य, आज्ञा, इच्छा, सम्भावना, सङ्केत	७

			बोध	लेखन • खोज तथा परियोजनामा आधारित भई समालोचनात्मक चिन्तनसहितको लेखन		
७.	गीति कविता	सामाजिक /सांस्कृतिक	• कविताको संरचना (विषयको क्रम, भाषा, लय आदि) को बोध • पद्य र गद्य कविताको लयबोध • गजलको संरचना बोध	• कविताको लयबद्ध वाचन • गीति कविता सिर्जना • विद्युतीय सञ्चारमा उपलब्ध मुक्तक तथा कवितात्मक सामग्रीको अध्ययन र कक्षामा प्रस्तुति • गजलको रचना	उपसर्ग र प्रत्ययद्वारा शब्द निर्माणसम्बन्धी अभ्यास	७
८.	कथा	समाज मनोवैज्ञानिक	• कथाको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध	• कथामा वर्णित घटनाको सिलसिलाबद्ध टिपोट • कथाका पात्रहरूको चरित्र वर्णन • कथा सिर्जनाको अभ्यास • आफूले अध्ययन गरेको कम्तीमा कुनै एक उपन्यासको विषयवस्तु, पात्र, परिवेश, सन्देश आदि बारेमा मौखिक तथा लिखित अभिव्यक्ति	द्वित्व र समास प्रक्रियाद्वारा शब्द निर्माणसम्बन्धी अभ्यास	७
९.	आख्यानात्मक रचना	सञ्चार, विज्ञान तथा प्रविधि	• आख्यानको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध	• आख्यानमा वर्णित घटनाको सिलसिलाबद्ध टिपोट • आख्यानका पात्रहरूको चरित्र वर्णन • कथा सिर्जनाको	कारक र विभक्तिको पहिचान र प्रयोग (अ) कारकका सरल र तिर्यक् रूप (आ) कारकका प्रकार : कर्ता, कर्म, करण, सम्प्रदान,	८

				अभ्यास • आफूले अध्ययन गरेको कुनै एक आख्यानको विषयवस्तु, पात्र, परिवेश, सन्देश आदि बारेमा मौखिक तथा लिखित अभिव्यक्ति	अपादान, अधिकरण (इ) विभक्तिको प्रयोग	
१०.	संवादात्मक रचना	समाज, संस्कृति र शिक्षा	• संवादको संरचना (विषय, प्रस्तुतिक्रम, हाउभाउ, तर्क, संवाद, भाषाशैली आदि) को बोध	• संवादमा प्रस्तुत विषयवस्तुको टिपोट • हाउभाउसहित विषयको प्रस्तुति • निर्दिष्ट विषयमा संवाद लेखन तथा मौखिक अभिव्यक्ति र अभिनय • शिक्षा र सांस्कृतिक शीर्षकमा वक्तव्य, समाचार वाचन, प्रवचन आदिको अभ्यास	(क) वाक्य संश्लेषण र विश्लेषण (ख) वाच्य (कर्तृ, कर्म, भाव) को पहिचान र प्रयोग	८
११.	प्रबन्धात्मक रचना	कानुन, प्रशासन र व्यवस्थापन	• प्रबन्धको संरचना (विषय प्रस्तुतिको क्रम, अनुच्छेद योजना, भाषाशैली आदि) को बोध • प्रबन्धमा प्रयुक्त कठिन शब्दको अर्थबोध	• प्रबन्धमा वर्णित मुख्य विषयको बुँदाटिपोट, सारांश • प्रकृति तथा वातावरणको वर्णन गरी प्रबन्ध लेखन • प्रबन्धमा प्रयुक्त कठिन शब्दबाट वाक्य रचना • बैठक (माइन्युट) को उपस्थिति तथा निर्णय एवम् भरपाई, मुचुल्का र प्रशासनिक टिप्पणीको नमुना लेखन • व्यक्तिगत विवरण (बायोडाटा) लेखन	(अ) पदक्रम (क) सामान्य पदक्रम (ख) विशिष्ट पदक्रम (आ) लेख्य चिह्न र तिनको प्रयोग	८
१२.	रिपोर्ताजमूलक	अर्थ, उद्योग	• रिपोर्ताज पाठको	• निर्दिष्ट पाठसँग	(अ) उक्ति परिवर्तन	८

	रचना	र वाणिज्य	बोध (अनुमान, संरचना पहिचान आदि) • रिपोर्ताज पाठमा प्रयुक्त प्राविधिक तथा पारिभाषिक शब्दको अर्थबोध • विभिन्न पत्रिकामा प्रकाशित रिपोर्ताजको अध्ययन र प्रस्तुति	सम्बन्धित रचना • बुँदाटिपोट र सारांश लेखन • निर्दिष्ट अनुच्छेदको उत्तर लेखन • अनुकरणात्मक लेखन • विद्युतीय सञ्चार माध्यममा आधारित विविध लेखन अभ्यास	(आ) उद्देश्य र विधेय विस्तार (इ) शब्दकोशीय प्रयोग	
जम्मा						९६

द्रष्टव्य :

(क) विधाको माध्यमबाट विद्यार्थीले बोध, अभिव्यक्ति र भाषातत्त्वअन्तर्गतका विषयवस्तुको सिकाइ गरी भाषिक सिपहरू र भाषिक कार्यहरूमा आवश्यक सक्षमताको विकास गर्नेछन् ।

(ख) रिपोर्ताजमूलक रचना भनेको कुनै पनि विषयमा गरिएको खोजमूलक र आख्यानात्मक संरचना भएको तथ्यमा आधारित समसामयिक प्रचलित लेखन हो ।

(ग) पाठ्यपुस्तक विकास गर्दा प्रयोजनपरक रचनाहरूलाई साहित्यिक विधासँग सम्बन्धित पाठहरूको बिचमा आवश्यकतानुसार क्रम मिलाएर राख्नुपर्ने छ ।

(घ) विधाको क्षेत्र तथा क्रम र विस्तृतीकरणमा उल्लेख भएका पाठहरूमा प्रयोग भएका आधारमा उपयुक्तताअनुसार शब्दभण्डारको अभ्यास गराउनुपर्ने हुन्छ । यसका लागि पर्यायवाची शब्द, विपरीतार्थी शब्द, अनुकरणात्मक शब्द, अनेकार्थी शब्द, श्रुतिसमभिन्नार्थक शब्द, सङ्क्षिप्त शब्द, उखान टुक्का, लघुतावाची शब्द, सिङ्गो शब्द, समूहवाचक शब्द, पारिभाषिक/ प्राविधिक जस्ता शब्दहरूको अर्थ र सन्दर्भपूर्ण प्रयोगको अभ्यास गराउनु अपेक्षित छ । पाठमा प्रयुक्त भएका शब्दहरूलाई केन्द्रबिन्दु मानी विभिन्न का शब्दभण्डारको विकास गराउने दृष्टिकोण यसमा राखिएको छ । शब्दका विभिन्न अर्थ सम्बन्धहरू र गत विविधतालाई ख्याल राखी शब्दहरूको अर्थ र सन्दर्भपूर्ण प्रयोगमा जोड दिइने छ । यस क्रममा प्रयुक्त र तत्सम्बन्धी उखान टुक्काहरूको प्रयोगलाई पनि समावेश गरिने छ ।

(ङ) यस पाठ्यक्रम कार्यान्वयन र शिक्षण सिकाइका क्रममा सिर्जनात्मक सोचाइ/चिन्तन, समस्या समाधान, विद्युतीय सञ्चार सिप, सहकार्य र स्वव्यस्थापन, खोज, अन्वेषण, तार्किकता जस्ता भाषासम्बद्ध जीवनोपयोगी सिपहरूलाई यथासम्भव एकीकृत गरिने छ ।

५. सिकाइ सहजीकरण प्रक्रिया

सिकाइ सहजीकरण पाठ्यक्रमलाई कक्षाकोठामा प्रभावकारी रूपमा हस्तान्तरण गर्ने विधि हो । भाषा शिक्षणमा भाषिक सिपको विकासका लागि सिकाइ सहजीकरण प्रक्रिया अपरिहार्य हुन्छ । भाषा शिक्षणका क्रममा विद्यार्थीलाई सक्रिय गराएर सिकाइलाई विद्यार्थीकेन्द्रित बनाउनुपर्छ । यसका लागि कक्षाकोठामा बहुभाषिक, स्थिति भएमा पहिलो भाषा र दोस्रो भाषाका रूपमा नेपाली शिक्षणका विधिमा ध्यान पुऱ्याउनुपर्छ । सिकाइ सहजीकरण प्रक्रिया पाठ्यक्रमको उद्देश्य, विषयवस्तु, विद्यार्थीको पृष्ठभूमि, स्थानीय स्रोत साधनको उपलब्धता आदिमा निर्भर हुन्छ । यो व्यक्तिगत र सामूहिक अभ्यासमा पनि आधारित हुन्छ । यस पाठ्यक्रममा सिकाइ सहजीकरणका सिपमा आधारित विधागत शिक्षणमा जोड दिइने छ । भाषा शिक्षण भाषाका सिपहरूको शिक्षण हो । भाषाका सुनाइ, बोलाइ, पढाइ र लेखाइ सिपको एकीकृत शिक्षण गरेर नै भाषाको शिक्षण गरिन्छ । साहित्यिक विधा तथा प्रयोजनपरक पाठका माध्यमबाट भाषिक सिपको शिक्षण गर्नु भाषा सिकाइको मूल पक्ष हो । भाषा शिक्षणमा साहित्यिक विधा र प्रयोजनपरक भेदहरूको निम्नअनुसार उपयोग गरिन्छ :

(क) कविता

कविता भाषाको लययुक्त भेद हो । कविताको शिक्षण गर्दा लयबोध, शब्दार्थ र वाक्यमा प्रयोग, संरचना (आदि, मध्य र अन्त्य) बोध, भावबोध, व्याख्या जस्ता क्रियाकलाप गराउनुपर्दछ । कविता शिक्षण गर्दा पूर्व तयारी, पठन वा श्रवण र पठनपश्चात्का चरणमा बाँडी पठन पृष्ठभूमि, उद्देश्य निर्धारण, प्रश्नको सूची, प्रश्नोत्तर, भावबोध जस्ता क्रियाकलाप गराउनुपर्दछ । यसका लागि नमुना कविता दिई अनुकरणात्मक लेखन गराउने र सिर्जनात्मक अभ्यास पनि गराउनुपर्दछ ।

(ख) कथा

कथा आख्यानात्मक विधा हो । आख्यानात्मक स्वरूपका कारण कथा रुचिपूर्ण हुन्छ । कथा शिक्षण गर्दा उच्चारण, गति, यतिसहित हाउभाउपूर्ण पठन गराइन्छ । कथाबाट कथाकथन, घटना वर्णन, घटना टिपोट, बोध, प्रश्नोत्तर, भाव वर्णन र अनुकरणात्मक तथा स्वतन्त्र सिर्जनात्मक अभ्यास गराउनुपर्छ । पठन क्रियाकलापलाई योजनाबद्ध रूपमा प्रस्तुत गराउन कथा विधा उपयोगी हुन्छ । कथा शिक्षण गर्दा पूर्वपठन, पठन र पठनपश्चात्का चरणमा बाँडी पूर्वानुमान गर्ने, सहकार्यात्मक पठन, छलफल र प्रस्तुतीकरण गर्ने तथा प्रश्न निर्माण गराउने क्रियाकलाप पनि गराउनुपर्छ ।

(ग) निबन्ध

निबन्ध गद्य विधा हो । निजात्मक र वस्तुपरक अनुभूतिका लागि निबन्ध उपयुक्त विधा हो । निबन्ध शिक्षण गर्दा शब्दार्थ र वाक्यमा प्रयोग, पठनबोध, विषयबोध, बुँदाटिपोट, व्याख्या, सारांश, प्रश्नोत्तर, अनुच्छेद लेखन र स्वतन्त्र लेखन जस्ता क्रियाकलाप गराउनुपर्छ । यो लेखाइ सिप विकासका लागि उपयुक्त विधा हो । परियोजना कार्य, घटना अध्ययन, कक्षा छलफल र प्रस्तुतीकरण जस्ता क्रियाकलाप गराएर निबन्ध लेखन क्रियाकलाप गराउनुपर्छ ।

(घ) जीवनी

जीवनी भाषाको गद्य भेद हो । जीवनीबाट विद्यार्थीलाई घटना वर्णन, घटना लेखन, बुँदाटिपोट, प्रश्नोत्तर, सारांश लेखन र जीवनी लेखन जस्ता अभ्यास गराउनुपर्छ । जीवनी लेखनसँगसम्बद्ध गराएर अन्तर्वार्ता, परियोजना कार्य, घटना अध्ययन जस्ता क्रियाकलाप गराउनुपर्छ । जीवनी शिक्षणबाट मूलतः भाषाका पढाइ र लेखाइ सिपको विकास हुने भए पनि लेखन अभ्याससम्बन्धी क्रियाकलाप बढी प्रभावकारी हुन्छ । यसका लागि नमुना जीवनी प्रस्तुत गर्दै अनुकरणात्मक जीवनीमा अभ्यास गराई स्वतन्त्र अभ्यास गराउनुपर्छ ।

(ङ) रूपक

रूपक भनेको अभिनयात्मक विधा हो । यसमा पात्रले परिस्थिति, अवस्था, विषयवस्तु र व्यक्ति विशेषको चारित्रिक भूमिकालाई ध्यानमा राखेर हाउभाउसहित भूमिका निर्वाह गर्छ । यो कथ्य भाषासँग सम्बन्धित भएकाले मौखिक अभिव्यक्तिका माध्यमले व्यक्तिका भावना, चारित्र आदिको प्रदर्शन गरिन्छ । नाटक, एकाङ्की, संवाद, वादविवाद, मनोवाद, वक्तृता आदिका माध्यमबाट रूपकीय प्रस्तुति गरिन्छ । तसर्थ रूपकको प्रकारअनुसार हाउभाउ प्रदर्शन गरी विचारको प्रस्तुतीकरण र व्यवहार गर्ने, अभिनयात्मक ढङ्गबाट अरूले गरेका व्यवहारको अनुकरण गर्ने, जीवन्त रूपमा मौखिक भाषाको प्रयोग गर्ने, तार्किक क्षमताको विकास गर्ने जस्ता क्रियाकलापबाट रूपक शिक्षण गर्नुपर्छ । साथै अभिनयात्मक कलाका अतिरिक्त रूपक विधाबाट अन्य भाषिक सिपको पनि अभ्यास गराउन सकिन्छ ।

(च) प्रयोजनपरक पाठहरू

दैनिक जीवनमा प्रयोगमा आउने विभिन्न समसामयिक का ज्ञान, सिप एवम् विविध प्राविधिक र पारिभाषिक शब्दका माध्यमबाट भाषा सिकाइमा सहजता प्रदान गर्नका लागि यस तहमा प्रयोजनपरक रचनाहरू समावेश गरिएको छ । यसमा सिकारुका दैनिक जीवनयापन र व्यावसायिक क्षेत्रमा आवश्यक पर्ने ज्ञान, सिप, अभिवृद्धि, मूल्य र काम गर्ने तत्परतालाई व्यावहारिक रूपले उपयोग गर्न सक्ने गरी स्वास्थ्य, योग तथा चिकित्सा, कृषि, वन तथा वातावरण, पर्यटन, जलस्रोत र ऊर्जा, सञ्चार, विज्ञान तथा प्रविधि, समाज, संस्कृति र शिक्षा, कानुन, प्रशासन र व्यवस्थापन, अर्थ, उद्योग र वाणिज्य जस्ता विषयमा आधारित रचनालाई समावेश गरिएको छ । यस्ता रचनाका माध्यमबाट विद्यार्थीले वाणिज्य, अर्थ, विज्ञान, स्वास्थ्य, कानुन, शिक्षा, योग जस्ता विषयको रचनात्मक, प्रयोजनपरक भाषिक प्रयोग र संरचनाको अभ्यास गराइने छ । प्रयोजनपरक पाठहरूलाई रोचक बनाउनका लागि साहित्यिक विधाका रूपमा प्रस्तुत गरिने छ । सिकाइ सहजीकरणका क्रममा विभिन्न प्रयोजनपरक शीर्षक दिई तिनमा अनुकरणात्मक, निर्देशनात्मक र स्वतन्त्र लेखनको

अभ्यास गराइन्छ । उदाहरणमा आधारित पाठ वा रचनाको अभ्यास, पाठको मौखिक र लिखित अभिव्यक्ति, समूह छलफल र प्रस्तुतीकरण, परियोजना र खोजमूलक कार्य गराउने अभ्यास गराउनुपर्दछ । त्यस्तै आवश्यकतानुसार प्रचलित र सान्दर्भिक विद्युतीय सञ्चार माध्यममा उपलब्ध उपयोगी सामग्रीको अध्ययन गरी कक्षामा प्रस्तुत गर्न लगाउनुपर्छ ।

७. विद्यार्थी मूल्याङ्कन प्रक्रिया

मूल्याङ्कन गर्दा निर्माणात्मक र निर्णयात्मक दुई किसिमका प्रक्रिया अपनाइने छ । निर्णयात्मक मूल्याङ्कन गर्दा आन्तरिक र बाह्य गरी दुई तरिका अवलम्बन गरिने छ । निर्णयात्मक मूल्याङ्कनका लागि निर्माणात्मक मूल्याङ्कनमा उपयोग गरिएका विभिन्न प्रक्रिया, साधनहरू तथा तिनको अभिलेखीकरणलाई समेत आधार बनाउन सकिने छ । निर्माणात्मक मूल्याङ्कन शिक्षण सिकाइ सहजीकरण प्रक्रियाकै निरन्तरता मानिने भएकाले यसलाई निरन्तर मूल्याङ्कनका रूपमा प्रयोग गर्न सकिन्छ । स्तरोन्नति तथा कक्षोन्नतिका लागि शैक्षिक सत्रको अन्तमा निर्णयात्मक मूल्याङ्कन अन्तिम परीक्षाका माध्यमबाट गरिने छ । निर्माणात्मक वा निरन्तर मूल्याङ्कनमा क्षेत्रीय अध्ययन, परियोजना कार्य, अध्ययन भ्रमण, घटना अवलोकन तथा अध्ययन, सिर्जनात्मक तथा रचनात्मक कार्य, विद्युतीय सञ्चार माध्यममा प्राप्त सान्दर्भिक सामग्रीको अध्ययन र प्रस्तुति, सिकारुका कार्यकलापको निरीक्षण, व्यक्तिगत र सामूहिक छलफल, लिखित परीक्षा, हाजिरीजवाफ, प्रश्नोत्तर, कक्षाकार्यको परीक्षण, भाषिक व्यवहारको निरन्तर अवलोकन र तिनको अभिलेखीकरण जस्ता साधनहरूको उपयोग गरिने छ ।

नेपाली भाषाको मूल्याङ्कनमा सक्षमता र सिकाइ उपलब्धिमा लेखिएका भाषिक सिपको मापन गरिने छ । विद्यार्थीको भाषिक सिपगत सक्षमताको मापनगर्ने प्रश्नहरूको निर्माण गर्दा व्याकरण र शब्दभण्डारसम्बन्धी प्रश्नहरूसमेत भाषिक एकाइ र रचनामा केन्द्रित गरिने छ । व्याकरणको मूल्याङ्कन कार्यमूलक प्रकृतिको हुने छ । प्रश्नहरू विद्यार्थीको भाषिक दक्षताका अतिरिक्त रचनात्मक र समालोचनात्मक क्षमतालाई पनि सम्बोधन गर्ने खालका हुने छन् ।

(क) आन्तरिक मूल्याङ्कन

आन्तरिक तथा प्रयोगात्मक मूल्याङ्कनका लागि प्रत्येक विद्यार्थीहरूको कार्यसञ्चयिका फाइल बनाई सोको आधारमा उनीहरूको कार्य र उनीहरूले गरेका कार्य र उनीहरूमा आएको व्यवहार परिवर्तनका अभिलेख राखी सोका आधारमा अङ्क प्रदान गर्नुपर्दछ । सिकाइका क्रममा कक्षाकोठामा कक्षागत शिक्षण सिकाइको अभिन्न अङ्गका रूपमा गृहकार्य, कक्षाकार्य, परियोजना कार्य, सामुदायिक कार्य, सह/अतिरिक्त क्रियाकलाप, एकाइ परीक्षा, मासिक परीक्षा जस्ता मूल्याङ्कन साधनहरूको प्रयोग गर्न सकिने छ । यस्तो मूल्याङ्कनका लागि विद्यार्थीको अभिलेख राखी त्यही अभिलेखका आधारमा सिकाइस्तर निर्धारण गर्न सकिन्छ । आवश्यकतानुसार सुधारात्मक तथा उपचारात्मक शिक्षण सिकाइ क्रियाकलाप सञ्चालन गर्नुपर्छ । विशेष सिकाइ आवश्यकता भएका विद्यार्थीका लागि विषय शिक्षकले नै उपयुक्त प्रक्रिया अपनाई मूल्याङ्कन गर्नुपर्ने छ । यस विषयमा निर्माणात्मक मूल्याङ्कन प्रक्रियाको महत्त्वपूर्ण भूमिका रहेको हुन्छ । विद्यार्थीहरूले के कति सिके भन्ने कुरा पत्ता लगाई नसिकेको भए कारण पहिचान गरी पुनः सिकाइनुपर्छ । आन्तरिक मूल्याङ्कनको भार २५% छुट्याइएको छ । यस विषयको आन्तरिक मूल्याङ्कनमा कक्षा सहभागिता, कक्षा कार्य/परियोजना कार्य, विषयवस्तुको मूल्याङ्कन तथाा आन्तरिक परीक्षाबाट प्राप्त विद्यार्थीको सिकाइ उपलब्धिलाई समेटिनु पर्दछ ।

यस खण्डको मूल्याङ्कन विद्यार्थीले व्यक्तिगत तथा समूह कार्य तथा परियोजनाको गुणस्तरको आधारमा विद्यालय तहमा गठन गरिने मूल्याङ्कन समितिले गर्ने छ भने तोकिएको निकायबाट यसको प्राविधिक परीक्षण हुने छ । आन्तरिक मूल्याङ्कनका आधारहरू र अङ्क विभाजन निम्नानुसार हुने छ :

आन्तरिक मूल्याङ्कनको विस्तृतीकरण

क्र.सं	क्षेत्र	परीक्षण गर्ने पक्ष	अङ्कभार	मूल्याङ्कनका आधार
१.	सहभागिता	कक्षा सहभागिता	३	विद्यार्थीको दैनिक हाजिरीको अभिलेखलाई आधार लिने भाषिक सिप विकासका लागि व्यक्तिगत, युगल र समूहगत आदि कक्षागत सिकाइ सहभागितालाई आधार मान्ने

२.	कक्षा कार्य/परियोजना कार्य	कक्षा कार्य/परियोजना कार्य	६	सुनाइ, बोलाइ, पढाइ, लेखाइ सिप विकाससम्बद्ध लिखित तथा मौखिक प्रस्तुति, गृहकार्य, कक्षा कार्य वा भाषिक सिप विकाससम्बन्धी परियोजना कार्यको प्रतिवेदन र अन्तर्वार्ता (भाइबा) लाई आधार लिने
३.	विषयवस्तुगत मूल्याङ्कन	(क) सुनाइ	३	रेडियो, क्यासेट, मोबाइल वा अन्य विद्युतीय सामग्रीबाट समाचार, संवाद, साहित्यिक अभिव्यक्ति, वा अन्य सन्देशमूलक गद्यांश सुनाएर अनुमान, पूर्वानुमान, प्रश्नोत्तर, शब्दबोध, अर्थबोध, सन्दर्भबोध, भावबोध, कथाकथन, घटना वर्णन, मुख्य बुँदा टिपोट आदिसँग सम्बन्धित प्रश्नहरू सोधी भन्न वा लेख्न लगाउने । वा १५० देखि २०० शब्दसम्मको कुनै गद्यांश वा पद्यांश (अदृष्टांश) सुनाएर अनुमान, पूर्वानुमान, प्रश्नोत्तर, शब्दबोध, अर्थबोध, सन्दर्भबोध, भावबोध, कथाकथन, घटना वर्णन, मुख्य बुँदा टिपोट आदिसँग सम्बन्धित प्रश्नहरू सोध्ने ।
		(ख) बोलाइ		
		(अ) मौखिक वर्णन/ कथा कथन	४	कुनै विषयवस्तु, चित्र, परिवेश आदि दिएर मौखिक वर्णन गर्न लगाउने (यसरी वर्णन गर्दा वक्ताले बोलेको कुरामा स्पष्टता, शैली, भाषिक स्तर, शुद्धोच्चारण, गति, यति, लय र हाउभाउ जस्ता पक्षमा ध्यान दिने) वा कुनै कथा सुनी कथाकथन गर्न लगाउने, घटना, पात्र र परिवेशको वर्णन गर्न लगाउने
		(आ) सस्वरवाचन	३	कुनै पत्रपत्रिका वा कुनै लिखित सामग्रीबाट १५० शब्दसम्मको गद्यांश वा पद्यांश दिएर गति, यति, लय मिलाएर भावानुकूल सस्वरवाचन गर्न लगाउने । (यसरी वाचन गर्दा स्पष्टता, भाषिक शुद्धता, गति, यति, लय र हाउभाउ जस्ता पक्षमा विशेष ख्याल गर्ने)
४	त्रैमासिक परीक्षा	त्रैमासिक परीक्षाको अङ्कबाट	६	पहिलो त्रैमासिक परीक्षाबाट ३ अङ्क र दोस्रो त्रैमासिक परीक्षाबाट ३ अङ्क
	जम्मा		२५	

द्रष्टव्य : आन्तरिक मूल्याङ्कनका आधारको विस्तृत विवरण आन्तरिक मूल्याङ्कन कार्यविधिका आधारमा हुने छ ।

(ख) बाह्य मूल्याङ्कन

(आ) भाषिक सिप (पढाइ र लेखाइ) कक्षा ११

क्र.सं	भाषिक सिप (पढाइ र लेखाइ)	विषयक्षेत्र	अङ्कभार
१.	वर्ण पहिचान	व्याकरण	३
२.	वर्णविन्यास	व्याकरण	३
३.	पदवर्ग पहिचान	व्याकरण	२
४.	शब्दनिर्माण	व्याकरण	४
५.	रूपायन र पदसङ्गति	व्याकरण	३
६.	काल, पक्ष, भाव र वाच्य	व्याकरण	५
७.	शब्दस्रोत र शब्दकोशीय प्रयोग	व्याकरण	२
८.	वाक्यान्तरण	व्याकरण	३
९.	पठनबोध	प्रयोजनपरक रचना	८
१०.	बुँदाटिपोट र सारांश	गद्य रचना	२ + ३ = ५
११.	पाठगत बोध (सन्दर्भमा आधारित छोटो उत्तरात्मक)	कथा, कविता, निबन्ध, जीवनी, रूपक, प्रयोजनपरक रचना	८
१२.	पाठगत बोध (समीक्षात्मक)	कथा, कविता, निबन्ध, जीवनी, प्रयोजनपरक रचना	४+४=८
१३.	स्वतन्त्र रचना	निबन्ध	८
१४.	प्रतिक्रिया लेखन	सामयिक विषय	४
१५.	व्यावहारिक लेखन	व्यावहारिक लेखन, पत्ररचना	४
१६.	प्रतिवेदन तथा टिप्पणी लेखन	प्रतिवेदन र टिप्पणी	५
जम्मा			७५

कक्षा १२

क्र.सं	भाषिक सिप (पढाइ र लेखाइ)	विषयक्षेत्र	अङ्कभार
१.	अक्षर संरचना	व्याकरण	३
२.	वर्णविन्यास	व्याकरण	३
३.	पदवर्ग पहिचान	व्याकरण	३
४.	शब्दनिर्माण	व्याकरण	३
५.	कारक र विभक्ति तथा पदसङ्गति	व्याकरण	४
६.	काल, पक्ष, भाव र वाच्य	व्याकरण	५
७.	वाक्यान्तरण	व्याकरण	४
८.	पठनबोध	प्रयोजनपरक रचना	८
९.	बुँदाटिपोट र सारांश	गद्य विधा	२+३=५
१०.	पाठगत बोध (सन्दर्भमा आधारित उत्तरात्मक)	उपन्यास, कथा, कविता, निबन्ध, जीवनी र प्रयोजनपरक रचना	८
११.	पाठगत बोध (समीक्षात्मक)	उपन्यास, कथा, कविता, निबन्ध, जीवनी, प्रयोजनपरक रचना	४+४=८
१२.	स्वतन्त्र रचना	निबन्ध	८
१३.	प्रतिक्रिया लेखन	प्रतिक्रिया	४
१४.	व्यावहारिक लेखन	व्यावहारिक लेखन, पत्ररचना	४
१५.	प्रतिवेदन तथा टिप्पणी लेखन	प्रतिवेदन	५
जम्मा			७५

Secondary Education Curriculum
2076
Mathematics

Grades: 11 and 12 **Subject code:** Mat. 401 **(Grade 11),** Mat. 402 **(Grade 12)**

Credit hrs: 5 **Working hrs: 160**

1. Introduction

Mathematics is an indispensable in many fields. It is essential in the field of engineering, medicine, natural sciences, finance and other social sciences. The branch of mathematics concerned with application of mathematical knowledge to other fields and inspires new mathematical discoveries. The new discoveries in mathematics led to the development of entirely new mathematical disciplines. School mathematics is necessary as the backbone for higher study in different disciplines. Mathematics curriculum at secondary level is the extension of mathematics curriculum offered in lower grades (1 to 10).

This course of Mathematics is designed for grade 11 and 12 students as an optional subject as per the curriculum structure prescribed by the National Curriculum Framework, 2076. This course will be delivered using both the conceptual and theoretical inputs through demonstration and presentation, discussion, and group works as well as practical and project works in the real world context. Calculation strategies and problem solving skills will be an integral part of the delivery.

This course includes different contents like; Algebra, Trigonometry, Analytic Geometry, Vectors, Statistics and Probability, Calculus, Computational Methods and Mechanics or Mathematics for Economics and Finance.

Student's content knowledge in different sectors of mathematics with higher understanding is possible only with appropriate pedagogical skills of their teachers. So, classroom teaching must be based on student-centered approaches like project work, problem solving etc.

2. Level-wise Competencies

On completion of this course, students will have the following competencies:

1. use basic properties of elementary functions and their inverse including linear, quadratic, reciprocal, polynomial, rational, absolute value, exponential, logarithm, sine, cosine and tangent functions.
2. use principles of elementary logic to find the validity of statement and also acquire knowledge of matrix, sequence and series, and combinatory.
3. identify and derive equations or graphs for lines, circles, parabolas, ellipses, and hyperbolas, and identify the plane and its properties in space.
4. make connections and present the relationships between abstract algebraic structures with familiar number systems such as the integers, real numbers and complex numbers.
5. articulate personal values of statistics and probability in everyday life.
6. use vectors and mechanics in day to day life.

7. apply derivatives to determine the nature of the function and determine the maxima and minima of a function in daily life context.
8. explain anti-derivatives as an inverse process of derivative and use them in various situations.
9. apply numerical methods to solve algebraic equation and calculate definite integrals and use simplex method to solve linear programming problems (LPP).
10. use relative motion, Newton's laws of motion in solving related problems.
11. develop proficiency in application of mathematics in economics and finance.

3. Grade-wise Learning Outcomes

On completion of the course, the students will be able to:

S. N.	Content Domain/area	Learning Outcomes	
		Grade 11	**Grade 12**
1.	**Algebra**	1.1 acquaint with logical connectives and use them. 1.2 construct truth tables. 1.3 prove set identities. 1.4 state field axioms, order axioms of real numbers. 1.5 define interval and absolute value of real numbers. 1.6 interpret real numbers geometrically. 1.7 define domain and range of a function, inverse function composite function. 1.8 find domain and range of a function. 1.9 find inverse function of given invertible function. 1.10 calculate composite function of given functions. 1.11 define odd and even functions, periodicity of a function, monotonicity of a function. 1.12 sketch graphs of polynomial functions ($eg: \frac{a}{x}, \frac{x^2-a^2}{x-a}, \frac{a}{x+a}, ax^2 + bx + c, ax^3$), trigonometric, exponential, logarithmic	1.1 solve the problems related to permutation and combinations. 1.2 state and prove binomial theorems for positive integral index. 1.3 state binomial theorem for any index (without proof). 1.4 find the general term and binomial coefficient. 1.5 use binomial theorem in application to approximation. 1.6 define Euler's number. 1.7 Expand e^x, a^x and log(1+x) using binomial theorem. 1.8 define binary operation and apply binary operation on sets of integers. 1.9 state properties of binary operations. 1.10 define group, finite group, infinite group and abelian group. 1.11 prove the uniqueness of identity, uniqueness of inverse, cancelation law. 1.12 state and prove De Moivre's theorem.

		functions. 1.13 define sequence and series. 1.14 classify sequences and series (arithmetic, geometric, harmonic). 1.15 solve the problems related to arithmetic, geometric and harmonic sequences and series. 1.16 establish relation among A.M, G. M and H.M. 1.17 find the sum of infinite geometric series. 1.18 obtain transpose of matrix and verify its properties. 1.19 calculate minors, cofactors, adjoint, determinant and inverse of a square matrix. 1.20 solve the problems using properties of determinants. 1.21 define a complex number. 1.22 solve the problems related to algebra of complex numbers. 1.23 represent complex number geometrically. 1.24 find conjugate and absolute value (modulus) of a complex numbers and verify their properties. 1.25 find square root of a complex number. 1.26 express complex number in polar form.	1.13 find the roots of a complex number by De Moivre's theorem. 1.14 solve the problems using properties of cube roots of unity. 1.15 apply Euler's formula. 1.16 define polynomial function and polynomial equation. 1.17 state and apply fundamental theorem of algebra (without proof). 1.18 find roots of a quadratic equation. 1.19 establish the relation between roots and coefficient of quadratic equation. 1.20 form a quadratic equation with given roots. 1.21 find the sum of finite natural numbers, sum of squares of first n-natural numbers, sum of cubes of first n-natural numbers by using principle of mathematical induction. 1.22 solve system of linear equations by Cramer's rule and matrix method (row-equivalent and inverse) up to three variables.
2.	**Trigonometry**	2.1 solve the problems using properties of a triangle (sine law, cosine law, tangent law, projection laws, half angle laws). 2.2 solve the triangle(simple cases)	2.1 define inverse circular functions. establish the relations on inverse circular functions. 2.2 find the general solution of trigonometric equations
3.	**Analytic geometry**	3.1 find the length of perpendicular from a given point to a given	3.1 obtain standard equation of ellipse and hyperbola.

		line. 3.2 find the equation of bisectors of the angles between two straight lines. 3.3 write the condition of general equation of second degree in x and y to represent a pair of straight lines. 3.4 find angle between pair of lines and bisectors of the angles between pair of lines given by homogenous second degree equation in x and y. 3.5 solve the problems related to condition of tangency of a line at a point to the circle. 3.6 find the equations of tangent and normal to a circle at given point. 3.7 find the standard equation of parabola. 3.8 find the equations of tangent and normal to a parabola at given point.	3.2 find direction ratios and direction cosines of a line. 3.3 find the general equation of a plane. 3.4 find equation of a plane in intercept and normal form. 3.5 find the equation of plane through three given points. 3.6 find the equation of geometric plane through the intersection of two given planes. 3.7 find angle between two geometric planes. 3.8 write the conditions of parallel and perpendicular planes. 3.9 find the distance of a point from a plane.
4.	**Vectors**	4.1 identify collinear and non-collinear vectors; coplanar and non-coplanar vectors. 4.2 write linear combination of vectors. 4.3 find scalar product of two vectors. 4.4 find angle between two vectors. 4.5 interpret scalar product of vectors geometrically. 4.6 apply properties of scalar product of vectors in trigonometry and geometry.	4.1 define vector product of two vectors, interpretation vector product geometrically. 4.2 solve the problems using properties of vector product. 4.3 apply vector product in geometry and trigonometry.
5.	**Statistics and Probability**	5.1 calculate the measures of dispersion (standard deviation). 5.2 calculate variance, coefficient of variation and coefficient of skewness. 5.3 define random experiment,	5.1 calculate correlation coefficient by Karl Pearson's method. 5.2 calculate rank correlation coefficient by Spearman method. 5.3 interpret correlation

		sample space, event, equally likely cases, mutually exclusive events, exhaustive cases, favorable cases, independent and dependent events. 5.4 find the probability using two basic laws of probability.	coefficient. 5.4 obtain regression line of y on x and x on y. 5.5 solve the simple problems of probability using combinations. 5.6 solve the problems related to conditional probability. 5.7 use binomial distribution and calculate mean and standard deviation of binomial distribution.
6.	**Calculus**	6.1 define limits of a function. 6.2 identify indeterminate forms. 6.3 apply algebraic properties of limits. 6.4 evaluate limits by using theorems on limits of algebraic, trigonometric, exponential and logarithmic functions. 6.5 define and test continuity of a function. 6.6 define and classify discontinuity. 6.7 interpret derivatives geometrically. 6.8 find the derivatives, derivative of a function by first principle (algebraic, trigonometric exponential and logarithmic functions). 6.9 find the derivatives by using rules of differentiation (sum, difference, constant multiple, chain rule, product rule, quotient rule, power and general power rules). 6.10 find the derivatives of parametric and implicit functions. 6.11 calculate higher order derivatives.	6.1 find the derivatives of inverse trigonometric, exponential and logarithmic functions by definition. 6.2 establish the relationship between continuity and differentiability. 6.3 differentiate the hyperbolic function and inverse hyperbolic function 6.4 evaluate the limits by L'hospital's rule (for 0/0, ∞/∞). 6.5 find the tangent and normal by using derivatives. 6.6 interpret geometrically and verify Rolle's theorem and Mean Value theorem. 6.7 find the anti-derivatives of standard integrals, integrals reducible to standard forms and rational function (using partial fractions also). 6.8 solve the differential equation of first order and first degree by separable variables, homogenous, linear and exact differential equation.

		6.12 check the monotonicity of a function using derivative. 6.13 find extreme values of a function. 6.14 find the concavity of function by using derivative. 6.15 define integration as reverse of differentiation. 6.16 evaluate the integral using basic integrals. 6.17 integrate by substitution and by integration by parts method. 6.18 evaluate the definite integral. 6.19 find area between two curves.	
7.	**Computational methods**	7.1 describe the basic characteristics of numerical computing (accuracy, rate of convergence, numerical stability and efficiency), solve algebraic equation and transcendental equation by bisection method and by Newton-Raphson method and find approximate error by these methods 7.2 integrate numerically by trapezoidal rule and Simpson's rule	7.1 solve the linear programming problems (LPP) by simplex method 7.2 solve the system of linear equations by Gauss Elimination method (up to 3 variables)
8.	**Mechanics**	8.1 find resultant forces by parallelogram of forces. 8.2 solve the problems related to composition and resolution of forces. 8.3 obtain resultant of coplanar forces/vectors acting on a point. 8.4 solve the forces/vectors related problems using triangle laws of forces and Lami's theorem. 8.5 solve the problems of motion of particle in a straight line, motion with uniform acceleration, motion under the gravity, motion in a smooth inclined plane.	8.1 find the resultant of like and unlike parallel forces/vectors. 8.2 solve the problems related to Newton's laws of motion and projectile. Or

	Or **Mathematics for Economics and Finance**	Or 8.1 interpret results in the context of original real- world problems. 8.2 test how well it describes the original real- world problem and how well it describes past and/or with what accuracy it predicts future behavior. 8.3 Model using demand and supply function. 8.4 Find cost, revenue, and profit functions. 8.5 Compute elasticity of demands. 8.6 Construct mathematical models involving supply and income, budget and cost constraint. 8.7 Test the equilibrium and break even condition.	8.1 use quadratic functions in economics, 8.2 understand input- output analysis and dynamics of market price. 8.3 find difference equations. 8.4 work with Cobweb model and lagged Keynesian macroeconomic model. 8.5 explain mathematically equilibrium and break-even. 8.6 construct mathematical models involving consumer and producer surplus. 8.7 use quadratic functions in economics. 8.8 do input- output analysis. 8.9 analyze dynamics of market. 8.10 construct difference equations, 8.11 understand cobweb model, lagged Keynesian macroeconomics model.

4. Scope and Sequence of Contents

S.N.	Content area	Grade 11		Grade 12	
		Contents	**Working hrs**		**Working hrs**
1	**Algebra**	**1.1 Logic and Set**: introduction of Logic, statements, logical connectives, truth tables, basic laws of logic, theorems based on set operations. **1.2 Real numbers:** field axioms, order axioms, interval, absolute value, geometric	31	**1.1 Permutation and combination**: Basic principle of counting, Permutation of (a) set of objects all different (b) set of objects not all different (c) circular arrangement (d) repeated use of the same objects, Combination of things all different, Properties of combination **1.2 Binomial Theorem:**	31

		representation of real numbers. **1.3 Function**: Review, domain & range of a function, Inverse function, composite function, functions of special type, algebraic (linear, quadratic & cubic), Trigonometric, exponential, logarithmic) **1.4 Curve sketching**: odd and even functions, periodicity of a function, symmetry (about origin, x-and y-axis), monotonicity of a function, sketching graphs of polynomials and some rational functions $(\frac{a}{x}, \frac{x^2-a^2}{x-a}, \frac{a}{x+a}, ax^2+bx+c, ax^3)$, Trigonometric, exponential, logarithmic function (simple cases only) **1.5 Sequence and series:** arithmetic, geometric, harmonic sequences and series and their properties A.M, G.M, H.M and their relations, sum of infinite geometric series. **1.6 Matrices and determinants:** Transpose of a matrix and its properties, Minors and cofactors, Adjoint, Inverse matrix, Determinant,		Binomial theorem for a positive integral index, general term, Binomial coefficient, Binomial theorem for any index (without proof), application to approximation, Euler's number, Expansion of e^x, a^x and log(1+x) (without proof) **1.3 Elementary Group Theory**: Binary operation, Binary operation on sets of integers and their properties, Definition of a group, finite and infinite groups. Uniqueness of identity, Uniqueness of inverse, Cancelation law, Abelian group. **1.4 Complex numbers:** De Moivre's theorem and its application in finding the roots of a complex number, properties of cube roots of unity. Euler's formula. **1.5 Quadratic equation**: Nature and roots of a quadratic equation, Relation between roots and coefficient. Formation of a quadratic equation, Symmetric roots, one or both roots common. **1.6 Sequence and series:** Sum of finite natural numbers, sum of squares of first n-natural numbers, Sum of cubes of first n- natural numbers, principle of mathematical induction. **1.7 Matrix based system of linear equation**: Solution of a system of linear equations by Cramer's rule and matrix method (row- equivalent and inverse) up to three	

		Properties of determinants (without proof) **1.7 Complex number:** definition imaginary unit, algebra of complex numbers, geometric representation, absolute value (Modulus) and conjugate of a complex numbers and their properties, square root of a complex number, polar form of complex numbers.		variables.	
2	**Trigonometry**	2.1 Properties of a triangle (Sine law, Cosine law, tangent law, Projection laws, Half angle laws). 2.2 Solution of triangle(simple cases)	8	2.1 Inverse circular functions. 2.2 Trigonometric equations and general values	8
3	**Analytic Geometry**	**3.1 Straight Line**: length of perpendicular from a given point to a given line, Bisectors of the angles between two straight lines. **Pair of straight lines**: General equation of second degree in x and y, condition for representing a pair of lines, Homogenous second-degree equation in x and y, angle between pair of lines, Bisectors of the angles between pair of lines. **3.2 Circle**: Condition of tangency of a line at a point to the circle, Tangent and normal to	13	**3.1 Conic section:** Standard equations of Ellipse and hyperbola. **3.2 Coordinates in space**: direction cosines and ratios of a line, general equation of a plane, equation of a plane in intercept and normal form, plane through 3 given points, plane through the intersection of two given planes, parallel and perpendicular planes, angle between two planes, distance of a point from a plane.	13

		a circle. **3.3 Conic section**: Standard equation of parabola, equations of tangent and normal to a parabola at a given point.			
4	**Vectors**	**4.1 Vectors:** collinear and non collinear vectors, coplanar and non-coplanar vectors, linear combination of vectors, **4.2 Product of vectors:** scalar product of two vectors, angle between two vectors, geometric interpretation of scalar product, properties of scalar product, condition of perpendicularity, application of dot product in trigonometry and geometry.	7	**4.1 Product of Vectors:** vector product of two vectors, geometrical interpretation of vector product, properties of vector product, application of vector product in geometry and trigonometry.	7
5	**Statistics & Probability**	**5.1 Measure of Dispersion:** introduction, standard deviation, variance, coefficient of variation, Skewness (Karl Pearson and Bowley) **5.2 Probability:** independent cases, mathematical and empirical definition of probability, two basic laws of probability(without proof).	9	**5.1 Correlation and Regression**: correlation, nature of correlation, correlation coefficient by Karl Pearson's method, interpretation of correlation coefficient, properties of correlation coefficient (without proof), rank correlation by Spearman, regression equation, regression line of y on x and x on y. **5.2 Probability**: Dependent cases, conditional probability (without proof), binomial distribution, mean and standard deviation of binomial distribution	9

				(without proof).	
6	**Calculus**	**6.1 Limits and continuity**: limits of a function, indeterminate forms. algebraic properties of limits (without proof), Basic theorems on limits of algebraic, trigonometric, exponential and logarithmic functions, continuity of a function, types of discontinuity, graphs of discontinuous function. **6.2 Derivatives:** derivative of a function, derivatives of algebraic, trigonometric, exponential and logarithmic functions by definition (simple forms), rules of differentiation. derivatives of parametric and implicit functions, higher order derivatives, geometric interpretation of derivative, monotonicity of a function, interval of monotonicity, extreme values of a function, concavity, points of inflection, derivative as rate of measure. **6.3 Anti-derivatives:** introduction, integration using basic integrals, integration by substitution and by parts methods, the	31	**6.1 Derivatives:** derivative of inverse trigonometric, exponential and logarithmic function by definition, relationship between continuity and differentiability, rules for differentiating hyperbolic function and inverse hyperbolic function, L'Hospital's rule (0/0, ∞/∞), differentials, tangent and normal, geometrical interpretation and application of Rolle's theorem and mean value theorem. **6.2 Anti-derivatives:** anti-derivatives of standard integrals, integrals reducible to standard forms, integrals of rational function. **6.3 Differential equations**: differential equation and its order, degree, differential equations of first order and first degree, differential equations with separable variables, homogenous, linear and exact differential equations.	31

		definite integral, the definite integral as an area under the given curve, area between two curves.			
7	**Computational Methods**	**7.1 Numerical computation:** ▪ Characteristics of numerical computation (accuracy, rate of convergence, efficiency) ▪ Roots of algebraic and transcendental equation (bisection method and Newton-Raphson method) **7.2 Numerical integration:** Trapezoidal rule and Simpson's 1/3 rule	10	**7.1 Linear programming problems (LPP)**: simplex method (maximization problems only) **7.2 System of linear equations:** Gauss Elimination method	10
8	**Mechanics** **Or** **Mathematics for Economics and**	**8.1 Statics:** Forces and resultant forces, parallelogram law of forces, composition and resolution of forces, Resultant of coplanar forces acting on a point, Triangle law of forces and Lami's theorem. **8.2 Dynamics:** Motion of particle in a straight line, Motion with uniform acceleration, motion under the gravity, motion down a smooth inclined plane. **8.3 Mathematics for economics and**	11	**8.1 Statics**: Resultant of like and unlike parallel forces. **8.2 Dynamics:** Newton's laws of motion and projectile. **8.3 Mathematics for economics and finance:** Consumer and Producer Surplus, Quadratic functions in Economics, Input-Output analysis, Dynamics of market price, Difference equations, The Cobweb model, Lagged Keynesian macroeconomic model.	11

	Finance	**finance:** Mathematical Models and Functions, Demand and supply, Cost, Revenue, and profit functions, Elasticity of demand, supply and income , Budget and Cost Constraints, Equilibrium and break even			
Total			**120**		**120**

5. Practical and project activities

The students are required to do different practical activities in different content areas and the teachers should plan in the same way. Total of 40 working hours is allocated for practical and project activities in each of the grades 11 and 12. The following table shows estimated working hours for practical activities in different content areas of grade 11 and 12

S. No.	Content area/domain	Working hrs in each of the grades 11 and 12
1.	Algebra	11
2.	Trigonometry	2
3.	Analytic geometry	5
4.	Vectors	3
5.	Statistics & Probability	3
6.	Calculus	11
7.	Computational methods	2
8.	Mechanics or Mathematics for Economics and Finance	3
	Total	**40**

Here are some sample (examples) of practical and project activities.

Sample project works/mathematical activities for grade 11

1. Take a square of arbitrary measure assuming its area is one square unit. Divide it in to four equal parts and shade one of them. Again take one not shaded part of that square and shade one fourth of it. Repeat the same process continuously and find the area of the shaded region.
2. Write two simple statements related to mathematics and write four compound statements by using them.
3. Prepare a model to illustrate the values of sine function and cosine function for different angles which are multiples of $\frac{\pi}{2}$ and π.
4. Verify the sine law by taking particular triangle in four quadrants.
5. Prepare a concrete material to show parabola by using thread and nail in wooden panel.
6. Verify that the equation of a line passing through the point of intersection of two lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ is of the form $(a_1x + b_1y + c_1) + K(a_2x + b_2y + c_2) = 0$.
7. Prepare a model and verify that angle in a semi-circle is a right angle by using vector method.
8. Geometrically interpret the scalar product of two vectors.
9. Collect the scores of grade 10 students in mathematics and English from your school.
    a. Make separate frequency distribution with class size 10.
    b. Which subject has more uniform/consistent result?
    c. Make the group report and present.
10. Roll two dices simultaneously 20 times and list all outcomes. Write the events that the sum of numbers on the top of both dice is a) even b) odd in all above list. Examine either they are mutually exclusive or not. Also find the probabilities of both events.
11. Find the area of circular region around your school using integration.
12. Take a metallic bar available at your surrounding and make a rectangular frame. Find the dimension of the rectangular metallic frame with maximum area.
13. Find the roots of any polynomial equation by using any ICT tools and present it in the classroom.
14. Investigate a daily life problem on projectile motion. Solve that problem and present in the classroom.
15. Construct mathematical models involving supply and income, budget and cost constraint of a production company.

Sample project works/mathematical activities for grade 12

1. Represent the binomial theorem of power 1, 2, and 3 separately by using concrete materials and generalize it with n dimension relating with Pascal's triangle.
2. Take four sets R, Q, Z, N and the binary operations $+, -, \times$. Test which binary operation forms group or not with R, Q, Z, N.

3. Prepare a model to explore the principal value of the function $\sin^{-1}x$ using a unit circle and present in the classroom.
4. Draw the graph of $\sin^{-1}x$, using the graph of sin x and demonstrate the concept of mirror reflection (about the line y = x).
5. Fix a point on the middle of the ceiling of your classroom. Find the distance between that point and four corners of the floor.
6. Construct an ellipse using a rectangle.
7. Express the area of triangle and parallelogram in terms of vector.
8. Verify geometrically that: $\vec{c} \times (\vec{a} + \vec{b}) = \vec{c} \times \vec{a} + \vec{c} \times \vec{b}$
9. Collect the grades obtained by 10 students of grade 11 in their final examination of English and Mathematics. Find the correlation coefficient between the grades of two subjects and analyze the result.
10. Find two regression equations by taking two set of data from your textbook. Find the point where the two regression equations intersect. Analyze the result and prepare a report.
11. Find, how many peoples will be there after 5 years in your districts by using the concept of differentiation.
12. Verify that the integration is the reverse process of differentiation with examples and curves.
13. Correlate the trapezoidal rule and Simpson rule of numerical integration with suitable example.
14. Identify different applications of Newton's law of motion and related cases in our daily life.
15. Construct and present Cobweb model and lagged Keynesian macroeconomic model .

6. Learning Facilitation Method and Process

Teacher has to emphasis on the active learning process and on the creative solution of the exercise included in the textbook rather than teacher centered method while teaching mathematics. Students need to be encouraged to use the skills and knowledge related to maths in their house, neighborhood, school and daily activities. Teacher has to analyze and diagnose the weakness of the students and create appropriate learning environment to solve mathematical problems in the process of teaching learning.

The emphasis should be given to use diverse methods and techniques for learning facilitation. However, the focus should be given to those method and techniques that promote students' active participation in the learning process. The following are some of the teaching methods that can be used to develop mathematical competencies of the students:

- Inductive and deductive method
- Problem solving method
- Case study
- Project work method

- Question answer and discussion method
- Discovery method/ use of ICT
- Co-operative learning

7. Student Assessment

Evaluation is an integral part of learning process. Both formative and summative evaluation system will be used to evaluate the learning of the students. Students should be evaluated to assess the learning achievements of the students. There are two basic purposes of evaluating students in Mathematics: first, to provide regular feedback to the students and bringing improvement in student learning-the formative purpose; and second, to identify student's learning levels for decision making.

a. Internal Examination/Assessment

i. **Project Work**: Each Student should do one project work from each of eight content areas and has to give a 15 minute presentation for each project work in classroom. These eight project works will be documented in a file and will be submitted at the time of final examination. Out of eight projects, any one should be presented at the time of final examination by each student.

ii. **Mathematical activity**: Mathematical activities mean various activities in which students willingly and purposefully work on Mathematics. Mathematical activities can include various activities like (i) Hands-on activities (ii) Experimental activities (iii) physical activities. Each student should do one activity from each of eight content area (altogether eight activities). These activities will be documented in a file and will be submitted at the time of final examination. Out of eight activities, any one should be presented at the time of final examination by each student.

iii. **Demonstration of Competency in classroom activity**: During teaching learning process in classroom, students demonstrate 11 competencies through activities. The evaluation of students' performance should be recorded by subject teacher on the following basis.

- Through mathematical activities and presentation of project works.
- Identifying basic and fundamental knowledge and skills.
- Fostering students' ability to think and express with good perspectives and logically on matters of everyday life.
- Finding pleasure in mathematical activities and appreciate the value of mathematical approaches.
- Fostering and attitude to willingly make use of mathematics in their lives as well as in their learning.

iv. **Marks from trimester examinations**: Marks from each trimester examination will be converted into full marks 3 and calculated total marks of two trimester in each grade.

The weightage for internal assessment are as follows:

Classroom participation	Project work/Mathematical activity	Demonstration of competency in classroom activity	Marks from terminal exams	Total
3	10	6	6	25

b. External Examination/Evaluation

External evaluation of the students will be based on the written examination at the end of each grade. It carries 75 percent of the total weightage. The types and number questions will be as per the test specification chart developed by the Curriculum Development Centre.

English

Grade: 11 and 12 **Subject code: Eng. 003 (Grade 11), Eng. 004 (Grade 12)**

Credit hour: 4 **Annual working hour: 128**

1. Introduction

English is a lingua franca and is an appropriate international language for Nepal to be connected with global community. It is not only the language of international communication but also a language of higher education, mass media, information and communication technology (ICT), business, tourism, science and medicine. In the context of Nepal, English is necessary for various purposes. To be specific, our learners need English to participate in classroom interactions; to study course materials; to read things for pleasure and general information; to gain access to the world body of knowledge; to read and enjoy a wide range of literary texts, to participate in international meetings, seminars and conferences; to communicate with foreigners in general; to enhance their career development, and many more. English is taught as a compulsory subject from grade one to the bachelors level.

Ministry of Education, Science and Technology (MoEST) has approved the National Curriculum Framework (NCF), 2076 addressing the changed socio-political condition of the country and the current needs of the learners. This grade 11and 12 E nglish curriculum has been developed in line with the spirit of the new NCF. The present curriculum addresses all four language skills with prime focus on reading and writing skills. It focuses on the types of reading and writing skills that are necessary for the students in their real life. It also includes the language functions which the students need for their further studies and the world of work. A strong grammatical foundation is also given due consideration in this curriculum. This curriculum is based on the principle that learners learn language when they get sufficient opportunity to use it in appropriate contexts. Content should not be detached from the use of language. Content and language should be integrated while teaching. Therefore, the curriculum has focused not only on language and language functions, but also on a variety of fiction and non-fiction texts which provide a meaningful context for language learning. For some students, secondary education serves as a basis for preparation for the university education, whereas for some other students, it may be a preparation for entry into the world of work. This curriculum tries to address the linguistic requirements of both types of students.

This curriculum focuses on both the intensive reading of texts which is intended for language development in the learners and the extensive reading of texts which is intended for processing content and developing higher order reading and writing skills. Soft skills including critical thinking and creativity of the students have also been given due importance. For this purpose, a wide variety of texts have been included under various themes and topics. This curriculum includes level-wise competencies of students, grade-wise learning outcomes, scope and sequence of contents, learning facilitation process and evaluation process.

2. Competencies

This curriculum of Grade 11 and 12 in English language aims at developing the following competencies in the learners:

1. Use both spoken and written English for general and academic purposes in a variety of personal, social and academic contexts.

2. Read a wide variety of texts for information and understanding.
3. Read a variety of literary texts for pleasure and appreciation.
4. Read, reflect and interpret a wide range of texts.
5. Critically analyze and evaluate ideas in a wide range of level apprapriate taxts.
6. Search, select and manage information from various textual and online sources.
7. Create a variety of writing for different purposes and audiences with appropriate content, style and accuracy.
8. Produce a variety of creative and critical writings.
9. Appreciate diverse cultures.
10. Listen and respond in English with accuracy and fluency
11. Communicate clearly and effectively in a range of situations using verbal and non-verbal communication strategies.

3. Grade-wise Learning Outcomes

The learning outcomes in this curriculum are distributed between grade eleven and twelve based on their levels of difficulty. However, the same learning outcomes may be introduced in grade eleven and consolidated in grade twelve. Therefore, these may go in a sequence and will be addressed in the resource materials and pedagogy.

3.1 Listening

	Learning outcomes	
Listening constructs	**Grade 11**	**Grade 12**
1. Identify and discriminate stress and intonation patterns.	▪ Identify the speaker's attitudes and feelings through their use of stress and intonation. ▪ Show an understanding of differentiating tones (warnings, advice, suggestion, etc.). ▪ Identify the effects of supra-segmental features in a connected speech.	▪ Identify the speaker's attitudes and feelings through their use of stress and intonation. ▪ Identify the speaker's purpose by distinguishing tone and intonation patterns. ▪ Identify the effects of supra-segmental features and phonological processes in a connected speech. ▪ Identify the key words and phrases in the given text. ▪ 1.5 Identify the differences between formal and informal English.
2. Listen to the spoken text and understand its gist and retrieve specific information from it.	▪ Identify the gist of a listening text. ▪ Retrieve specific information from spoken English. ▪ Compare and contrast information. ▪ Show an understanding of the functions of common discourse markers.	▪ Identify the gist, main idea and supporting details of a listening text. ▪ Retrieve specific information from spoken English, and take notes. ▪ Compare and contrast information. ▪ Distinguish between cause and

		effect. ▪ Interpret information and auditory cues. ▪ Show an understanding of the functions of a wide range of discourse markers.
3. Make inference while listening	▪ Make predictions about the subsequent content using prior knowledge, phonological clues and contextual clues. ▪ Make inference about themes and message of the spoken text from prior knowledge and contextual clues.	▪ Make predictions about the subsequent content, actions and events using prior knowledge, phonological clues and contextual clues. ▪ Make inference about purpose, intentions, themes and message of the spoken text from prior knowledge and contextual clues.
4. Listen to the spoken text and critically analyse and evaluate the information in it.	▪ Distinguish between facts and opinions in a spoken text. ▪ Draw conclusions from main ideas, specific details, prior knowledge and contextual clues. ▪ Identify the content and organisation of presentations. ▪ Form opinions about ideas presented in listening texts. ▪ Understand the meaning of common idiomatic expressions.	▪ Separate facts from opinions in a spoken text. ▪ Draw conclusions from main ideas, specific details, prior knowledge and contextual clues. ▪ Identify different points of view and make judgment. ▪ Make judgment on the relevance of spoken message. ▪ Evaluate the content and organisation of presentations. ▪ Form and interpret opinions about ideas presented in texts. ▪ Understand and interpret the meaning of common and grade appropriate idiomatic expressions.
5. Listen to the spoken text and take note of important information.	▪ Listen to a variety of audio materials (e.g. lectures, conversations, personal accounts, narratives and explanations) and take notes of them. ▪ Restate what has been heard.	▪ Listen to a variety of audio materials (e.g. lectures, conversations, personal accounts, narratives and explanations) and take notes of them. ▪ Restate what has been heard.

6. Participate actively and effectively in an interaction.	▪ Participate as an active listener in an interaction and discussion. ▪ Ask for clarification and elaboration. ▪ Respond to the speaker with appropriate facial expressions and gestures. ▪ Respect the age, gender, social position and cultural traditions of the speaker.	▪ Participate as an active listener in an interaction and discussion. ▪ Ask for clarification and elaboration. ▪ Respond to the speaker with appropriate facial expressions and gestures. ▪ Respect the age, gender, social position and cultural traditions of the speaker. ▪ Collaborate with others in order to explore and discuss understanding of spoken texts.
7. Listen to instructions, directions and announcements and follow them.	▪ Show an understanding of complex directions and instructions. ▪ Show an understanding of common public announcements e.g. at an airport, at a stadium, etc.	▪ Show an understanding of complex directions and instructions. ▪ Show an understanding of common public announcements e.g. at an airport, at a stadium, etc..
8. Gain knowledge and understanding of target culture (s) through listening.	▪ Identify nationality/ background of speaker (s) of listening texts ▪ Demonstrate an understanding of the patterns of interactions from various English speaking cultures. ▪ Show an understanding of verbal and non- verbal social conventions that characterize the English speaking culture. ▪ Compare and contrast the practices of both national and international cultures.	▪ Demonstrate an understanding of the patterns of interactions from various English speaking cultures. ▪ Analyse the verbal and non- verbal social conventions that characterize the English speaking cultures. ▪ Show an understanding of verbal and non- verbal social conventions that characterize the English speaking culture. ▪ Evaluate the practices and values of both national and international cultures.

3.2 Speaking

S.N.	Speaking constructs	Learning outcomes	
		Grade 11	**Grade 12**
1.	1. Participate effectively in interactions and conversations.	▪ Initiate, maintain and conclude an interaction using appropriate expressions. ▪ Take part in conversations on subjects of common interest. ▪ Speak fluently, accurately and effectively in different situations on a wide range of general or leisure topics. ▪ Understand and respond to what has been said by the other interlocutors in conversation. ▪ Ask questions for clarification and understanding. ▪ Respond to questions. ▪ Present ideas, opinions, experiences and arguments with confidence. ▪ Respect age, gender, social position of the listener. ▪ Indicate understanding and express certainty or uncertainty. ▪ Make proper use of extra linguistic features such as facial expressions and gestures. ▪ Use common discourse markers.	▪ Initiate, maintain and conclude an interaction using both verbal and non-verbal expressions and with confidence. ▪ Take part in relatively long conversation with multiple speakers on subjects of common interest. ▪ Speak fluently, accurately and effectively according to social norms and cultural values in different situations on a wide range of general, academic, vocational or leisure topics. ▪ Understand and respond to what has been said by the other interlocutors in conversation. ▪ Ask questions for clarification and understanding. ▪ Respond to questions in a convincing way. ▪ Respect age, gender, social position and cultural traditions of the listener. ▪ Present ideas, opinions, experiences and arguments with confidence. ▪ Use discourse markers to enable others to follow what is being said. ▪ Respond with suggestions, feedback and different viewpoints. ▪ Change the topic of an interaction as required. ▪ Indicate understanding and express certainty or uncertainty. ▪ Negotiate meaning in communication. ▪ Make proper use of extra linguistic features such as facial expressions and

			gestures. ▪ Use a wide range of discourse markers.
2.	Participate effectively in an informal discussion.	▪ Convey message effectively using appropriate language functions. ▪ Comment and put forward point of a view clearly. ▪ Give opinions on the topic of discussion. ▪ Comment on another person's opinions or viewpoints. ▪ Express thoughts and ideas using verbal and non-verbal communication strategies. ▪ Respect others' views and ideas.	▪ Convey message effectively using appropriate language functions and idiomatic expressions. ▪ Comment and put forward a point of view clearly and evaluate alternative proposals. ▪ Give opinions by providing relevant explanations, arguments and comments. ▪ Comment on and judge another person's views and opinions with argument. ▪ Be aware of social etiquette and apply in conversation. ▪ Respect others' views and ideas.
3.	Participate effectively in a formal discussion.	▪ Have a discussion on matters related to his/her field. ▪ Ask and reformulate questions as required. ▪ Present a point of view clearly. ▪ Present and respond to arguments. ▪ Take part in informal debates on the issues of current topics and concerns.	▪ Have a discussion on matters related to his/her field. ▪ Ask, reformulate and paraphrase questions as required. ▪ Present a point of view clearly and in a convincing way. ▪ Present and respond to arguments convincingly. ▪ Take part in both formal and informal debates on the issues of current topics and concerns. ▪ Make critical remarks or express disagreement.
4.	Give and take an interview.	▪ Actively participate in an interview both as a interviewer and as an interviewee. ▪ Expand the points being discussed. ▪ Check and confirm information. ▪ Ask questions and respond to them properly.	▪ Actively participate in an interview, including group interview both as a interviewer and as an interviewee. ▪ Expand the points being discussed in a persuasive way. ▪ Check and confirm information. ▪ Ask questions and respond to them properly.
5.	Use telecommunications effectively.	▪ Use telecommunications such as telephone, Skype and Viber effectively for	▪ Use telecommunications such as telephone, Skype and Viber effectively for personal and

		personal purposes.	professional purposes. ▪ Maintain appropriate etiquette and ethics of telecommunications.
6.	Narrate a sequence of events or process	▪ Narrate a sequence of events or processes using appropriate structures and vocabulary.	▪ Narrate a sequence of events or processes using appropriate structures and vocabulary.
7.	Use supra-segmental features like stress, tone and intonation for expressing a range of meanings and emotions.	▪ Speak fluently and accurately with acceptable pronunciation, stress and intonation patterns. ▪ Produce utterances with appropriate features of connected speech such as assimilation and elision.	▪ Speak fluently and accurately with acceptable pronunciation, stress and intonation patterns. ▪ Produce utterances with appropriate features of connected speech such as assimilation and elision.
8.	Make effective presentations.	▪ Generate ideas and make presentations appropriate to the purpose and audience. ▪ Choose appropriate expressions and registers according to the context/field. ▪ Maintain appropriate posture and eye contact.	▪ Generate ideas and make presentations appropriate to the purpose, audience, time and style. ▪ Choose appropriate expressions and registers according to the context/field. ▪ Use appropriate discourse markers. ▪ Maintain appropriate posture and eye contact. ▪ Use effective presentation skills.
9.	Describe, people, objects, events, etc.	▪ Describe people, objects, events, etc. using appropriate structures and vocabulary.	▪ Describe people, objects, events, etc. using appropriate structures and vocabulary.
10.	Seek and provide a wide variety of information.	▪ Use a range of question forms for seeking and confirming required information. ▪ Give detailed information on different topics.	▪ Use a range of expressions for seeking, confirming, checking and elaborating required information. ▪ Give detailed information on different topics.
11.	Speak with critical analysis and evaluation.	▪ Express personal opinions to clarify the points expressed. ▪ Present reasons and examples from different sources such as reviews of books, plays and interviews to defend opinions and judgments.	▪ Express personal opinions to clarify the points expressed and persuade the interlocutors. ▪ Present reasons, examples and the details from different sources such as reviews of books, plays and interviews to defend opinions and

			judgments.
12.	Understand and demonstrate inter-cultural understanding.	▪ Express one's own cultural values and practices effectively and clearly. ▪ Express tolerance and respect for the cultural practices of other people.	▪ Express one's own cultural values and practices and compare it with that of others. ▪ Express tolerance and respect for the cultural practices of other people.

Note: The prescribed language functions should be included while selecting topics and tasks for speaking.

3.3 Reading

S. N.	Reading constructs	Learning outcomes	
		Grade 11	**Grade 12**
1.	Read the texts intensively for information and understanding.	▪ Scan the text and retrieve specific information from it. ▪ Skim the text and get its main idea/theme. ▪ Identify the topic sentence of a paragraph. ▪ Distinguish between cause and effect. ▪ Separate facts from opinions. ▪ Compare and contrast ideas. ▪ Find out main ideas and supporting details. ▪ Deduce the meanings of unfamiliar words and phrases in a given context. ▪ Read the texts and identify the order of events. ▪ Identify explicit as well as implicit information. ▪ Read and interpret the graphic organizers (e.g. Venn diagram, time line, semantic webs, etc.) given in the text to facilitate understanding of grade appropriate reading texts.	▪ Scan the text and retrieve specific information from it. ▪ Skim the text and get its main idea/theme. ▪ Distinguish between cause and effect and fact and opinions. ▪ Compare and contrast ideas. ▪ Identify different points of view. ▪ Find out main ideas and supporting details. ▪ Deduce the meanings of unfamiliar words and phrases in a given context. ▪ Read the text and identify the order of events. ▪ Identify explicit as well as implicit information. ▪ Read and interpret the graphic organizers (e.g. Venn diagram, time line, semantic webs, etc.) given in the text to facilitate understanding of grade appropriate reading texts. ▪ Follow the pattern of arguments with the help of the clues available in the text.
2.	Read a variety of literary texts for pleasure,	▪ Read and interpret literary texts (e.g. short stories, essays, poems and dramas)	▪ Read and interpret literary texts (e.g. short stories, essays, poems and dramas) from a wide variety of authors,

	appreciation and interpretation.	from a wide variety of authors, subjects and genres. ▪ Read and respond to literary works that represent a range of social, historical and cultural perspectives. ▪ Interpret multiple levels of meaning such as literal meaning, contextual meaning, figurative meaning and intended meaning in literary texts. ▪ Analyse and evaluate fiction and non-fiction including the effect of diction and figurative language. ▪ Analyse special features of languages that distinguish literary texts from non-literary ones. ▪ Appreciate literary texts of appropriate level. ▪ Determine the themes of literary texts. ▪ Describe the characters of the literary texts.	subjects and genres. ▪ Read and respond to literary works that represent a range of social, historical and cultural perspectives. ▪ Interpret multiple levels of meaning such as literal meaning, contextual meaning, figurative meaning and intended meaning in literary texts. ▪ Analyse and evaluate fiction and non-fiction including the effect of diction and figurative language. ▪ Analyse special features of languages that distinguish literary texts from non-literary ones. ▪ Appreciate literary texts of appropriate level. ▪ Determine the themes of literary texts. ▪ Describe the characters of the literary texts.
3.	Read the texts and critically analyse, interpret and evaluate the information.	▪ Determine the writer's attitude, perspectives, purposes and intended meaning. ▪ Identify the particular kind of language used in a particular text. ▪ Analyse and synthesize information from different sources by making connections and showing relationships with other texts, ideas and subjects. ▪ Form a variety of questions at different levels about the text. ▪ Read, review and present a critical response to a text. ▪ Express opinions and make judgments about ideas, information, experiences	▪ Determine the writer's attitude, perspectives, purposes and intended meaning. ▪ Identify the particular kind of language used in a particular text. ▪ Analyse and synthesize information from different sources by making connections and showing relationships with other texts, ideas and subjects. ▪ Form a variety of questions at different levels about the text. ▪ Read, review and present a critical response to a text. ▪ Express opinions and make judgments about ideas, information, experiences and issues presented in literary and factual texts. ▪ Arrive at conclusion and

		and issues presented in literary and factual texts. ▪ Arrive at conclusion and comment on a given text. ▪ Summarise the texts.	comment on a given text. ▪ Summarise the texts.
4.	Read the texts closely and understand the structure and organization of the text.	▪ Identify the structure and organization of paragraphs and longer texts by developing an awareness of cohesive devices. ▪ Analyse the organisational patterns of a text (such as chronological, cause-effect, problem-solution and reason-conclusion). ▪ Identify cohesive devices and their referents. ▪ Identify the discourse markers and their functions in the texts.	▪ Identify the structure and organization of paragraphs and longer texts by developing an awareness of cohesive devices. ▪ Analyse the organisational patterns of a text (such as chronological, cause-effect, problem-solution and reason-conclusion). ▪ Identify cohesive devices and their referents. ▪ Identify the discourse markers and their functions in the texts. ▪ Compare the structure of different types of text organization.
5.	Read the texts and predict the content and make inference.	▪ Read the title and predict the content of the text. ▪ Make predictions about the content of a text while reading based on contextual clues, text features, background knowledge, patterns of relationship of ideas, etc. ▪ Make predictions about upcoming events in the narrative texts. ▪ Make inferences from contextual information, writer's viewpoints, implied information, etc. ▪ Use knowledge of the world or background knowledge while reading.	▪ Read the title and predict the content of the text. ▪ Make predictions about the content of a text while reading based on contextual clues, text features, background knowledge, patterns of relationship of ideas, etc. ▪ Make predictions about upcoming events in the narrative texts. ▪ Make inferences from contextual information, writer's viewpoints, implied information, etc. ▪ Use knowledge of the world or background knowledge while reading.
6.	Read the texts and take notes.	▪ Make notes by reading various resources. ▪ Read a text and make notes covering the key points.	▪ Make notes by reading various resources. ▪ Read a text and make notes covering the key points. ▪ Organise the notes and write on what has been read.
7.	Read and	▪ Interpret and integrate	▪ Interpret and integrate

	interpret the para-orthographic texts.	information presented in diagrammatic forms (charts, graphs, tables, maps etc.) ▪ Paraphrase information or ideas of the texts.	information presented in diagrammatic forms (charts, graphs, tables, maps etc.) ▪ Paraphrase information or ideas of the texts.
8.	Read texts and deduce the meaning of unfamiliar lexical items from the context.	▪ Deduce the meaning of unfamiliar lexical items on the basis of contextual, syntactic and semantic clues.	▪ Deduce the meaning of unfamiliar lexical items on the basis of contextual, syntactic and semantic clues.
9.	Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference material.	▪ Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference materials.	▪ Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference materials.
10.	Read and identify the practices and values of national and target cultures.	▪ Read and identify the practices and values of national and target cultures. ▪ Read a variety of texts from both national and international cultures for information and understanding. ▪ Read and compare social, democratic, political and economic issues in both national and international cultures. ▪ Read expository texts on issues affecting social, political, economic and cultural aspects in a given society.	▪ Read and identify the practices and values of national and target cultures. ▪ Read a variety of texts from both national and international cultures for information and understanding. ▪ Read and compare social, democratic, political and economic issues in both national and international cultures. ▪ Read expository texts on issues affecting social, political, economic and cultural aspects in a given society.

3.4 Writing

S. N.	Writing constructs	Learning outcomes	
		Grade 11	Grade 12
1.	Compose well-	▪ Compose well-formed	▪ Compose well-formed paragraphs including the

	formed paragraphs.	paragraphs including the appropriate topic sentence, supporting details and a concluding sentence.	appropriate topic sentence, supporting details and a concluding sentence.
2.	Write different kinds of letters and emails with appropriate format and layout.	▪ Write different types of personal letters such as letters to friends, and relatives. ▪ Write emails. ▪ Create blogs for expression.	▪ Write different types of formal letters such as letters to the editors, complain letters, job application letter, and business letters. ▪ Write emails. ▪ Prepare curriculum vitae (CV) with appropriate format and layout. ▪ Create blogs for expression.
3.	Write well organised essays on the given topics and the topics of own interest.	▪ Write well organised descriptive, narrative, argumentative and expository essays on the given topics and the topics of interest. ▪ Edit the written products.	▪ Write well organised descriptive, narrative, argumentative and expository essays on the given topics and the topics of interest. ▪ Edit the written products.
4.	Write news articles on current issues.	▪ Write articles on current issues using appropriate forms and styles.	▪ Write articles on current issues using appropriate forms and styles.
5.	Write formal reports in an appropriate style and format.	▪ Write study reports based on project works or mini-researches in an appropriate form and format.	▪ Write study reports based on project works or mini-researches in an appropriate form and format.
6.	Narrate a sequence of events and personal experiences.	▪ Narrate an event in a chronological order. ▪ Narrate a personal experience appropriately. ▪ Write stories.	▪ Narrate an event in a chronological order. ▪ Narrate a personal experience appropriately. ▪ Write biographies of famous national and international people. ▪ Write a travelogue/memoire.
7.	Describe a person or event appropriately.	▪ Describe a person or event using appropriate structures and vocabularies.	▪ Describe a person or event using appropriate structures and vocabularies.
8.	Summarise a text.	▪ Summarise a text into a short form condensing the information.	▪ Summarise a text into a short form condensing the information.
9.	Write a character sketch.	▪ Write a character sketch of the characters in a text.	▪ Write a character sketch of the characters in a text with

			sufficient arguments.
10.	Write a book/film review.	▪ Write a critical review of a book/film.	▪ Write a critical review of a book/film.
11.	Transfer information from tables, graphs and charts to prose and vice versa.	▪ Transfer information from tables, graphs and charts to prose and vice versa. ▪ Describe and interpret tables, charts and graphs clearly.	▪ Transfer information from tables, graphs and charts to prose and vice versa. ▪ Describe and interpret tables, charts and graphs clearly.
12.	Prepare communiqué and press release.	▪ Prepare communiqué in a simple and clear form.	▪ Prepare a press release of an organisation.
13.	Use the mechanics of writing properly.	▪ Write a variety of text types using spelling, punctuation, capitalisation, contractions, abbreviations, acronyms, numbers and numerals properly.	▪ Write a variety of text types using spelling, punctuation, capitalisation, contractions, abbreviations, acronyms, numbers and numerals properly.
14.	Use various strategies for generating and organising ideas for writing.	▪ Use writing strategies such as brainstorming, making mind maps and spider grams for generating ideas. ▪ Gather required information for writing from various printed and online sources. ▪ Draft interview questions to collect information. ▪ Take notes while reading or interviewing and use the notes for writing. ▪ Use a range of organisational strategies such as clustering, webbing, and mapping to present information. ▪ Critically analyse the sample writings to find out their structure and styles.	▪ Use writing strategies such as brainstorming, making mind maps and spider grams for generating ideas. ▪ Gather required information for writing from various printed and online sources. ▪ Draft interview questions to collect information. ▪ Take notes while reading or interviewing and use the notes for writing. ▪ Use a range of organisational strategies such as clustering, webbing, and mapping to present information. ▪ Critically analyse the sample writings to find out their structure and styles.
15.	Apply process approach to writing for producing a variety of	▪ Apply the stages of process approach (i.e. planning, making an outline, preparing the first draft and revising, editing and	▪ Apply the stages of process approach (i.e. planning, making an outline, preparing the first draft and revising, editing and producing the final

	creative writings.	producing the final draft) for creating a variety of creative writings such as essays, personal experiences and articles.	draft) to create a variety of creative writings such as essays, personal experiences and articles.
16.	Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference material.	▪ Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference materials for drafting, revising and editing their writing. ▪ Develop personal dictionary.	▪ Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference materials for drafting, revising and editing their writing. ▪ Develop personal dictionary.

Note:

Self-exploration and self-expression/creative writing should be dealt with as an inherent part while interacting with texts.

4. **Scope and Sequence**

4.1 Reading

The content of reading section is divided into two parts: Part I and Part II. Part I includes a wide variety of contemporary issue-based thematic texts intended for the practice of (a) intensive reading (b) grammar (c) vocabulary (d) listening and speaking (e) writing. Part II is built on the successful exposition of Part I. Part II includes literary genre-based selected texts of different types for reading for pleasure, for both intensive and extensive purposes so as to enable the learners to discern different aspects of literary texts and practise creative writings, which involves expression of imagination.

Part I (Outlines for the selection of texts)

There will be a wide variety of texts on different issues- both local and global of mainly contemporary concerns, which include gender issues, diaspora, science and technology, depletion of natural resources, etc. There will be maximum 21 reading texts of moderate length not exceeding 2000 words and technical terms at each grade. The texts should be taken from various thematic areas that have been proposed below. Around each selected text, specially tailored exercises will be developed for supporting the learners' engagement with the texts.

S. No.	Thematic areas	Possible topics
1.	Education and humanity	ethics, human values, moral values, education, spirituality, animal rights, patriotism, responsibility of citizens
2.	Health, sports and adventure	yoga, travelogue, illness, disease, diet, nutrition, epidemics, hygiene, mental health, physical exercise, traditional and alternative medicine, meditation
3.	Media and society	change in communication and pace of life, advertising, bias in media, the Internet, radio and television, telephone, press

4.	History and culture	identity, language, ethnicity, ethnic groups in Nepal, folk literature, folk songs, folk culture/children's literature diaspora, ethics, cultural diversity, beliefs, values and norms, etiquette, historical events, national customs
5.	Ecology and development	global warming, deforestation, diversity, sustainable development, population, agronomy, forestry, wildlife, weather, ecosystem, food and water, the effect of man on nature, the environment, natural disaster
6.	Science and technology	ethics and science, impact of ICT on society, entertainment, renewable energy
7.	Globalisation and economy	international economy, migration, poverty and famine, global citizenship
8.	Humour and satire	humour, satire
9.	Democracy and human rights	democracy, human rights, gender, law and justice, legal awareness, children's rights, women's rights, rights of senior citizens, non-violence, charity
10.	Home life, family and social relationships	celebrations and social events, friendship, work, family, social acceptance, sex education
11.	Arts, music and creation	painting, arts, music, creation
12.	Fantasy	fantasy, imagination
13.	Career and entrepreneurship	jobs, career, entrepreneurship, problems of unemployment
14.	Power and politics	power, politics, struggle, conflict
15.	War and peace	war, peace
16.	Critical thinking	critical thinking, divergent thinking, logical thinking

Possible text types for part I

A wide variety of texts will be covered for reading purposes. Reading texts for part I will cover the following types:

- interviews
- book/film reviews
- news reports and articles
- literary writings
- reports
- academic publications
- letters
- essays
- news articles

- biographies/auto-biographies
- product guides
- poems
- blogs
- brochures
- emails
- travelogues/memoire

Part II (Outline for the selection of reading texts)

As mentioned before, this part will consist of different types of creative works that involve the expression of imagination and art so that the students can perceive how language functions differently. These are higher functions. This section will expose the students to a different world of imagination and art. This will encourage them to read more, think more and express with individual artistry. There lies infinite possibility of growing independently. In this part, there will be maximum **20** reading texts of moderate length at each grade.

The genres that will be included in this part along with the number of texts of each genre is given below:

S. N.	Genres	Number of texts to be included
1.	Short stories	7
2.	Poems	5
3.	Essays	5
4.	One act plays	3
Total		20

Based on the above genres, different types of reading and writing tasks should be developed so that the students can think more independently, work creatively and develop a good foundation for the university level education.

The tasks incorporated in this part will focus on:

- glossary
- literary devices used in the texts
- comprehension questions (short and long: literature-based reading, reading between the lines, appreciation of texts, interpretation of texts)
- writing a summary
- describing the character
- comparing and contrasting
- critical and creative writing

4.2 Writing

Grade 11	**Grade 12**
1. Paragraphs 2. Personal letters (letters to friends and	1. Paragraphs 2. Formal letters (letters to the editors, job

relatives) emails, blogs 3. Essays (descriptive, narrative, argumentative and expository) 4. News articles 5. Formal reports based on project works or mini-research 6. Narratives (personal experiences, stories, events, travelogues, memoire) 7. Descriptions (persons, events) 8. Summaries 9. Character sketch 10. Book/film review 11. Transferring information from para-orthographic texts 12. Communique 13. Mechanics of writing 14. Writing strategies 15. Process approach to writing	application, business letters) 3. Curriculum vitae 4. Essays (descriptive, narrative, argumentative and expository) 5. News articles 6. Formal reports based on project works or mini-research 7. Narratives (personal experiences, stories, events, travelogues, memoire) 8. Descriptions (persons, events) 9. Summaries 10. Character sketch 11. Book/film review 12. Transferring information from para-orthographic texts 13. Press release 14. Mechanics of writing 15. Writing strategies 16. Process approach to writing

4.3 Listening and speaking

As far as possible listening and speaking skills will be practised not in isolation but in the context of reading texts in an integrated way. Listening texts will cover the following types in both grades:

- Lectures
- Talks
- Presentations
- Conversations
- Personal accounts (e.g. oral anecdotes, past experiences, etc.)
- Interviews
- Short discussions
- Narratives (e.g. radio dramas)
- Procedures (e.g. instructions and directions)
- Factual accounts (news reports, eye witness accounts)
- Explanations (e.g. how an engine works)
- Expositions (debates, speech, advertisements)
- Public announcements
- Weather forecast

Speaking skill will be linked with the prescribed language functions. The prescribed language functions will be included in the tasks and topics for speaking. Speaking tasks and topics should be linked directly to the reading texts. Speaking tasks will cover the following main areas in both grades:

- conversations/interactions
- formal and informal discussions
- interviews
- telecommunications
- narrating
- making presentations
- describing

4.4. Language functions

The language functions prescribed in this curriculum should be the basis developing tasks for listening and speaking, and the grammar should be linked to the language functions.

Grade 11	Grade 12
1. Expressing good wishes 1. Giving directions and instructions 2. Expressing agreement/disagreement 3. Expressing decisions, intentions and plans 4. Expressing obligation 5. Requesting and offering 6. Suggesting and advising 7. Describing objects, people and places 8. Asking about opinions/giving opinions 9. Describing experiences 10. Describing hopes, wants and wishes 11. Expressing certainty, probability, doubt 12. Interrupting 13. Generalizing and qualifying 14. Expressing reactions, e.g. indifference 15. Talking about regular actions and activities 16. Encouraging/discouraging 17. Persuading 18. Comparing past and present 19. Narrating past events, actions and experiences 20. Expressing complements 21. Reporting	1. Expressing feelings, emotions and attitudes 2. Expressing certainty 3. Expressing indifference 4. Making comparisons and contrasts 5. Arguing/defending a point 6. Responding to counter arguments 7. Expressing disappointment 8. Clarifying 9. Describing processes 10. Predicting 11. Expressing degrees of certainty 12. Expressing necessity 13. Speculating 14. Giving reasons 15. Denying 16. Complaining/criticizing 17. Reminding 18. Summarizing 19. Narrating past events, actions and experiences 20. Reporting 21. Announcing

4. 5. Grammar

The grammar part of the curriculum will include the following topics:

a. Adjectives and adverbs
b. Concord/subject verb agreement
c. Prepositions
d. Modal auxiliaries
e. Tense and aspects
f. Infinitives and gerunds
g. Conjunctions,
h. Relative clause
i. Voice
j. Reported speech

The grammar should not be taught separately. It should be dealt with in the texts as far as possible.

4.6. Sounds, vocabulary and dictionary use

a. Sound system of English
   - Consonants
   - Vowels

b. Vocabulary study-word formation

- Stem/root	- Suffixes
- Prefixes	- Derivation
- Inflexion	- Synonyms/antonyms
- Parts of speech	- Idioms and phrases
- Nouns-number	- Verb conjugation
- Spelling	- Punctuation

c. Dictionary use (focus on the use of electronic dictionary)

d. Idioms and phrasal verbs

The Curriculum has two broad sections : Language Development and literature. The allocation of working hours for language development and literature will be 73 and 55 respectively.

Note: Activities focusing on the specific features of vocabulary e.g. prefixes, suffixes, changing word class, synonyms, antonyms, giving single words, concussing words, etc. should be designed based on the reading texts.

5 Learning Facilitation Process

5.1 Principles of Language Pedagogy

The current grade XI and XII curriculum is based on the following pedagogic principles :

- ***Content and language integrated learning:*** Language learning becomes effective when the learners develop an awareness of some specific content knowledge. Meaningful content relating to the real world helps learners comprehend not only the content itself but also the accompanying language. Integrating content and language is a clear departure from the mere communication towards a meaningful cognition through the language being learnt.
- ***Real world link:*** The principle of real world link is about exposing learners to the realities of the world through meaningful information and knowledge. Simulated and real tasks allow learners to envisage how the English language will be used in their real life.
- ***Diversity as a resource:*** In diverse classrooms, with learners from multilingual and multi-cultural backgrounds, exploiting diversity as a resource helps not only in the teaching learning process but also in creating social cohesion. The content from diverse contexts establishes the pluralistic concept first in the classrooms and later in the real world.
- ***Learning through Information and Communication Technology (ICT):*** With the advent of the ICT, language learning has been more accessible to the learners. The mobile and media technologies allow learners to access learning materials from anywhere and anytime. The use of ICT tools in the classroom pedagogy gives learners more autonomy in different ways.
- ***Learner engagement:*** Language learning becomes enriching as well as fulfilling when learners are fully engaged. Their engagement in the pedagogical process should be ensured with their involvement in the meaningful tasks, projects and out of class activities. Engaged learners are not only successful in developing their language but also become a resource for the class.

5.2 Learning Activities

Based on the above-mentioned pedagogical principles, the following activities have been suggested in order to achieve the competencies of this curriculum:

- Reading and presentation
- Writing projects
- Dramatization, role-play and simulation
- Inquiry-based writing
- Reading for comprehension
- Reading for critical assessment/analysis
- Discussion sessions
- Think - Pair- Share
- RDWS (Read, Discuss, Write and Say/Share)
- Teacher-guided self-study
- Journal writing
- Library visits
- Listening to lyrical poems and songs
- Reciting lyrical poems and songs
- Watching movies (animated/unanimated, comic) and dramas
- Brainstorming and mind mapping
- Quick write/flash writing
- Book/film reviews
- Paraphrasing

5.3 Instructional Materials for Learning Facilitation

Each student must have a textbook. Each teacher should have a teacher's guide and a set of teacher support materials for the appropriate grade, including digital and electronic materials as far as practicable. Teachers should make an extensive and proper use of the board. To make learning easy, effective and interesting, a variety of materials should be used including the following:

- Charts
- Comparison tables
- Role cards
- Newspapers
- Bulletins, brochures
- Pictures/drawings
- Audio-visual materials
- Writing samples (e.g. essay, book/film review, mind mapping, brainstorming, etc.)
- Worksheets
- Flash cards
- Formats (of book review/film review/project work, etc.)
- Dictionaries, computers, audio players and mobile phones
- Multi-media
- Online resources
- Readers
- Additional references
- Sample interpretation/sample summaries/character sketches/poems, etc.

6. Student Assessment

The letter grading system will be used for assessing the students' performance. In order to assess the student's learning achievement as expected by this curriculum, formative as well as summative and internal as well as external assessment will be done.

In order to ensure the learning of the students, informal assessment will be conducted regularly and timely feedback will be provided to the students for improvement. The goal of formative assessment is to help the learners to learn more rather than to check what they have learnt and what they have not. Formative assessment should focus on those areas which pose problems in learning. This can also take the form of remedial teaching. Formative assessment should focus on the development of all the language skills and aspects in the learners. Various classroom activities and techniques should be used to help the learners to learn more. The following techniques/activities can be used as tools for formative assessment:

• Observation of students' linguistic behaviour • Anecdotal record • Rating scale • Check lists • Work sample/written samples • Interviews • Home assignments	• Portfolio • Tests (class, weekly, monthly, trimister) • Project works • Creative works • Self-initiation in learning • Class work	• Games • Debates • Story telling/retelling • Poetry recitation • Dramatization/simulation • Role play • Group discussion • Journal writing

As a part of summative assessment, tests for assessing four skills of language, viz. listening, speaking, reading and writing will be conducted terminally. Listening and speaking tests will be conducted on practical basis. There will be both internal as well as external evaluation as part of summative or final assessment.

6.1 Internal Evaluation: The international evaluation convers 25 marks. The allocation of marks is as follows:

S. N.	Areas	Marks
1.	Participation	3
2	Listening test	6
3	Speaking test	10
4	Score from terminal exams	6
	Total marks	**25**

6.2 External evaluation: The external evaluation carries 75 marks. The allocation of marks for each language skill and aspect is given below:

S. N.	Language skills and aspects	Marks
1.	Reading	35
2.	Writing	25
3.	Grammar	10
4.	Vocabulary	5
	Total marks	**75**

6.3 Alternative Evaluation

For the students with disabilities, alternative assessment tools will be used. They are suggested in the test specification grid.

6.4 Elaboration of Internal Assessment

S. N.	Areas	Marks	Guidelines for evaluation
1.	Participation	3	This covers students' attendance, participation in classroom activities and their performance on classwork, homework and project works assigned to them. The teacher needs to maintain the record of students. The same record is to be consulted to award the marks for this aspect.
2	Listening test	6	**1. Listening comprehension** **Types of sound files:** (The sound files may contain: lectures, talks, presentations, poetry, interviews, conversations, short discussions, advertisements, personal accounts (oral anecdotes, past experiences) narratives (e.g. radio dramas), instructions and directions, factual accounts (e.g. eye news reports, eye witness accounts) explanations, public announcements operating instructions, weather forecast) There will be two listening tasks on two different sound files. Each task should consist of three questions. *Note: The sound files should be authentic and clearly articulated with normal speed of delivery. Each sound file should be of 3 minute maximum in length.*

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Listening constructs to be focused:
a. Specific information
b. Gist
c. Main information and supporting details
d. Specific information and important details

Number of sound files: Two sound files each carrying 3 marks will be used.

Length of the sound file: Maximum three minutes

Types of test items
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<td>1. Multiple choice
2. Fill in the blanks
3. Matching</td>
<td>4. Short answer questions</td>
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Alternative test methods for students with speech and hearing difficulties

For the students with speech and hearing difficulties, any one of the following types of questions can be asked:

1. Paragraph writing on a given topic
2. Writing a letter
3. Writing a description of the given picture

Time: 20 minutes.
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<tr>
<td>3</td>
<td>Speaking</td>
<td>10</td>
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The speaking test will be administered practically. The test starts with greeting and introducing to make the students feel comfortable. This will not carry any marks. The speaking test consists of the following sections:

1. Introduction and interview (3 marks)

The students will be asked at least any three questions on their personal affairs and immediate situation. (How are you preparing for the exam? What will you study after grade 12? What’s your aim in life? Do you like English? Why?/Why not?

2. Describing pictures (4 marks)

The students are given a picture or a set of pictures. They are expected to describe the picture in at least 8 sentences.

3. Speaking on a given topic (3marks)

The students will be given a topic like; my school, my hobby, my family. They will get one-minute time to
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			think over the topic and then they will speak on the topic. This will also be done individually. **Time:** 10 to 15 minutes for per student **Alternative test methods for students with visual difficulties** For the students with visual difficulties, ask them to narrate a sequence of events instead of the task 2 'describing pictures' above.
4	**Score from terminal exams**	**6**	3 marks from each terminal exams

Computer Science

Grades: 11 and 12 **Subject code:** Com. 427 **(Grade 11),** Com. 428 **(Grade 12)**

Credit hrs: 5 **Working hrs: 160**

1. Introduction

The world has witnessed a radical change in the field of Information and Communication Technology (ICT) in recent and this process is still going on. The relevance of computer education has been increasing day by day. Realizing the same the curriculum of computer science for Grades 11 and 12 has been developed according to the National Curriculum Framework, 2076. The study of this course will help the students to enter the job market. This will also provide basis for the students to pursue their further study in the field.

This curriculum comprises of an introduction to basic computer system, the basic number system and Boolean logic, computer software and operating system, application package, multimedia and network. It also includes contents of web technology, programming, information security and cyber law, digital society and computer ethics and recent trends in ICT. The course itself is of practical nature and the pedagogical approaches in delivering the course should consider the balance between theory and practice. The same applies in case of student evaluation procedure too.

The curriculum has been divided to different sections: level-wise competences, grade-wise learning outcomes, scope and sequence of contents with their elaboration, some indication to learning facilitation process and student assessment.

2. Level-wise competencies

1. Relate principles of computer system including input, process, output and storage devices, Boolean logic and number system.
2. Use operating system, word processor, spread sheet and apply in real-life and educational contexts.
3. Design website using new web technologies.
4. Demonstrate the programming concept and logic into software development process.
5. Use Database concept in basic SQL level.
6. Apply networking concept into LAN and wireless network.
7. Define OOPs concept and trace the recent trends of technological enhancement in 21st century.

3. Grade wise learning Outcomes

Grade 11

S. N.	Content Area	Learning outcomes
1	Computer system	1.1 Introduce computer with its characteristics and application. 1.2 Describe the evolution of computer. 1.3 Describe the measurement unit of processing speed and storage unit and use them. 1.4 Introduce Super, Mainframe, Mini and Microcomputers and compare them. 1.5 Introduce mobile computing and its application and use it. 1.6 Sketch and describe computer architecture and organization. 1.7 Identify and explain the components of computer system. 1.8 Introduce and explain microprocessor and bus system. 1.9 Introduce and explain primary and secondary memory. 1.10 Identify and use input and output devices. 1.11 Describe hardware interfaces and use them.
2	Number System and Conversion Boolean Logic	2.1 Introduce the number system, Decimal-Binary-Octal-Hexadecimal conversion and binary calculation. 2.2 Introduce the Boolean Algebra, Boolean values and truth table, Boolean expression and Boolean function. 2.3 Introduce and explain Logic Gates. 2.4 Describe Laws of Boolean Algebra.
3	Computer Software and Operating System	3.1 Explain software with its categories. 3.2 State the concept of operating system with its functions and etymologies. 3.3 Describe GUI based operating system and its features. 3.4 Introduce desktop application and windows environment. 3.5 Create file and folders with file explorer. 3.6 Customize the start screen and desktop. 3.7 Install and remove the devices. 3.8 Manage password and privacy. 3.9 Use control panel, system tools and accessories 3.10 State the concept of open sources and mobile operating system.

		3.11 Introduce Linux, UNIX and Linux distribution. 3.12 Explain the types of mobile operating system.
4	Application Package	4.1 Describe the office package (Word, Processor, Spreadsheet and Presentation) and apply them. 4.2 Introduce the domain-specific tools.
5	Programming Concepts & Logics	5.1 Introduce the programming language and identify its levels. 5.2 Introduce and compare Compiler, Interpreter and Assembler. 5.3 Introduce Syntax, Semantic and Runtime errors and apply them. 5.4 Introduce control structures and use them. 5.5 Identify programme design tools and use them. 5.6 Describe absolute binary, BCD, ASCII and Unicode. 5.7 State the features and structure of C language. 5.8 Introduce C preprocessor and header files and use them. 5.9 Introduce character set and apply it. 5.10 Explain the Identifiers, Keywords and Tokens. 5.11 Introduce and explain the basic data types. 5.12 Introduce constants, variables, operators and expressions and apply them. 5.13 Identify the types of specifier and apply them. 5.14 Identify the simple and compound statements and apply them. 5.15 Introduce Input/output (I/O) functions. 5.16 Introduce Selection Control Statement and Iteration Control Statement. 5.17 Describe array and string functions and apply them.
6	Web Technology I	6.1 Explore web browsers and search engines. 6.2 Overview internet and web technology. 6.3 Explain and use Content Management System (CMS). 6.4 Describe with objectives and structure of HTML. 6.5 Differentiate between tags and attributes. 6.6 Describe and use the types of tags in HTML. 6.7 Introduce Cascading Style Sheet (CSS), describe its types and use them.
7	Multimedia	7.1 Introduce and apply multimedia.

		7.2 Describe the components of multimedia.
8	Information Security and Cyber Law	8.1 Describe digital society and computer ethics. 8.2 State the concept of information security and cybercrime. 8.3 Explore and apply the protective measures of cybercrime. 8.4 Identify key aspects intellectual property right and follow it. 8.5 State the concept of digital signature and use it. 8.6 Analyze cyber law and ICT policy in Nepal

Grade 12

S. N.	Content Area	Learning outcomes
1	DBMS Concept	1.1 Introduce Database Management System (DBMS) with its aspects. 1.2 State the advantages of using DBMS. 1.3 Define Data Definition Language (DDL) and Data Manipulation Language (DML). 1.4 Introduce and use database model. 1.5 State the concept of normalization. 1.6 Compare between centralized and distributed database. 1.7 Introduce database security and apply it.
2	Concept of Network and Data Communication	2.1 Describe the communication system with its basic elements and model. 2.2 Describe the data communication with its elements and mode. 2.3 Define and apply LAN and WAN. 2.4 Describe transmission medium and use it. 2.5 Define terminologies for transmission impairments. 2.6 Introduce network architecture. 2.7 Define basic terms and tools used in computer network. 2.8 Define network tools, devices and topologies and use them. 2.9 State the concept of OSI Reference Model and Internet Protocol Addressing
3	Web Technology II (CSS, JavaScript, PHP)	3.1 Introduce internet technology. 3.2 Introduce Server side and Client Side Scripting.

		3.3 Introduce and use java script fundamental and java script data types and add java script to HTML page. 3.4 Introduce and use variables and operators in java script. 3.5 Use functions and control structure in java script. 3.6 Apply object based programming with java script and event handling. 3.7 Introduce basic programming concept in PHP. 3.8 Use operators and variables in PHP. 3.9 Introduce and use data base connectivity. 3.10 Use SQL queries and create SQL database.
4	Programming II	4.1 Review the concept of C programming. 4.2 Introduce functions with prototype, call and return statements. 4.3 State the concept of library and user defined functions and their advantages. 4.4 State the concept of storage and recursion and apply them. 4.5 Introduce and differentiate between structure and union. 4.6 Define pointers and apply them. 4.7 State the concept of data file with sequential and random file. 4.8 Apply the file manipulation function. 4.9 Open, read, write and append the data file.
5	OOP Concept	5.1 Introduce object Oriented Programming (OOP) with programming paradigms and features. 5.2 State advantages and applications of OOP.
6	Software Process Model (SDLC, Software Process only)	6.1 State the concept of software project, software development process and SDLC. 6.2 Compare between system analyst and software engineer. 6.3 State the concept of system design. 6.4 Show the relation between software and quality. 6.5 Explain the software development model.
7	Recent Trends in ICT	7.1 Describe the recent trends in ICT

4. Scope and Sequence of Contents

Grade 11

S. N.	Content Area	Elaboration of Contents	Working Hour
1	Computer system	1.1 Introduction of computer 1.1.1 Definition, characteristics and application of computer 1.1.2 Evolution of computer technology 1.1.3 Measurement unit of processing speed and storage unit 1.1.4 Super, Mainframe, Mini and Microcomputers 1.1.5 Mobile Computing and its Application 1.2 Computer system and I/O devices 1.2.1 Concept of computer architecture and organization 1.2.2 Components of computer system: input unit, output unit, processing unit, memory unit and storage 1.2.3 Microprocessor: basic concepts, clock speed, word length, components and functions 1.2.4 Bus System: data bus, address bus and control bus 1.2.5 Primary memory: Definition, RAM, ROM, Cache, Buffer, types of RAM and ROM 1.2.6 Secondary Memory: Definition, Magnetic Disk, Flash Memory, Optical Disk, External Storage Device and memo stick 1.2.7 Input Devices – Keyboard, Mouse, Scanner, Light Pen, OMR, OCR, BCR, MICR, Scanner, Touch Screen, Microphone and Digital Camera. 1.2.8 Output Devices: Monitor (LCD, LED), Printer (Dot Matrix, Inkjet, Laser), Speaker 1.2.9 Hardware Interfaces: Parallel Port, Serial Port, USB Ports, HDMI and Expansion Slots	20

2	Number system and conservation Boolean Logic	2.1 Number System and conversion 2.1.1 Decimal, Binary, Octal, Hexadecimal Number System & conversion 2.1.2 Calculation in binary addition, subtraction 2.1.3 One's and Two's complement methods of binary subtraction 2.2 Logic Function and Boolean Algebra 2.2.1 Introduction to Boolean algebra 2.2.2 Introduction to Boolean values, truth table, Boolean expression and Boolean function. 2.2.3 Logic Gates –AND, OR, NOT, NAND, NOR, XOR and XNOR – its definition, truth table, logic symbol, logic function 2.2.4 Laws of Boolean algebra – Boolean identities, Complement Laws, Identity, Commutative, Associative and Distributive 2.2.5 Statement and verification of Laws of Boolean algebra using truth table	11
3	Computer Software and Operating System	3.1 Concept of Software 3.1.1 Definition of software 3.1.2 Categories of software: System, Utility, Application, Web Based, Mobile Apps 3.2 Concept of Operating System 3.2.1 Introduction to Operating System 3.2.2 Role of Operating System 3.2.3 Functions of an Operating System 3.2.4 Operating system terminology: multiprogramming, multitasking, multiprocessing and distributed 3.3 Windows Operating System 3.3.1 Introduction to GUI based Operating system and its features 3.3.2 Working in Desktop Application and Window Environment 3.3.3 Manage Files and Folders with File Explorer 3.3.4 Customize the start screen and desktop	12

		3.3.5 Installing and removing devices 3.3.6 Manage passwords and privacy levels 3.3.7 Use of control panel, system tools and accessories 3.4 Open sources and Mobile Operating System 3.4.1 Concept of Open Sources Operating System 3.4.2 Introduction to Linux and UNIX 3.4.3 Linux Distributions 3.4.4 Concept of Mobile Operating System 3.4.5 Types of Mobile Operating System	
4	Application Package	4.1 Introduction to Office Package - Word processor, Presentation tool, spreadsheet package, database management system; 4.2 Introduction to domain-specific tools - school management system, inventory management system, payroll system, financial accounting, hotel management, weather forecasting system.	5
5	Programming Concepts & Logics	5.1 Programming Concept 5.1.1 Introduction to programming languages 5.1.2 Low level, High level, 4 GL programming languages 5.1.3 Compiler, Interpreter and Assembler 5.1.4 Syntax, Semantic and Runtime errors 5.1.5 Control Structures: Sequence, Selection and Iteration 5.1.6 Program Design tools – Algorithm, Flowchart and Pseudocode 5.1.7 Absolute binary, BCD, ASCII and Unicode 5.2 C Programming Languages 5.2.1 Introduction and features of C Language 5.2.2 Structure of C program 5.2.3 C Preprocessor and Header Files 5.2.4 Character Set used in C 5.2.5 Use of Comments	8

		5.2.6 Identifiers, Keywords and Tokens 5.2.7 Basic Data Types in C 5.2.8 Constants and Variables 5.2.9 Type of Specifier 5.2.10 Simple and Compound Statements 5.2.11 Operators and Expressions: arithmetic, relational, logical, assignment, unary and conditional operators 5.2.12 Input/output (I/O) Functions 5.2.13 Selection Control Statement: Decisions (if, if-else, if-else-if, nested and, switch) 5.2.14 Iteration Control Statement: Looping (while, do while, for nested) 5.2.15 Array: definition, types(1D and 2D), matrix addition and subtraction 5.2.16 String: definition and string function : strlen(), strcat(), strcmp(), strrev(), strcpy(), strlwr(), strupr()	
6	Web Technology I	6.1 Introduction: Web development introduction 6.2 Web browsers and search Engines 6.3 Overview of various internet & web technologies 6.4 Content Management System (CMS) 6.4. HTML: The Language of the Web 6.4.1 Objectives 6.4.2 Structure of HTML 6.4.3 Published and Hosting 6.4.4 HTML Tags vs. Attributes 6.4.5. Basic Tags of HTML: HTML, HEAD, TITLE, BODY (Setting the Fore color and Background color, Background Image, Background Sound) 6.4.6 Heading tag (H1 to H6) and attributes(ALIGN), 6.4.7 FONT tag and Attributes (Size: 1 to 7 Levels, BASEFONT, SMALL, BIG,COLOR) 6.4.8 Paragraph Formatting (P) 6.4.9 Break Line BR	8

		6.4.10. Comment in HTML (<! >) 6.4.11. Formatting Text (B, I, U, Mark, Sup, Sub, EM, BLOCKQUOTE, PREFORMATTED) 6.4.12. Ordered List- OL (LI, Type- 1, I, A, a; START,VALUE) 6.4.13. Unordered List - UL (Bullet Type- Disc, Circle, Square, DL, DT, DD) 6.4.14 ADDRESS Tag • Creating Links: Link to other HTML documents or data objects • Links to other places in the same HTML documents • Links to places in other HTML documents • Anchor Tag and Hyperlink 6.4.15. Tables: Creating Tables using TH, TR and TD tags 6.4.16 Forms: Creating form using Textbox, radio, checkbox, text area, button 6.4.17 Introduction to HTML 5 Elements including audio, embed, source, track and video attributes 6.4.18 HTML 5 Graphics using canvas and svg tags 6.4.19 Concept of domain name and web hosting 6.5 Cascading Style Sheets 6.5.1 Introduction to Cascading Style Sheet (CSS) 6.5.2 Inline CSS 6.5.3 Embedded CSS 6.5.4 External CSS	
7	Multimedia	7.1 Introduction to Multimedia 7.2 Component of Multimedia: Text, Graphics, Audio, Video and Animation 7.3 Application of Multimedia	6
8	Information Security and	8.1 Digital society and computer ethics	10

	Cyber Law	8.2 Concept of Information security 8.3 Concept of Cybercrime 8.4 Malicious software and Spam 8.5 Protection from cybercrime 8.6 Intellectual Property Right 8.7 Concept of Digital Signature 8.8 Concept of Cyber Law in Nepal 8.9 ICT Policy in Nepal	
Total			**80**

Grade 12

S. N.	Content Area	Contents	Working Hour
1	Database Management System (DBMS)	1.1 Introduction to data, database, Database system, DBMS 1.2 Field, Record, Objects, Primary Key, Alternate key, Candidate key 1.3 Advantages of using DBMS 1.4 DDL (Data Definition Language) and DML (Data Manipulation Language) 1.5 Database Model: Network Model, Hierarchical Model, Relational database model 1.6 Concept of Normalization: 1NF, 2NF, 3NF 1.7 Centralized Vs. Distributed Database 1.8 Database Security	12
2	Data Communication and Networking	2.1 Basic elements of Communication System: 2.2 Concept of Communication System 2.3 Block Diagram of communication System /Model 2.4 Elements of Data Communication/Transmission 2.5 Simplex, Half duplex and Full duplex communication mode 2.6 Concept of LAN and WAN 2.7 Transmission Medium: Guided and Unguided 2.8 Transmission impairments terminology (Jitter, Singing, Echo, Crosstalk, Distortion, Noise, Bandwidth, Number of receivers)	15

		2.9 Basic concept of Networks Architecture: Client-Server and Peer-to-peer 2.10 Some Basic Terms and Tool Used in Computer Network: IP Address, Sub Net Mask and Gateway, MAC address, Internet, Intranet, Extranet 2.11 Network Tool: Packet tracer, Remote Login 2.12 Network Connecting Devices: NIC, Modem, router, switch 2.13 Network Topologies: Bus, Ring and star topology 2.14 Basic Concept OSI Reference Model 2.15 Internet Protocol Addressing	
3	Web Technology II	3.1 Introduction 3.2 Server side and Client Side Scripting 3.3 Introduction of internet technology 3.4 Adding Java script to HTML page 3.5 Java script fundamental 3.6 Java Script Data types 3.7 Variables and operators 3.8 Functions and control structure if-else, if-else-if, switch-case, for, while, do while loop 3.9 Object based programming with Java Script and Event handling 3.10 Image, event and form objects 3.11 Form validation, JQuery 3.12 Server Side Scripting using PHP 3.13 Introduction to PHP: Hardware and Software Requirements 3.14 Object oriented programming with server side scripting 3.15 Basic PHP syntax 3.16 PHP data types 3.17 Basic Programming in PHP 3.18 Operators (Arithmetic, logical, comparison, operator precedence) 3.19 Variables Manipulation 3.20 Database Connectivity	12

		3.21 Connecting server side script to database 3.22 Making SQL queries 3.23 Fetching data sets getting data about data 3.24 Creating SQL database with server side scripting 3.25 Displaying queries in tables	
4	Programming in C	4.1 Review of C programming concept 4.2 Functions 4.2.1 Concept of library and user defined functions and advantages 4.2.2 function definition, prototype, call and return statements 4.2.3 Accessing a Function by passing values 4.2.4 Concept of storage: automatic and external 4.2.5 Concept of Recursion: factorial and Fibonacci problems 4.3 Structures and Unions 4.3.1 Structure: Definition, Declaration, Initialization and Size of Structure. 4.3.2 Accessing member of structure 4.3.3 Array of structure 4.3.4 Union: Definition, Declaration 4.3.5 Difference between union and structure. 4.4 Pointers 4.4.1 Definition of Pointer 4.4.2 Address (&) and indirection (*) operator 4.4.3 Pointer Expression and Assignment 4.4.4 Call by values and call by reference 4.5 Working with Files 4.5.1 Concept of Data File 4.5.2 Sequential and Random File 4.5.3 File manipulation function: putw, getw, putc, getc, fscanf, fprintf 4.5.4 Opening, Reading, Writing and Appending data file	12
5	Object-Oriented Programming	5.1 Programming paradigms: procedural, structural and object oriented 5.2 Features of OOP: Class, Object, Polymorphism and	10

	(OOP)	Inheritance 5.3 Advantages of OOP 5.4 Application of OOP	
6	Software Process Model (SPM)	6.1 Software Project Concept 6.2 Concept of software development process 6.3 Concept SDLC life cycle 6.4 System Analyst Vs Software Engineer 6.5 Requirement Collection Methods 6.6 Concept of system design 6.7 Software and quality 6.8 Software development model: waterfall, prototype, agile	10
7	Recent Trends in Technology	7.1 Concept of Artificial Intelligence (AI) and Robotics 7.2 Concept of Cloud Computing 7.3 Concept of Big Data 7.4 Concept of Virtual Reality 7.5 Concept of e-com, e-medicine, e-gov. 7.6 Concept of Mobile Computing **7.7** Concept of Internet of things (IoT)	9
		Total	80

5. Suggested Practical/Project Activities

a) Suggested Practical

Grade 11			
S. N.	**Content Area**	**Tasks**	**Working Hour**
1	Number system and conservation Boolean Logic	Use Simulator : Demonstrate Logic Gates and its expression using simulator	3
2	Computer Software and operating system	With Window OS or Linux platform: Working in Desktop Application and Window Environment	8

		• Manage files and folders with file explorer • Customize the start screen and desktop • Installing and removing devices • Manage passwords and privacy levels • Use of control panel, system tools and accessories	
3	Application package	Application Package (Word Processor, Spreadsheet and Presentation) 1.Word processor • Basic terms of word processing • Creating document and environment • Formatting text and paragraphs • Spelling grammar, thesaurus, comments • Managing lists and tables • Inserting graphic objects • Controlling page appearance • Performing a mail merge • Preparing to publish a document • Levels and table of contents • Export documents: PDF 2. Spread Sheet • Basic fundamentals of Spread Sheet • Entering data, cell manage, concept of cell references • Formatting a worksheet • Creating and working with charts • Managing workbooks • General functions and formulas • Data filter and sorting • Pivot tables and pivot chart • Working with other objects • Printing worksheets 3. Presentation • Basic fundamental of presentation • Create presentation slides	25

		• Design and formatting presentation • Animation and custom animation • Transition of presentation • Working with tables, graphics and word art • Working with graphs and organization charts • Working with multimedia	
4	Programming Concepts and Logics	Input/output (I/O) Functions • Selection Control Statement: Decisions (if, if-else, if-else-if, nested and, switch) • Iteration Control Statement: Looping (while, do while, for nested) • Array: definition, types (1D and 2D), matrix addition and subtraction • String: definition and string function : strlen(), strcat(), strcmp(), strrev(), strcpy(), strlwr(), strupr()	14
5	Web Technology	• Practices on HTML 4 using basic Tags of HTML, <H1> , <FONT>, <P>, , <!>, <OL>, <UL>, <A>, <img>, <table>, <form> • Practices on HTML 5 including audio, embed, source, track and video attributes, Graphics using canvas and svg tags • Practice on cascading Style Sheets including Inline, Embedded, External CSS	15
6	Multimedia	• Graphics (Photo and image editing) • Image capture, resize, crop, add layer, save in different format • Audio recording, editing and save in different format using mobile • Video recording, spilt, save in differ format	15
Total			**80**

Grade 12			
S. N.	Content Area	**Tasks**	**Working Hours**
1	DBMS	Perform the following activities in SQL	25

	Concept	1. Install latest DBMS software (MySQL or PostgreSQL or MSSQL or Oracle) 2. Work with CREATE, DROP, ALTER DDL SQL statement 3. Work with SELECT, INSERT, UPDATE, DELETE DDL SQL statement	
2	Concept of network and data communication	Perform the following task 1. Demonstrate Ipconfig, ping 2. Construct twisted pair cable (Straight through and crossover) 3. Demonstrate the basic router Configuration (ADSL, DSL) 4. Demonstrate the server based OS (Windows Server or Linux) 5. Share file, folder and printer in network 6. Assign private IP Address in LAN network	15
3	Web Technology II	Perform the following task in Java script 1. Functions and control structure if-else, if-else-if, switch-case, for, while, do while loop 2. Event handling 3. Practice on form validation in JQuery Perform the following task in PHP 1. Server Side Scripting using PHP 2. Basic PHP syntax 3. PHP data types 4. Basic Programming in PHP 5. Operators (Arithmetic, logical, comparison, operator precedence) 6. Variables Manipulation 7. Database Connectivity 8. Making SQL queries 9. Fetching data sets getting data about data	20
4	Programming II	C Programming Languages 1. Factorial and Fibonacci problems 2. Array, Union and Structure 3. Pointers 4. File manipulation function: putw, getw, putc, getc,	20

		fscanf, fprintf 5. Opening, Reading, Writing and Appending data file	
Total			**80**

b) Suggested project work

Grade-wise sample project works are suggested below.

Grade 11

1. Prepare basic computer system devices and peripheral specifications of your personal computer.
2. Write a report on "Major cyber bullying in Nepal" with real examples and suggest the preventing measures
3. Conduct a survey to identify the popular search engines (any 5) and its features.
4. Develop the real life project on Office Package or web technology

Grade 12

1. Study Wi-Fi network available in your area and identify the security features.
2. Prepare a document for data collection method to develop software
3. Conduct a mini research to identify most recently used technologies and uses.

6. Learning Facilitation Method and Process

Students should be facilitated to learn rather than just helping them to accumulate information.. Student centered teaching-learning process is highly emphasized in delivering this course. Students are supposed to adopt multiple pathway of learning such as; online search, field visit, library work, laboratory work, individual and group work, research work etc. with the support of teacher. Self-study is highly encouraged and learning should not be confined to the scope of curriculum. Teacher should keep in mind intra and inter-disciplinary approach to teaching and learning, as opposed to compartmentalization of knowledge. Supportive role of parents/guardians in creating conducive environment for promoting the spirit of inquiry and creativity in students' learning is anticipated. The following methods and techniques will be adopted in delivering this course.

- Practical/application/experimental methods
- Laboratory based practical works
- Project work methods (Research work i.e. survey and mini research, innovative work or experiential learning, connection to theory and application)
- Lecture
- Interaction
- Question answer
- Demonstrations
- Online based instructions
- Cooperative learning

- Group discussions (satellite learning group, peer group, small and large group)
- Daily assignment

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students. Class tests, unit tests, oral question-answer, home assignment etc., are some ways of conducting formative evaluation. There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces internal evaluation including evaluation of project/research work or innovative work, theoretical examination and practical examination.

a) Internal Evaluation

Internal evaluation is both formative and summative. For summative purpose it covers 25% of total weightage. Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. The criteria for internal evaluation are given in the table.

S. N.	Criteria	Marks
1	Classroom participation (Daily attendance, home assignment and classwork, participation in learning, participation in other activities)	3
2	Trimester exam (3 marks from each trimester exam)	6
3	Project work, project report and presentation	16
	Total	**25**

b) External Evaluation

External evaluation covers 75 % of total weightage. External evaluation consists of both the practical and written examination. The practical examination carries 25% and written examination carries 50%. Practical examination will be conducted in the presence of examiners. Practical evaluation must cover all the practical course areas and the criteria for Practical evaluation are in the table given below.

S.N.	Criteria	Marks
1	Writing process of given practical task	5
2	Demonstration of practical task	15
3	Viva voce	5
Total		25

The types and number questions for written examiniation will be as per the test specification chart developed by the Curriculum Development Centre.

Chemistry

Grades: 11 and 12 **Subject code:** Che. 301 **(Grade 11),** Che. 302 **(Grade 12)**

Credit hrs: 5 **Working hrs: 160**

1. Introduction

This curriculum is of grade 11 and 12 chemistry. This is designed to provide students with general understanding of the fundamental scientific laws and principles that govern the scientific phenomena in the world. It focuses to develop scientific knowledge, skills, and attitudes required at secondary level (grade 11 and 12) irrespective of what they do beyond this level, as envisioned by national goals. Understanding of scientific concepts and their application, in day to day context as well as the process of obtaining new knowledge through holistic approach of learning in the spirit of national qualification framework is emphasized in the curriculum.

This curriculum aims: to provide sufficient knowledge and skills to recognize the usefulness and limitations of laws and principles of chemistry, to develop science related attitudes such as concern for safety and efficiency, concern for accuracy and precision, objectivity, spirit of enquiry, inventiveness, appreciation of ethno-science, and willingness to use technology for effective communication, to provide opportunity for the learners who have deeper interest in the subject to delve into the more advanced contents so that the study of chemistry becomes enjoyable and satisfying to all.

The curriculum prepared in accordance with National Curriculum Framework is structured for two academic years in such a way that it incorporates the level-wise competencies, grade-wise learning outcomes, scope and sequence of contents, suggested practical/project-work activities, learning facilitation process and assessment strategies so as to enhance the learning of the subject systematically.

2. Level-wise competencies

The expected competencies of this course are to:

1. think critically and creatively, communicate effectively in written and oral form and reason quantitatively
2. apply appropriate principles, concepts, theories, laws, models and patterns to interpret the findings, draw conclusion, make generalization, and to predict from chemical facts, observation and experimental data.
3. correlate old principles, concepts, theories, laws, tools, techniques; to the modern, sustainable and cost-effective skills, tools and techniques in the development of scientific attitude.
4. apply the principles and methods of science to develop the scientific skill in an industrial process to produce various chemicals in small as well as in industrial scale that are useful in our daily life and in the service of mankind.
5. explain the social, economic, environmental and other implications of chemistry and appreciate the advancement of chemistry and its applications as essential for the growth of national economy.

6. describe chemistry as a coherent and developing framework of knowledge based on fundamental theories of the structure and process of the physical world.
7. develop skills in safe handling of chemicals, taking into account of their physical and chemical properties, risk, environmental hazards, etc.
8. conduct either a research work or an innovative work in an academic year, under the guidance of teacher, using the knowledge and skills learnt.

3. Grade-wise learning Outcomes

Grade 11	Grade 12
Content Area: General and Physical Chemistry	
1. Foundation and Fundamentals 1.1 Recognize the importance and scope of chemistry. 1.2 Explain the terms atom, molecule, radicals, valency molecular formula and empirical formula. 1.3 Calculate percentage composition of constituent elements from molecular formula. 1.4 Define and use the terms relative atomic mass, relative molecular mass and relative formula mass.	**1. Volumetric Analysis** 1.1 Define and explain the terms volumetric and gravimetric analysis. 1.2 Express the concentration of solutions in terms of percentage, g/l, molarity, molality, normality, ppm, ppb 1.3 Define and calculate the equivalent weight of (elements, acids, bases, salts, oxidising and reducing agents). 1.4 Express the concentration of solution in terms of normality. 1.5 Explain and apply the concept of law of equivalence in chemical calculation. 1.6 Define and explain primary and secondary standard substance. 1.7 Explain different types of titration and their applications.
2. Stoichiometry 2.1 Explain Dalton's atomic theory and its postulates. 2.2 State and explain laws of stoichiometry (law of conservation of mass, law of constant proportion, law of multiple proportion, law of reciprocal proportion and law of gaseous volume). 2.3 Explain Avogadro's hypothesis and deduce some relationships among	**2. Ionic Equilibrium** 2.1 Explain the limitations of Arrhenius concepts of acids and bases. 2.2 Define Bronsted and Lowry concepts for acids and bases. 2.3 Define conjugate acids and conjugate base. 2.4 Identify conjugate acid-base pairs of Bronsted acid and base.

molecular mass with vapour density, volume of gas and number of particles. 2.4 Define mole and explain its relation with mass, volume and number of particles. 2.5 Interpret a balanced chemical equation in terms of interacting moles, representative particles, masses and volume of gases (at STP) and perform stoichiometric calculations. 2.6 Identify limiting and excess reagent in a reaction and calculate the maximum amount of products produced. 2.7 Calculate theoretical yield and percentage yield from the given actual yield. 2.8 Find empirical and molecular formula from percentage composition.	2.5 Define and explain Lewis acids and bases. 2.6 Use the extent of ionization and dissociation constant of acid (ka) and base (kb). 2.7 Explain ionization constant of water and calculate pH and pOH in aqueous medium using Kw values. 2.8 Show understanding of, and use, the concept of solubility product Ksp. 2.9 Calculate Ksp from concentrations and vice versa. 2.10 Show understanding of the common ion effect. 2.11 Describe the application of solubility product principle and common ion effect in precipitation reactions. 2.12 Define a Buffer and show with equations how a Buffer system works. 2.13 Explain the choice of suitable indicators for acid-base titrations and describe the changes in pH during acid-base titrations. 2.14 Define and differentiate different types of salts (simple salts, double salts, complex salt, acidic salts, basic salts and neutral salts). 2.15 Explain hydrolysis of salts (salts of strong acid and strong base, salts of weak acid and strong base and salts of weak base and strong acid).
3. Atomic Structure 3.1 Explain Rutherford atomic model and its limitations. 3.2 Summarize Bohr's atomic theory and its importance. 3.3 Explain the origin of hydrogen spectra with the help of Bohr's model. 3.4 Explain the general idea about Debroglie's	**3. Chemical Kinetics** 3.1 Define chemical kinetics. 3.2 Explain and use the terms rate of reaction, rate equation, rate constant. 3.3 Explain qualitatively factors affecting rate of reaction. 3.4 Use collision theory to explain how the rate of chemical reaction is

wave equation and probability. 3.5 Explain quantum numbers and Planck's quantum theory. 3.6 Explain the concept and general shapes of s,p,d and f orbitals. 3.7 Use Aufbau principle, Pauli Exclusion Principle and Hund's rule to write the electronic configuration of the atoms and ions.	influenced by temperature, concentration and particle size. 3.5 Explain the meaning of the term activation energy and activated complex. 3.6 Derive and explain integrated rate equation and half life for zero, and first order reaction. 3.7 Construct and use rate equations calculating an initial rate using concentration data. 3.8 Explain the significance of Arrhenius equation and solve the related problems. 3.9 Explain and use the terms catalyst and catalysis (homogenous, heterogeneous). 3.10 Describe enzyme as biological catalyst. 3.11 Explain the role of catalyst in the reaction mechanism. 3.12 Solve related numerical problems based on rate, rate constant and order of zero and first order reactions.
4. Classification of elements and Periodic Table 4.1 Explain modern periodic table and its features. 4.2 Classify the elements of periodic table in different blocks and groups. 4.3 Identify the elements as metals, non-metals and metalloids. 4.4 Define the term nuclear charge and effective nuclear charge. 4.5 Explain and interpret the Periodic trend of atomic radii, ionic radii, ionization energy, electronegativity, electron affinity and metallic characters of elements.	**4. Thermodynamics** 4.1 Define thermodynamics. 4.2 Explain the energy change in chemical reactions. 4.3 Define the terms internal energy and state function. 4.4 State and explain first law of thermodynamics. 4.5 State and explain enthalpy and enthalpy changes in various process (enthalpy of solution, enthalpy of formation enthalpy of combustion and enthalpy of reaction). 4.6 Explain endothermic and exothermic process with the help of energy profile

	diagram. 4.7 State laws of thermo-chemistry and solve numerical problems related to Hess law. 4.8 Define the term entropy and spontaneity. 4.9 State and explain second law of thermodynamics. 4.10 Define standard Gibbs free energy change of reaction by means of the equation $\Delta G = \Delta H - T\Delta S$. 4.11 Calculate ΔG for a reaction using the equation $\Delta G = \Delta H - T\Delta S$. 4.12 State whether a reaction or process will be spontaneous by using the sign of ΔG. 4.13 Explain the relationship between ΔG and equilibrium constant.
5. Chemical Bonding and Shapes of Molecules 5.1 Show structure atoms and ions by Lewis dot method. 5.2 Explain the ionic bond and the properties of ionic compounds. 5.3 Explain the covalent bond, co-ordinate bond and the properties of covalent compound. 5.4 Describe the feature of sigma and Pi-bond 5.5 Describe the co-ordinate covalent compounds with some examples. 5.6 Write the lewis dot diagrams of some ionic and covalent compounds (NaCl, MgCl2, NH4Cl, Oxides of Hydrogen, Nitrogen and Phosphorous, common mineral acids). 5.7 Write the resonance structure of some covalent species. 5.8 Explain the properties of molecular and	**5. Electrochemistry** 5.1 Define the terms: standard electrode (redox) potential. 5.2 Explain about standard hydrogen electrode and calomel electrodes. 5.3 Calculate a standard cell potential by combining two standard electrode potential. 5.4 Describe the applications of electrochemical series. 5.5 Define and explain standard cell potential with reference to voltaic cell: Zn-Cu cell, Ag-Cu cell 5.6 Use standard cell potentials to: explain/deduce the direction of electron flow in a simple cell and predict the feasibility of a reaction. 5.7 Explain the relationship between cell potential and free energy change.

metallic solids on the basis of vanderwaal's and metallic bonding. 5.9 Use VSEPR theory to describe the shapes of simple covalent molecules. 5.10 Describe the concept of hybridization in simple covalent molecules. 5.11 Explain the characterstics of bond in terms of dipole moment, Ionic character and bond length. 5.12 Describe the hydrogen bondng and outline the importance of hydrogen bonding to the physical properties of substances, including ice and water (for example, boiling and melting points, viscosity, surface tension and solubility).	5.8 State the possible advantages of developing other types of cell, e.g. the hydrogen/oxygen fuel cell and lithium-ion, rechargeable batteries.
6. Oxidation and Reduction 6.1 Define oxidation and reduction in terms of electronic concept. 6.2 Define oxidation number and explain the rules of assigning oxidation number. 6.3 Calculate oxidation numbers of elements in compounds and ions. 6.4 Explain redox processes in terms changes in oxidation number. 6.5 Use oxidation number change to identify oxidizing and reducing agent. 6.6 Balance the given redox reaction by oxidation number change or half equation method. 6.7 Explain the qualitative and quantitative aspects of faradays laws of electrolysis.	-
7. States of Matter 7.1 List the postulates of kinetic molecular theory. 7.2 State and explain Gas laws, related equations and related numerical problems. 7.3 Explain Boyle's law, Charle's law, Avogadro law, combined gas law, Daltons	-

law, Graham's law 7.4 State and use the general gas equation PV = nRT in calculations. 7.5 Explain the meaning of Universal gas constant and its significance. 7.6 Distinguish between real gas and ideal gas. 7.7 Explain qualitatively in terms of intermolecular forces and molecular size: the conditions necessary for a gas to approach ideal behavior. 7.8 Explain the cause of deviation of real gas from the gas laws. 7.9 Explain the physical properties of liquid like Evaporation and condensation, vapour pressure and boiling, surface tension and viscosity in terms of intermolecular force and intermolecular space. 7.10 Describe Liquid crystals and their applications. 7.11 Explain about Liquid crystal and its application. 7.12 Differentiate between amorphous and crystalline solids. 7.13 Describe the properties of crystalline solid (anisotropy, allotropy, isomorphism, polymorphism, transition temperature, habit of crystal, crystal growth). 7.14 Define unit cell, crystal lattice, efflorescence, deliquescence, hygroscopy, water of crystallization with examples.	
8. Chemical equilibrium 8.1 Explain physical and chemical equilibrium in terms of reversible reaction. 8.2 Describe the meaning of dynamic nature of equilibrium with example. 8.3 Explain and deduce law of mass action. 8.4 Write equilibrium expression and equilibrium constant with significance.	-

8.5 Derive the relation between Kp and Kc. 8.6 State Lechateliar's Principle and apply it to systems in equilibrium with changes in concentration pressure, temperature or the addition of catalyst.	
Content Area: Inorganic Chemistry	
9. Chemistry of Non-metals 9.1 Describe and compare the chemistry of atomic and nascent hydrogen. 9.2 Explain isotopes of hydrogen and their uses, application of hydrogen as fuel, heavy water and its applications. 9.3 Explain types of oxides (acidic, basic, neutral, amphoteric, peroxide and mixed oxides). 9.4 Recognize applications of hydrogen peroxide. 9.5 State medical and industrial application of oxygen. 9.6 Describe occurrence, preparation (from oxygen), structure and test of ozone. 9.7 Describe ozone layer depletion (causes, effects and control measures) and uses of ozone. 9.8 Give reason for inertness of nitrogen and active nitrogen. 9.9 Give chemical properties of ammonia [Action with CuSO4 solution, water, FeCl3 solution, Conc. HCl, Mercurous nitrate paper, O2]. 9.10 Explain applications of ammonia and explain harmful effects of ammonia. 9.11 Write the name and formula of oxy-acids of nitrogen. 9.12 Explain the chemical properties of nitric acid [HNO3] as an acid and oxidizing agent (action with zinc, magnesium, iron, copper, sulphur, carbon, SO2 and	**6. Transition Metals** 6.1 Explain characteristics of transition metals. 6.2 Explain oxidation states of transition metals. 6.3 Describe complex ions and metal complexes. 6.4 Show shapes of complex ions. 6.5 Describe d-orbitals in complex ions (simple explanation by crystal field theory) for octahedral complex. 6.6 Explain reasons for the colour of transition metal compounds. **6.7** Explain catalytic properties of transition metals.

	H2S).	
9.13	Detect nitrate ion in laboratory.	
9.14	Explain general characteristics of halogens.	
9.15	Compare the methods of preparation of halogens without diagram and description.	
9.16	Explain chemical properties of halogens [With water, alkali, ammonia, oxidizing character, bleaching action] and uses of halogens (Cl2, Br2 and I2).	
9.17	Explain laboratory preparation of Cl2, Br2 and I2.	
9.18	Show preparation of haloacids (without diagram and description) and properties (reducing strength, acidic nature and solubility).	
9.19	State the uses of haloacids (HCl, HBr and HI).	
9.20	Explain allotropes of carbon (crystalline and amorphous) including fullerenes (structure, general properties and uses).	
9.21	State properties (reducing action, reaction with metals and nonmetals) and uses of carbon monoxide.	
9.22	Name allotropes of phosphorus.	
9.23	Show preparation without diagram and description, properties (basic nature, reducing nature, action with halogens and oxygen) and uses of phosphine.	
9.24	Explain allotropes of sulphur (name only) and uses of sulphur.	
9.25	Prepare hydrogen sulphide using Kipp's apparatus.	
9.26	Explain properties (Acidic nature, reducing nature, analytical reagent) and uses of hydrogen sulphide.	
9.27	Explain properties of sulphur dioxide (acidic nature, reducing nature, oxidising	

nature and bleaching action) and its uses. 9.28 Explain sulphuric acid and its properties (acidic nature, oxidising nature, dehydrating nature) and its uses. 9.29 Write formula of sodium thiosulphate and uses.	
10. Chemistry of Metals 10.1 Define metallurgy and its types (hydrometallurgy, pyrometallurgy, and electrometallurgy). 10.2 Define ores, gangue or matrix, flux and slag, alloy and amalgam. 10.3 Explain general principles of extraction of metals (different processes involved in metallurgy) – concentration, calcination and roasting, smelting, carbon reduction, thermite and electrochemical reduction, refining of metals (poling and electro-refinement). 10.4 Give general characteristics of alkali metals. 10.5 State and explain extraction of sodium from Down's process. 10.6 Describe properties of sodium (action with Oxygen, water, acids nonmetals and ammonia) and uses. 10.7 Explain properties and uses of sodium hydroxide (precipitation reaction and action with carbon monoxide). 10.8 State and explain properties and uses of sodium carbonate (action with CO2, SO2, water, precipitation reactions). 10.9 Give general characteristics of alkaline earth metals. 10.10 Write molecular formula and uses of (quick lime, bleaching powder, magnesia plaster of paris and epsom salt). 10.11 Explain solubility of hydroxides, carbonates and sulphates of alkaline	**7. Studies of Heavy Metals** 7.1 Explain occurrence of heavy metals. 7.2 Describe extraction of heavy metals. 7.3 Describe properties (with air, acids, aqueous ammonia and metal ions) and uses of copper. 7.4 Explain chemistry (preparation, properties and uses) of blue vitriol. 7.5 Write formula and uses red and black oxide of copper. 7.6 Describe properties (with air, acid, alkali, displacement reaction) and uses of zinc. 7.7 Explain chemistry (preparation, properties and uses) of white vitriol. 7.8 State properties of mercury. 7.9 Explain chemistry (preparation, properties and uses) of calomel and corrosive sublimate. 7.10 Explain properties and uses of iron. 7.11 Explain manufacture of steel by basic oxygen method and open hearth process. 7.12 Explain corrosion of iron and its prevention. 7.13 Explain preparation and uses of silver chloride and silver nitrate.

earth metals. 10.12 Explain stability of carbonate and nitrate of alkaline earth metals.	
11. Bio-inorganic Chemistry 11.1 Explain bio-inorganic chemistry and compare it with other branches of chemistry. 11.2 Eefine micro and macro nutrients with examples. 11.3 State and explain importance of metal ions in biological systems (ions of Na, K, Mg, Ca, Fe, Cu, Zn, Ni, Co, Cr). 11.4 Elaborate ion pumps (sodium-potassium and sodium-glucose pump). 11.5 Explain metal toxicity (toxicity due to iron, arsenic, mercury, lead and cadmium).	-
Content Area: Organic Chemistry	
12. Basic concept of organic chemistry 12.1 Define organic chemistry and organic compounds. 12.2 State and explain origin of organic compounds. 12.3 Describe reasons for the separate study of organic compounds. 12.4 Explain tetra-covalency and catenation property of carbon. 12.5 Describe classification of organic	**8. Haloalkanes** 8.1 Describe briefly the nomenclature, isomerism and classification of monohaloalkanes. 8.2 Show the preparation of monohaloalkanes from alkanes, alkenes and alcohols. 8.3 State physical properties of monohaloalkanes. 8.4 Describe chemical properties of haloalkanes: substitution reactions

compounds. 12.6 Define functional groups and homologous series with examples. 12.7 State and explain the structural formula, contracted formula and bond line structural formula. 12.8 Introduce preliminary idea of cracking and reforming, quality of gasoline, octane number, cetane number and gasoline additive.	SN1 and SN2 reactions (basic concept only). 8.5 Show the formation of alcohol, nitrile, amine, ether, thioether, carbylamines, nitrite and nitro alkane using haloalkanes. 8.6 Describe elimination reaction (dehydrohalogenation- Saytzeff's rule), Reduction reactions, Wurtz reaction. 8.7 Show the preparation of trichloromethane from ethanol and propanone. 8.8 Explain the chemical properties of trichloromethane: oxidation, reduction, action on silver powder, conc. nitric acid, propanone, and aqueous alkali.
13: Fundamental principles 13.1 State IUPAC name of the organic compounds. 13.2 Detect N, S and halogens in organic compounds by Lassaigne's test. 13.3 Define and classify isomerism in organic compounds (structure isomerism, types of structure isomerism: chain isomerism, position, isomerism, functional isomerism, metamerism and tautomerism). 13.4 State and explain the concept of geometrical isomerism (cis&trans) & optical isomerism (d &l form). 13.5 Give preliminary idea of reaction mechanism (homolytic and herterolytic fission, electrophiles, nucleophiles and free- radicals, inductive effect: +I and –I effect, resonance effect: +R and –R effect, steric hindrance).	**9. Haloarenes** 9.1 Describe briefly the nomenclature and isomerism of haloarenes. 9.2 Show the preparation of chlorobenzene from benzene and benzene diazonium chloride. 9.3 State physical properties of haloarens. 9.4 Describe low reactivity of haloarenes as compared to haloalkanes in term of nucleophilic substitution reaction. 9.5 Explain the chemical propertiesof haloarens: reduction of chlorobenzene, electrophilic substitution reactions, action with Na (Fittig and Wurtz- Fittig reaction) and action with chloral. 9.6 Describe uses of haloarenes.
14. Hydrocarbons 14.1 Define and describe saturated	**10. Alcohols** 10.1 Describe briefly the nomenclature,

hydrocarbons (Alkanes). 14.2 Show preparation of alkanes from haloalkanes (Reduction and Wurtz reaction), Decarboxylation, Catalytic hydrogenation of alkene and alkyne. 14.3 Explain chemical properties of alkanes, i.e. substitution reactions (halogenation, nitration & sulphonation only), oxidation of ethane. 14.4 Define and describe unsaturated hydrocarbons (Alkenes & Alkynes). 14.5 Show preparation of alkenes by dehydration of alcohol, dehydrohalogenation and catalytic hydrogenation of alkyne. 14.6 Explain chemical properties of alkenes, i.e. addition reaction with HX (Markovnikov's addition and peroxide effect), H2O, O3 and H2SO4 only. 14.7 Show preparation of alkynes from carbon and hydrogen, 1,2dibromoethane, chloroform/iodoform only. 14.8 Describe chemical properties of alkynes, i.e. addition reaction with (H2, HX, H2O), acidic nature (action with Sodium, ammoniacal AgNO3 and ammoniacal Cu2Cl2). 14.9 Test unsaturation of hydrocarbons (ethene&ethyne): bromine water test and Baeyer's test. 14.10 Compare physical properties of alkane, alkene and alkyne. 14.11 Describe Kolbe's electrolysis methods for the preparation of alkane, alkene and alkynes.	isomerism and classification of monohydric alcohol. 10.2 Distinguish primary, secondary and tertiary alcohols by Victor Meyer's Method. 10.3 Show the preparation of monohydric alcohols from Haloalkane, primary amines and esters. 10.4 Explain the industrial preparation alcohol from: oxo process, hydroboration-oxidation of ethane & fermentation of sugar. 10.5 Define absolute alcohol, power alcohol, denatured alcohol (methylated spirit), rectified spirit; and alcoholic beverage. 10.6 State physical properties monohydric alcohols. 10.7 Explain chemical properties of monohydric alcoholswith HX, PX3, PCl5, and SOCl2. Action with reactive metals like Na, K and Li. Dehydration of alcohols. Oxidation of primary, secondary and tertiary alcohol with mild oxidizing agents like acidified KMnO4 or K2Cr2O7. Catalytic dehydrogenation of 1º and 2º alcohol and dehydration of 3º alcohol, Esterification reaction and test of ethanol.
15. Aromatic Hydrocarbons 15.1 Define aromatic compounds and their characteristics. 15.2 State and explain Huckel's rule, Kekule structure of benzene, resonance and	**11. Phenols** 11.1 Describe briefly the nomenclature of phenol. 11.2 Show the preparation of phenol from chlorobenzene, Diazonium salt and

isomerism. 15.3 Show the preparation of benzene from: decarboxylation of sodium benzoate, phenol, ethyne and chlorobenzene. 15.4 Explain physical properties and chemical properties of benzene (Addition reaction: hydrogen, halogen and ozone, Electrophilic substitution reactions: orientation of benzene derivatives (o, m & p), nitration, sulphonation, halogenation Friedal-Craft's alkylation and acylation, combustion of benzene) and uses.	benzene sulphonic acid 11.3 State physical properties of phenol. 11.4 Describe acidic nature of phenol (comparison with alcohol and water). 11.5 Explain the chemical properties of phenol with NH3, Zn, Na, benzene diazonium chloride and phthalic anhydride, Acylation reaction, Kolbe's reaction and Reimer-Tiemann's reaction Electrophilic substitution (nitration, sulphonation, brominaiton and Friedal-Craft's alkylation). 11.6 Describe test of phenol (FeCl3 test, aq. Bromine test &Libermann test). 11.7 State important uses of phenol.
-	**12. Ethers** 12.1 Describe briefly the nomenclature, classification and isomerism of ethers. 12.2 Show the preparation of aliphatic and aromatic ethers from Williamson's synthesis. 12.3 State physical properties of ether. 12.4 Explain chemical properties of ethoxyethane with HI , Conc. HCl, Conc. H2SO4, air and Cl2 12.5 State important uses of ethers.
-	**13. Aldehydes and Ketones** **(A) Aliphatic aldehydes and ketones** 13.1 Describe briefly the nomenclature and isomerism of aliphatic aldehydes and ketones. 13.2 Show the preparation of aldehydes and ketones from dehydrogenation, oxidation of alcohol, ozonolysis of alkenes, acid chloride, gem dihaloalkane and catalytic hydration of alkynes 13.3 State physical properties of aldehydes

	and ketones. 13.4 Describe structure and nature of carbonyl group. 13.5 Explain chemical properties of aliphatic aldehydes and ketones, i.e .addition of H2, HCN and NaHSO3. action of aldehyde and ketone with ammonia derivatives, i.e. NH2OH, NH2-NH2, phenyl hydrazine and semicarbazide. Aldol condensation, Cannizzaro's reaction, Clemmensen'sreduction. and Wolf-Kishner reduction. Action with PCl5 and action with LiAlH4 .Action of methanal with ammonia and phenol. 13.6 Distinguish between aliphatic aldehydes and ketones by using 2,4-DNP reagent, Tollen's reagent and Fehling's solution. 13.7 Define formalin and state its uses. **(B) Aromatic aldehydes and Ketones** 13.8 Show the preparation of benzaldehyde from toluene and acetophenone from benzene. 13.9 Explain chemical properties of benzaldehyde, i.e. Perkin condensation, Benzoin condensation, Cannizzaro's reaction and electrophilic substitution reaction.
-	**14. Carboxylic Acid and its Derivatives** **(A) Aliphatic and aromatic carboxylic acids** 14.1 Describe briefly the nomenclature and isomerism of aliphatic and aromatic carboxylic acids. 14.2 Show the preparation of monocarboxylic acids from: aldehydes, nitriles, dicarboxylic acid, sodium alkoxide and trihaloalkanes. 14.3 Show the preparation of benzoic acid

	from alkyl benzene. 14.4 State physical properties of monocarboxylic acids. 14.5 Explain chemical properties of aliphatic and aromatic carboxylic acids: Action with alkalies, metal oxides, metal carbonates, metal bicarbonates, PCl3, LiAlH4 and dehydration of carboxylic acid. Hell-Volhard-Zelinsky reaction. Electrophilic substitution reaction of benzoic acid (bromination, nitration and sulphonation). 14.6 Explain effect of constituents on the acidic strength of carboxylic acid. 14.7 Describe abnormal behaviour of methanoic acid. **(B) Derivatives of Carboxylic acids (acid halides, amides, esters and anhydrides)** 14.8 Show the preparation of acid derivatives from carboxylic acid. 14.9 Explain the comparative physical properties of acid derivatives. 14.10 Explain the comparative chemical properties of acid derivatives (hydrolysis, ammonolysis, amines-RNH2), alcoholysis, and reduction only. Claisen condensation and hofmannbromamide reaction. 14.11 Describe amphoteric nature of amide and relative reactivity of acid derivatives.
-	**15. Nitro Compounds** 15.1 Describe briefly the nomenclature and isomerism of nitro compounds. 15.2 Show the preparation from haloalkane and alkane. 15.3 State physical properties of nitro compounds.

	15.4 Explain chemical properties of nitro compounds, i.e. reduction. 15.5 Show preparation of nitrobenzene from benzene. 15.6 State physical properties of nitrobenzene. 15.7 Explain chemical properties of nitrobenzene, i.e. reduction in different media and electrophilic substitution reactions (nitration, sulphonation & bromination). 15.8 State important uses of nitro-compounds.
-	**16. Amines** **(A) Aliphatic amines** 16.1 Describe briefly the nomenclature, classification and isomerism of amines. 16.2 Show the separation of primary, secondary and tertiary amines by Hoffmann's method. 16.3 Show preparation of primary amines from haloalkane , nitriles, nitroalkanes and amides. 16.4 State physical properties of aliphatic amines. 16.5 Explain chemical properties of aliphatic amines, i.e. basicity of amines, comparative study of basic nature of 10, 20 and 30 amines. Reaction of primary amines with chloroform, conc. HCl, R-X, RCOX and nitrous acid ($NaNO_2$ / HCl) and test of 10, 20 and 30 amines (nitrous acid test). **(B) Aromatic amine (Aniline)** 16.6 Show preparation of aniline from nitrobenzene and phenol. 16.7 State physical properties of aromatic

	amine. 16.8 Explain chemical properties of aromatic amine, i.e. basicity of aniline, comparison of basic nature of aniline with aliphatic amines and ammonia, alkylation, acylation, diazotization, carbylamines, coupling reaction and electrophilic substitution (Nitration sulphonation and bromination). 16.9 State important uses of aniline.
-	**17. Organometallic Compounds** 17.1 Describe briefly the general formula and examples of organolithium, organocopper and organocadmium compounds. 17.2 Explain the nature of Metal-Carbon bond. 17.3 Define Grignard reagent. 17.4 Show the preparation Grignard reagent (using haloalkane and haloarene). 17.5 Explain reaction of Grignard reagent with water, aldehydes and ketones (preparation of primary, secondary and tertiary alcohols), carbon dioxide, HCN, RCN, ester and acid chloride.
Content Area: Applied Chemistry	
16. Fundamentals of Applied Chemistry 16.1 Explain chemical industry and its importance. 16.2 Explain stages in producing in the development of a new product. 16.3 Explain economics of production. 16.4 Explain cash flow in the production cycle. 16.5 Describe running a chemical plant.	**18. Chemistry in the Service of Mankind** 18.1 Explain addition and condensation polymers. 18.2 Explain elastomers and fibres. 18.3 Describe natural and synthetic polymers. 18.4 Explain some synthetic polymers (polythene, PVC, Teflon, polystyrene, nylon and bakelite). 18.5 Explain types of dyes on the basis of

16.6 Design a chemical plant 16.7 Describe continuous and batch processing. 16.8 Explain environmental impact of the chemical industry.	structure and method of application. 18.6 Describe characteristics of drugs. 18.7 Differentiate natural and synthetic drugs. 18.8 Classify some common drugs. 18.9 Be aware of adverse effect of drug addiction. 18.10 Explain insecticides, herbicides and fungicides.
17. Modern Chemical Manufactures 17.1 State and show manufacture of ammonia by Haber's process (principle and flow-sheet diagram). 17.2 State and show manufacture of nitric acid by Ostwald's process (principle and flow-sheet diagram). 17.3 State and show manufacture of sulphuric acid by contact process (principle and flow-sheet diagram). 17.4 State and show manufacture of sodium hydroxide by Diaphragm Cell (principle and flow-sheet diagram). 17.5 State and show manufacture of sodium carbonate by ammonia soda or Solvay process (principle and flow-sheet diagram). 17.6 Describe fertilizers (Chemical fertilizers, types of chemical fertilizers, production of urea with flow-sheet diagram).	**19. Cement** 19.1 Explain introduction and raw materials for cement production. 19.2 Give main steps in cement production (crushing and grinding, strong heating and final grinding). 19.3 Explain OPC and PPC cement. 19.4 Explain Portland cement process with flow-sheet diagram. 19.5 Explain cement Industry in Nepal.
-	**20. Paper and Pulp** 20.1 Explain raw materials, sources of raw materials and stages in production of paper. 20.2 Give flow-sheet diagram for paper production. 20.3 Describe quality of paper.

-	**21. Nuclear Chemistry and Applications of Radioactivity** 21.1 Describe natural and artificial radioactivity. 21.2 Give units of radioactivity. 21.3 Explain nuclear reactions. 21.4 Distinguish between nuclear fission and fusion reactions. 21.5 Describe nuclear power and nuclear weapons. 21.6 Explain industrial uses of radioactivity. 21.7 State the medical uses of radioactivity. 21.8 Explain radiocarbon dating. 21.9 Describe harmful effects of nuclear radiations.

4. Scope and Sequence of Contents (Theory)

Grade 11	T H	Grade 12	T H
Content Area: General and Physical Chemistry			
1. Foundation and Fundamentals 1.1 General introduction of chemistry 1.2 Importance and scope of chemistry 1.3 Basic concepts of chemistry (atoms, molecules, relative masses of atoms and molecules, atomic mass unit (amu), radicals, molecular formula, empirical formula) 1.4 Percentage composition from molecular formula	**2**	**1. Volumetric Analysis** 1.1 Introduction to gravimetric analysis, volumetric analysis and equivalent weight 1.2 Relationship between equivalent weight, atomic weight and valency 1.3 Equivalent weight of compounds (acid, base, salt, oxidizing and reducing agents) 1.4 Concentration of solution and its units in terms of : Percentage, g/L , molarity, molality, normality and formality, ppm and	**8**

		ppb 1.5 Primary and secondary standard substances 1.6 Law of equivalence and normality equation 1.7 Titration and its types: Acid-base titration, redox titration (related numerical problems)	
2. Stoichiometry 2.1 Dalton's atomic theory and its postulates 2.2 Laws of stoichiometry 2.3 Avogadro's law and some deductions 2.3.1 Molecular mass and vapour density 2.3.2 Molecular mass and volume of gas 2.3.3 Molecular mass and no. of particles 2.4 Mole and its relation with mass, volume and number of particles 2.5 Calculations based on mole concept 2.6 Limiting reactant and excess reactant 2.7 Theoretical yield, experimental yield and % yield 2.8 Calculation of empirical and molecular formula from % composition (Solving related numerical problems)	**8**	**2. Ionic Equilibrium** **Introduction to Acids and Bases** 2.1. Limitation of Arrhenius concepts of acids and bases 2.2 Bronsted –Lowry definition of acids and bases 2.3 Relative strength of acids and bases 2.4 Conjugate acid –base pairs 2.5 Lewis definition of acids and bases 2.6 Ionization of weak electrolyte (Ostwald's dilution law) 2.7 Ionic product of water(Kw) 2.8 Dissociation constant of acid and base, (Ka& Kb) 2.9 Concept of pKa and pKb 2.10 pH value: pH of strong and weak acids, pH of strong and weak bases 2.11 Solubility and solubility product principle 2.12 Common Ion effect 2.13 Application of solubility product principle and common ion effect in precipitation reactions 2.14 Buffer solution and its application 2.15 Indicators and selection of indicators in acid base titration 2.16 Types of salts: Acidic salts, basic salts, simple salts, complex salts (introduction and examples) 2.17 Hydrolysis of salts	**10**

		2.17.1 Salts of strong acid and strong base 2.17.2 Salts of weak acid and strong base 2.17.3 Salts of weak base and strong acid (solving related numerical problems)	
3. Atomic Structure 3.1 Rutherford's atomic model 3.2 Limitations of Rutherford's atomic model 3.3 Postulates of Bohr's atomic model and its application 3.4 Spectrum of hydrogen atom 3.5 Defects of Bohr's theory 3.6 Elementary idea of quantum mechanical model: de Broglie's wave equation 3.7 Heisenberg's Uncertainty Principle 3.8 Concept of probability 3.9 Quantum Numbers 3.10 Orbitals and shape of s and p orbitals only 3.11 Aufbau Principle 3.12 Pauli's exclusion principle 3.13 Hund's rule and electronic configurations of atoms and ions (up to atomic no. 30)	**8**	**3. Chemical Kinetics** 3.1 Introduction 3.2 Rate of reactions: Average and instantaneous rate of reactions 3.3 Rate law and its expressions 3.4 Rate constant and its unit and significance 3.5 Order and molecularity 3.6 Integrated rate equation for zero and first order reaction 3.7 Half-life of zero and first order reactions 3.8 Collision theory, concept of activation energy and activated complex 3.9 Factors affecting rate of reactions: Effect of concentration, temperature (Arrhenius Equation) and effect of catalyst (energy profile diagram) 3.10 Catalysis and types of catalysis: homogeneous, heterogeneous and enzyme catalysis (solving related numerical problems based on rate, rate constant and order of zero and first order reactions)	**7**
4. Classification of elements and Periodic Table 4.1 Modern periodic law and modern periodic table 4.1.1 Classification of elements into different groups, periods and blocks	**5**	**4. Thermodynamics** 4.1 Introduction 4.2 Energy in chemical reactions 4.3 Internal energy 4.4 First law of thermodynamics 4.5 Enthalpy and enthalpy changes:	**8**

4.2 IUPAC classification of elements 4.3 Nuclear charge and effective nuclear charge 4.4 Periodic trend and periodicity 4.4.1 Atomic radii 4.4.2 Ionic radii 4.4.3 Ionization energy 4.4.4 Electron affinity 4.4.5 Electronegativity 4.4.6 Metallic characters (General trend and explanation only)		Endothermic and exothermic processes) 4.6 Enthalpy of reaction, enthalpy of solution, enthalpy of formation, enthalpy of combustion 4.7 Laws of thermochemistry (Laplace Law and Hess's law) 4.8 Entropy and spontaneity 4.9 Second law of thermodynamics 4.10 Gibbs' free energy and prediction of spontaneity 4.11 Relationship between ΔG and equilibrium constant (Solving related numerical problems)	
5. Chemical Bonding and Shapes of Molecules 5.1 Valence shell, valence electron and octet theory 5.2 Ionic bond and its properties 5.3 Covalent bond and coordinate covalent bond 5.4 Properties of covalent compounds 5.5 Lewis dot structure of some common compounds of s and p block elements 5.6 Resonance 5.7 VSEPR theory and shapes of some simple molecules (BeF_2, BF_3, CH_4, CH_3Cl, PCl_5, SF_6, H_2O,NH_3,CO_2,H_2S, PH_3) 5.8 Elementary idea of Valence Bond Theory 5.9 Hybridization involving s and p orbitals only 5.10 Bond characteristics: 5.10.1 Bond length 5.10.2 Ionic character 5.10.3 Dipole moment 5.11 Vander Waal's force and molecular solids	**9**	**5. Electrochemistry** 5.1 Electrode potential and standard electrode potential 5.2 Types of electrodes: Standard hydrogen electrode and calomel electrodes 5.3 Electrochemical series and its applications 5.4 Voltaic cell: Zn-Cu cell, Ag- Cu cell 5.5 Cell potential and standard cell potential 5.6 Relationship between cell potential and free energy 5.7 Commercial batteries and fuel cells (hydrogen/oxygen)	**7**

5.12 Hydrogen bonding and its application 5.13 Metallic bonding and properties of metallic solids			
6. Oxidation and Reduction 6.1 General and electronic concept of oxidation and reduction 6.2 Oxidation number and rules for assigning oxidation number 6.3 Balancing redox reactions by oxidation number and ion-electron (half reaction) method 6.4 Electrolysis 6.4.1 Qualitative aspect 6.4.2 Quantitative aspect(Faradays laws of electrolysis)	**5**	-	
7 States of Matter **7.1 Gaseous state** 7.1.1 Kinetic theory of gas and its postulates 7.1.2 Gas laws 7.1.2.1 Boyle's law and Charles' law 7.1.2.2 Avogadro's law 7.1.2.3 Combined gas equation 7.1.2.4 Dalton's law of partial pressure 7.1.2.5 Graham's law of diffusion 7.1.3 Ideal gas and ideal gas equation 7.1.4 Universal gas constant and its significance 7.1.5 Deviation of real gas from ideality (Solving related numerical problems based on gas laws)	**8**	-	

7.2 Liquid state 7.2.1 Physical properties of liquids 7.2.1.1 Evaporation and condensation 7.2.1.2 Vapour pressure and boiling point 7.2.1.3 Surface tension and viscosity (qualitative idea only) 7.2.2 Liquid crystals and their applications **7.3 Solid state** 7.3.1 Types of solids 7.3.2 Amorphous and crystalline solids 7.3.3 Efflorescent, Deliquescent and Hygroscopic solids 7.3.4 Crystallization and crystal growth 7.3.5 Water of crystallization 7.3.6 Introduction to unit crystal lattice and unit cell			
8. Chemical equilibrium 8.1 Physical and chemical equilibrium 8.2 Dynamic nature of chemical equilibrium 8.3 Law of mass action 8.4 Expression for equilibrium constant and its importance 8.5 Relationship between Kp and Kc 8.6 Le Chatelier's Principle (Numericals not required)	**3**	-	
Content Area: Inorganic Chemistry			
9. Chemistry of Non-metals **9.1 Hydrogen** 9.1.1 Chemistry of atomic and nascent hydrogen	**4**	**6. Transition Metals** 6.1 Introduction 6.1.1 Characteristics of transition metals 6.1.2 Oxidation states of transition	**5**

9.1.2 Isotopes of hydrogen and their uses 9.1.3 Application of hydrogen as fuel 9.1.4 Heavy water and its applications **9.2 Allotropes of Oxygen** 9.2.1 Definition of allotropy and examples 9.2.2 Oxygen: Types of oxides (acidic, basic, neutral, amphoteric, peroxide and mixed oxides) 9.2.3 Applications of hydrogen peroxide 9.2.4 Medical and industrial application of oxygen **9.3 Ozone** 9.3.1 Occurrence 9.3.2 Preparation of ozone from oxygen 9.3.3 Structure of ozone 9.3.4 Test for ozone 9.3.5 Ozone layer depletion (causes, effects and control measures) 9.3.6 Uses of ozone		metals 6.1.3 Complex ions and metal complexes 6.1.4 Shapes of complex ions 6.1.5 d-orbitals in complex ions (simple explanation by crystal field theory) for octahedral complex 6.1.6 Reasons for the colour of transition metal compounds 6.1.7 Catalytic properties of transition metals	
9.4 Nitrogen 9.4.1 Reason for inertness of nitrogen and active nitrogen 9.4.2 Chemical properties of ammonia [Action with $CuSO_4$ solution, water, $FeCl_3$ solution, Conc. HCl, Mercurous nitrate paper, O_2] 9.4.3 Applications of ammonia 9.4.4 Harmful effects of ammonia 9.4.5 Oxy-acids of nitrogen (name and formula) 9.4.6 Chemical properties of nitric acid [HNO_3 as an acid and oxidizing agent (action with zinc, magnesium, iron, copper, sulphur, carbon, SO_2 and H_2S) 9.4.7 Ring test for nitrate ion	**5**	**7. Studies of Heavy Metals** **7.1 Copper** 7.1.1 Occurrence and extraction of copper from copper pyrite 7.1.2 Properties (with air, acids, aqueous ammonia and metal ions) and uses of copper 7.1.3 Chemistry (preparation, properties and uses) of blue vitriol 7.1.4 Other compounds of copper (red oxide and black oxide of copper) formula and uses only **7.2 Zinc** 7.2.1 Occurrence and extraction of zinc from zinc blende 7.2.2 Properties (with air, acid, alkali, displacement reaction) and uses	**15**
9.5 Halogens	**5**		

9.5.1 General characteristics of halogens 9.5.2 Comparative study on preparation (no diagram and description is required), 9.5.2.1 Chemical properties [with water, alkali, ammonia, oxidizing character, bleaching action] and uses of halogens (Cl_2, Br_2 and I_2) 9.5.3 Test for Cl_2, Br_2 and I_2 9.5.4 Comparative study on preparation (no diagram and description is required), properties (reducing strength, acidic nature and solubility) and uses of haloacids (HCl, HBr and HI)		of zinc 7.2.3 Chemistry (preparation, properties and uses) of white vitriol **7.3 Mercury** 7.3.1 Occurrence and extraction of mercury from cinnabar 7.3.2 Properties of mercury 7.3.3 Chemistry (preparation, properties and uses) of calomel and corrosive sublimate **7.4 Iron** 7.4.1 Occurrence and extraction of iron 7.4.2 Properties and uses of iron 7.4.3 Manufacture of steel by Basic Oxygen Method and Open Hearth Process 7.4.4 Corrosion of iron and its prevention **7.5 Silver** 7.5.1 Occurrence and extraction of silver by cyanide process 7.5.2 Preparation and uses of silver chloride and silver nitrate	
9.6 Carbon 9.6.1 Allotropes of carbon (crystalline and amorphous) including fullerenes (structure, general properties and uses only) 9.6.2 Properties (reducing action, reaction with metals and nonmetals) and uses of carbon monoxide **9.7 Phosphorus** 9.7.1 Allotropes of phosphorus (name only) 9.7.2 Preparation (no diagram and description is required), properties (basic nature ,reducing nature , action with halogens and oxygen) and uses of phosphine	**3**		
9.8 Sulphur 9.8.1 Allotropes of sulphur (name only) and uses of sulphur 9.8.2 Hydrogen sulphide (preparation from Kipp's apparatus with diagram,) properties (Acidic nature, reducing nature, analytical reagent) and uses 9.8.3 Sulphur dioxide its properties (acidic nature, reducing nature,	**5**	-	

oxidising nature and bleaching action) and uses 9.8.4 Sulphuric acid and its properties (acidic nature, oxidising nature, dehydrating nature) and uses 9.8.5 Sodium thiosulphate (formula and uses)			
10 Chemistry of Metals **10.1 Metals and Metallurgical Principles** 10.1.1 Definition of metallurgy and its types (hydrometallurgy, pyrometallurgy, electrometallurgy) 10.1.2 Introduction of ores 10.1.3 Gangue or matrix, flux and slag, alloy and amalgam 10.1.4 General principles of extraction of metals (different processes involved in metallurgy) – concentration, calcination and roasting, smelting, carbon reduction, thermite and electrochemical reduction 10.1.5 Refining of metals (poling and electro-refinement)	**5**	**-**	
10.2 Alkali Metals 10.2.1 General characteristics of alkali metals 10.2.2 Sodium [extraction from Down's process, properties (action with Oxygen, water, acids nonmetals and ammonia) and uses] 10.2.3 Properties (precipitation reaction and action with carbon monooxide) and uses of sodium hydroxide 10.2.4 Properties (action with CO_2, SO_2, water, precipitation reactions) and uses of sodium carbonate 10.3 Alkaline Earth Metals 10.3.1 General characteristics of alkaline	**5**	**-**	

earth metals 10.3.2 Molecular formula and uses of (quick lime, bleaching powder, magnesia, plaster of paris and epsom salt) 10.3.3 Solubility of hydroxides, carbonates and sulphates of alkaline earth metals (general trend with explanation) 10.3.4 Stability of carbonate and nitrate of alkaline earth metals (general trend with explanation)			
11. Bio-inorganic Chemistry **11. Introduction to Bio-inorganic Chemistry** 11.1 Introduction 11.2 Micro and macro nutrients 11.3 Importance of metal ions in biological systems (ions of Na, K, Mg, Ca, Fe, Cu, Zn, Ni, Co, Cr) 11.4 Ion pumps (sodium-potassium and sodium-glucose pump) 11.5 Metal toxicity (toxicity due to iron, arsenic, mercury, lead and cadmium)	**3**	-	
Content Area: Organic Chemistry			
12 Basic Concept of Organic Chemistry 12.1 Introduction to organic chemistry and organic compounds 12.2 Reasons for the separate study of organic compounds from inorganic compounds 12.3 Tetra-covalency and catenation properties of carbon 12.4 Classification of organic compounds 12.5 Alkyl groups, functional groups and homologous series 12.6 Idea of structural formula,	**6**	**8. Haloalkanes** 8.1 Introduction 8.2 Nomenclature, isomerism and classification of monohaloalkanes 8.3 Preparation of monohaloalkanes from alkanes, alkenes and alcohols 8.4 Physical properties of monohaloalkanes 8.5 Chemical properties, substitution reactions SN1 and SN2 reactions (basic concept only) 8.6 Formation of alcohol, nitrile, amine, ether, thioether,	**8**

contracted formula and bond line structural formula 12.7 Preliminary idea of cracking and reforming, quality of gasoline, octane number, cetane number and gasoline additive		carbylamines, nitrite and nitro alkane using haloalkanes 8.7 Elimination reaction (dehydrohalogenation- Saytzeff's rule), Reduction reactions, Wurtz reaction 8.8 Preparation of trichloromethane from ethanol and propanone 8.9 Chemical properties of trichloromethane: oxidation, reduction, action on silver powder, conc. nitric acid, propanone, and aqueous alkali	
13 Fundamental Principles of Organic Chemistry 13.1 IUPAC Nomenclature of Organic Compounds (upto chain having 6-carbon atoms) 13.2 Qualitative analysis of organic compounds (detection of N, S and halogens by Lassaigne's test) 13.3 Isomerism in Organic Compounds 13.4 Definition and classification of isomerism 13.5 Structural isomerism and its types: chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism 13.6 Concept of geometrical isomerism (cis & trans) & optical isomerism (d & l form) **13.7 Preliminary Idea of Reaction Mechanism** 13.7.1 Homolytic and heterolytic fission 13.7.2 Electrophiles, nucleophiles and free- radicals 13.7.3 Inductive effect: +I and –I effect 13.7.4 Resonance effect: +R and –R effect	**10**	**9. Haloarenes** 9.1 Introduction 9.2 Nomenclature and isomerism of haloarenes 9.3 Preparation of chlorobenzene from benzene and benzene diazonium chloride 9.4 Physical properties 9.5 Chemical properties 9.5.1 Low reactivity of haloarenes as compared to haloalkanes in term of nucleophilic substitution reaction 9.5.2 Reduction of chlorobenzene 9.5.3 Electrophilic substitution reactions 9.5.4 Action with Na (Fittig and Wurtz- Fittig reaction) 9.5.5 Action with chloral 9.6 Uses of haloarenes	**3**
14. Hydrocarbons **14.1 Saturated Hydrocarbons**	**8**	**10. Alcohols** 10.1 Introduction	**7**

(Alkanes) 14.1.1 Alkanes: Preparation from haloalkanes (Reduction and Wurtz reaction), Decarboxylation, Catalytic hydrogenation of alkene and alkyne 14.1.2 Chemical properties: Substitution reactions (halogenation, nitration & sulphonation only), oxidation of ethane **14.2 Unsaturated hydrocarbons (Alkenes & Alkynes)** 14.2.1 Alkenes: Preparation by Dehydration of alcohol, Dehydrohalogenation, Catalytic hydrogenation of alkyne 14.2.1.1 Chemical properties: Addition reaction with HX (Markovnikov's addition and peroxide effect), H_2O, O_3, H_2SO_4 only **14.3 Alkynes: Preparation from carbon and hydrogen, 1,2 dibromoethane, chloroform/iodoform only** 14.3.1 Chemical properties: Addition reaction with (H_2, HX, H_2O), Acidic nature (action with Sodium, ammoniacal $AgNO_3$ and ammoniacal Cu_2Cl_2) **14.4 Test of unsaturation (ethene & ethyne): bromine water test and Baeyer's test** **14.5 Comparative studies of physical properties of alkane, alkene and alkyne** 14.6 Kolbe's electrolysis methods for the preparation of alkane, alkene and alkynes		10.2 Nomenclature, isomerism and classification of monohydric alcohol 10.3 Distinction of primary, secondary and tertiary alcohols by Victor Meyer's Method 10.4 Preparation of monohydric alcohols from Haloalkane, primary amines, and esters 10.5 Industrial preparation alcohol from: oxo process, hydroboration-oxidation of ethene & fermentation of sugar 10.6 Definition of common terms: Absolute alcohol, power alcohol, denatured alcohol (methylated spirit), rectified spirit; alcoholic beverage 10.7 Physical properties monohydric alcohols 10.8 Chemical properties of monohydric alcohols 10.8.1 Reaction with HX, PX_3, PCl_5, $SOCl_2$ 10.8.2 Action with reactive metals like Na, K, Li 10.8.3 Dehydration of alcohols 10.8.4 Oxidation of primary, secondary and tertiary alcohol with mild oxidizing agents like acidified $KMnO_4$ or $K_2Cr_2O_7$ 10.8.5 Catalyic dehydrogenation of 1^0 and 2^0 alcohol and dehydration of 3^0 alcohol 10.8.6 Esterification reaction 10.8.7 Test of ethanol	
15. Aromatic Hydrocarbons 15.1 Introduction and characteristics of aromatic compounds 15.2 Huckel's rule of aromaticity	**6**	**11. Phenols** 11.1 Introduction and nomenclature 11.2 Preparation of phenol from i. chlorobenzene ii. Diazonium salt and iii. benzene sulphonic acid	**4**

15.3 Kekule structure of benzene 15.4 Resonance and isomerism 15.5 Preparation of benzene from decarboxylation of sodium benzoate, phenol, and ethyne only 15.6 Physical properties of benzene 15.7 Chemical properties of benzene: Addition reaction: hydrogen, halogen, Electrophilic substitution reactions: orientation of benzene derivatives (o, m & p), nitration, sulphonation, halogenations, Friedal-Craft's reaction (alkylation and acylation), combustion of benzene (free combustion only) and uses		11.3 Physical properties of phenol 11.4 Chemical properties 11.4.1 Acidic nature of phenol (comparison with alcohol and water) 11.4.2 Action with NH_3, Zn, Na, benzene diazonium chloride and phthalic anhydride 11.4.3 Acylation reaction, Kolbe's reaction, Reimer-Tiemann's reaction 11.4.4 Electrophilic substitution: nitration, sulphonation, brominaiton and Friedal-Craft's alkylation 11.5 Test of phenol: ($FeCl_3$ test, aq. Bromine test & Libermann test) 11.6 Uses of phenol	
-		**12. Ethers** 12.1 Introduction 12.2 Nomenclature, classification and isomerism of ethers 12.3 Preparation of aliphatic and aromatic ethers from Williamson's synthesis 12.4 Physical properties of ether 12.5 Chemical properties of ethoxyethane: action with HI , Conc. HCl, Conc. H_2SO_4, air and Cl_2 12.6 Uses of ethers	**2**
-		**13. Aldehydes and Ketones** **13.1 Aliphatic aldehydes and ketones** 13.1.1 Introduction, nomenclature and isomerism 13.1.2 Preparation of aldehydes and ketones from: Dehydrogenation and oxidation of alcohol, Ozonolysis of alkenes, Acid chloride, Gem dihaloalkane,	**10**

		Catalytic hydration of alkynes 13.1.3 Physical properties of aldehydes and ketones 13.1.4 Chemical properties 13.1.4.1 Structure and nature of carbonyl group 13.1.4.2 Distinction between aldehyde and ketones by using 2,4- DNP reagent, Tollen's reagent, Fehling's solution 13.1.4.3 Addition reaction: addition of H2, HCN and $NaHSO_3$ 13.1.4.4 Action of aldehyde and ketone with ammonia derivatives; NH_2OH, NH_2-NH_2, phenyl hydrazine, semicarbazide, 13.1.4.5 Aldol condensation 13.1.4.6 Cannizzaro's reaction 13.1.4.7 Clemmensen's reduction 13.1.4.8 Wolf-Kishner reduction 13.1.4.9 Action with PCl_5 and action with $LiAlH_4$ 13.1.4.10 Action of methanal with ammonia and phenol 13.1.5 Formalin and its uses **13.2 Aromatic aldehydes and Ketones** 13.2.1 Preparation of benzaldehyde from toluene and acetophenone from benzene 13.2.2 Properties of benzaldehyde 13.2.2.1 Perkin condensation 13.2.2.2 Benzoin condensation 13.2.2.3 Cannizzaro's reaction 13.2.2.4 Electrophilic substitution reaction	
-		**14. Carboxylic Acid and its Derivaties** **14.1 Aliphatic and aromatic carboxylic acids**	**9**

		14.1.1 Introduction, nomenclature and isomerism 14.1.2 Preparation of monocarboxylic acids from: aldehydes, nitriles, dicarboxylic acid, sodium alkoxide and trihaloalkanes 14.1.3 Preparation of benzoic acid from alkyl benzene 14.1.4 Physical properties of monocarboxylic acids 14.1.5 Chemical properties: Action with alkalies, metal oxides, metal carbonates, metal bicarbonates, PCl_3, $LiAlH_4$ and dehydration of carboxylic acid 14.1.6 Hell-Volhard-Zelinsky reaction 14.1.7 Electrophilic substitution reaction of benzoic acid - bromination, nitration and sulphonation) 14.1.8 Effect of constituents on the acidic strength of carboxylic acid 14.1.9 Abnormal behaviour of methanoic acid **14.2 Derivatives of Carboxylic acids (acid halides, amides, esters and anhydrides)** 14.2.1 Preparation of acid derivatives from carboxylic acid 14.2.2 Comparative physical properties of acid derivatives 14.2.3 Comparative chemical properties of acid derivatives (hydrolysis, ammonolysis, amines (RNH_2), alcoholysis, and reduction only) 14.2.4 Claisen condensation 14.2.5 Hofmann bromamide reaction 14.2.6 Amphoteric nature of amide 14.2.7 Relative reactivity of acid derivatives	

-		**15. Nitro Compounds** **15.1 Nitroalkanes** 15.1.1 Introduction, nomenclature and isomerism 15.1.2 Preparation from haloalkane and alkane 15.1.3 Physical properties 15.1.4 Chemical properties: Reduction **15.2 Nitrobenzene** 15.2.1 Preparation from benzene 15.2.2 Physical properties 15.2.3 Chemical properties 15.2.4 Reduction in different media 15.2.5 Electrophilic substitution reactions (nitration, sulphonation & bromination) 15.2.6 Uses of nitro-compounds	**3**
-		**16. Amines** **16.1 Aliphatic amines** 16.1.1 Introduction, nomenclature, classification and isomerism 16.1.2 Separation of primary, secondary and tertiary amines by Hoffmann's method 16.1.3 Preparation of primary amines from haloalkane, nitriles, nitroalkanes and amides 16.1.4 Physical properties 16.1.5 Chemical properties: basicity of amines, comparative study of basic nature of 10, 20 and 30 amines 16.1.6 Reaction of primary amines with chloroform, conc. HCl, R-X, RCOX and nitrous acid ($NaNO_2$ / HCl) 16.1.7 Test of 10, 20 and 30 amines (nitrous acid test) **16.2 Aromatic amine (Aniline)**	**7**

		16.2.1 Preparation of aniline from nitrobenzene, phenol 16.2.2 Physical properties 16.2.3 Chemical properties: basicity of aniline, comparison of basic nature of aniline with aliphatic amines and ammonia, alkylation, acylation, diazotization, carbylamine and coupling reaction, electrophilic substitution: Nitration sulphonation and bromination 16.2.4 Uses of aniline	
-		**17. Organometallic Compounds** 17.1 Introduction, general formula and examples of organolithium, organocopper and organocadmium compounds 17.2 Nature of Metal-Carbon bond 17.3 Grignard reagent 17.3.1 Preparation (using haloalkane and haloarene) 17.3.2 Reaction of Grignard reagent with water, aldehydes and ketones (preparation of primary, secondary and tertiary alcohols), carbon dioxide, HCN, RCN, ester and acid chloride	**2**
Content Area: Applied Chemistry			
Unit: 16 Fundamentals of Applied Chemistry **16.1 Fundamentals of Applied Chemistry** 16.1.2 Chemical industry and its importance 16.1.3 Stages in producing a new product 16.1.4 Economics of production 16.1.5 Cash flow in the production cycle 16.1.6 Running a chemical plant	**4**	**18. Chemistry in the service of mankind** **18.1 Polymers** 18.1.1 Addition and condensation polymers 18.1.2 Elastomers and fibres 18.1.3 Natural and synthetic polymers 18.1.4 Some synthetic polymers (polythene, PVC, Teflon, polystyrene, nylon and bakelite **18.2 Dyes**	**4**

16.1.7 Designing a chemical plant 16.1.7 Continuous and batch processing 16.1.8 Environmental impact of the chemical industry		18.2.1 Introduction 18.2.2 Types of dyes on the basis of structure and method of application **18.3 Drugs** 18.3.1 Characteristics of drugs 18.3.2 Natural and synthetic drugs 18.3.3 Classification of some common drugs 18.3.4 Habit forming drugs and drug addiction **18.4 Pesticides** 18.4.1 Introduction to insecticides, herbicides and fungicides	
Unit: 17 Modern Chemical Manufactures **17.1 Modern Chemical Manufactures (principle and flow sheet diagram only)** 17.1.1 Manufacture of ammonia by Haber's process, 17.1.2 Manufacture of nitric acid by Ostwald's process, 17.1.3 Manufacture of sulphuric acid by contact process, 17.1.4 Manufacture of sodium hydroxide by Diaphragm Cell 17.1.5 Manufacture of sodium carbonate by ammonia soda or Solvay process **17.2 Fertilizers (Chemical fertilizers, types of chemical fertilizers, production of urea with flow-sheet diagram)**	**11**	**19. Cement** 19.1 Introduction 19.2 Raw materials for cement production 19.3 Main steps in cement production (crushing and grinding, strong heating and final grinding) 19.4 Types of cement- OPC and PPC 19.5 Portland cement process with flow-sheet diagram 19.6 Cement Industry in Nepal	**4**
-		**20. Paper and Pulp** 20.1 Introduction 20.2 Raw materials 20.3 Sources of raw materials 20.4 Stages in production of paper	**3**

		20.5 Flow-sheet diagram for paper production 20.6 Quality of paper	
-		**21 Nuclear Chemistry and Applications of Radioactivity** 21.1 Natural and artificial radioactivity 21.2 Units of radioactivity 21.3 Nuclear reactions 21.4 Nuclear fission and fusion reactions 21.5 Nuclear power and nuclear weapons 21.6 Industrial uses of radioactivity 21.7 Medical uses of radioactivity 21.8 Radiocarbon dating 21.9 Harmful effects of nuclear radiations	**2**
	128		**128**

5. Practical Portion **(32 Teaching hours)**

The practical work that students do during their course is aimed at providing them learning opportunities to accomplish competency of the curriculum as well as reinforcing their learning of the theoretical subject content. This part of the curriculum focuses more on skill development than knowledge building. Students must spend lots of time for working with chemical materials. Observations and investigations can enhance student learning. Project work may consist of activities designed to demonstrate the concepts and ideas through collecting, processing, analyzing and communicating data.

Students should learn to,

- collect and identify
- preserve
- dissect
- draw figure, chart, preparing models, slides etc
- handle the equipment, instruments and laboratory handling with experimentation
- draw conclusion

Students should perform at least 10 experiments, either listed below or designed by teacher, so that no more than three experiments come from the same categories mentioned below.

a) List of Experiments for grade 11

A. Experiments based on laboratory techniques:

1. To separate the insoluble component in pure and dry state from the given mixture of soluble and insoluble solids (NaCl, sand and camphor).
2. To separate a mixture of two soluble solids by fractional crystallization (KNO_3 + NaCl).
3. To prepare a saturated solution of impure salt and obtain the pure crystal of the same salt by crystallization.
4. To separate the component of a mixture of two insoluble solids (one being soluble in dil. acids).
5. To determine the number of water of crystallization of hydrated crystals.
6. To determine the volume occupied by 1 mole of hydrogen gas at NTP. (Wt of Mg = ...…g).
7. To obtain pure water from given sample of impure water (Distillation).

B. Experiments to study the different types of reactions (Neutralization, Precipitation, Redox reaction and Electrolysis):

8. To carry out the following chemical reactions, represent them in molecular as well as ionic forms and write the colour of the products formed:
    a. Ferrous sulphate solution + ammonia solution
    b. Ferric chloride solution + ammonia solution
    c. Copper sulphate solution + sodium hydroxide solution (heat the mixture)
    d. Copper sulphate solution + ammonia solution (add ammonia drop by drop at first and then excess)
    e. Ferric chloride solution + potassium ferrocyanide solution
    f. Ferrous sulphate solution + potassium ferricyanide solution
    g. Copper sulphate solution + potassium iodide solution
    h. Potassium chromate + silver nitrate solution
    i. Barium chloride solution + silver nitrate solution
    j. Dilute sulphuric acid + barium chloride solution
9. To perform precipitation reaction of $BaCl_2$and H_2SO_4 and obtain solid $BaSO_4$.
10. To neutralize sodium hydroxide with hydrochloric acid solution and recover the crystal of sodium chloride.
11. To test the ferrous ions in the given aqueous solution and oxidise it to ferric ion,

    (Ferrous and Ferric ion) (Redox Reaction)
12. To study the process of electrolysis and electroplating.

C. Experiments on quantitative analysis:

13. To determine the weight of given piece of Mg by hydrogen displacement method.
14. To determine the solubility of the given soluble solid at laboratory temperature.
15. To determine the relative surface tension of unknown liquid by drop count method.

16. To study the rate of flow of liquid through Ostwald's viscometer and determine the relative viscosity of unknown liquid.

17. To determine the molecular weight of given metal carbonate (M_2CO_3).

D. Experiments on preparation of gas and study of properties:

18. To prepare and collect hydrogen gas and study the following properties;

    a. Solubility with water, colour, odour;

    b. Litmus test;

    c. Burning match stick test; and

    d. Reducing properties of nascent hydrogen.

19. To prepare and collect ammonia gas and investigate the following properties:

    a. Solubility with water, colour and odour;

    b. Litmus test;

    c. Action with copper sulphate solution phenolphathalein solution

    d. Action with mercurous nitrate paper.

20. To prepare carbon dioxide gas and investigate the following properties:

    a. Solubility, colour and odour;

    b. Litmus paper test;

    c. Lime water test; and

    d. Action with burning magnesium ribbon.

21. To study the properties of hydrogen sulphide (physical, analytical and reducing).

22. To study the following properties of sulphuric acid:

    a. Solubility with water;

    b. Litmus paper test;

    c. Precipitating reaction; and

    d. Dehydrating reaction.

E. Experiments on qualitative analysis:

23. To detect the basic radical of the given salt by dry way and the acid radical by dry and wet ways in its aqueous solution.

    Basic radicals: Zn^{++}, Al^{+++}, Mg^{++}, Ca^{++} ,

    Acid radicals: CO_3^{--}, SO_4^{--}, NO_3^{-}, Br^{-}, I^{-}, Cl^{-}

24. To detect the presence of Cl^{-}, SO_4^{--} and CO_3^{--} in the given sample of tap water and distilled water.

b) List of Sample project works for grade 11

1. Observe in your surroundings (kitchen, school, shop, etc.) and make a possible list of organic and inorganic compounds. How are they different? Why is it necessary to study them separately, put your argument?

2. Study of the methods of purification of water.
3. Testing the hardness of drinking water from different sources and the study of cause of hardness.
4. Study of the acidity of different samples of the tea leaves.
5. Preparation of molecular models using stick and clay.
6. Study of adulteration of food materials.
7. Study of application and adverse effects of pesticides on human health.
8. Study of use and adverse effects of plastics on environment.
9. Analysis of soil samples. (elaboration need pH, humus content)
10. Investigation on corrosion and rusting on iron.
11. Comparison of ground and surface water quality of a given place-colour, odour, pH, conductivity, turbidity etc.
12. Design and development of water filter (Charcoal filter with sand can be designed and water quality can be monitored).

Note: Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the syllabus. However, repetition of topic should be discouraged.

c) List of experiments for grade 12

A. Experiments based on recovery and preparation of salt

1. To recover blue vitriol crystals from the given mixture of copper sulphate and sodium chloride.
2. To recover $CaCO_3$ from the mixture of $CaCO_3$ and $MgCO_3$ (dolomite).
3. To obtain hydrated calcium sulphate from the given marble chips.

B. Experiments based on volumetric analysis (Titration)

4. To prepare primary standard solution of Na_2CO_3 and standardize the given acid solution (HCl) by the standard solution.
5. To determine the strength of approximate $\frac{N}{10}$ NaOH solution with the help of standard decinormal solution of HCl supplied.
6. To determine the strength of bench sulphuric acid (H_2SO_4) with the help of standard NaOH or Na_2CO_3 solution and express the concentration in (i) normality (ii) molarity (iii) gm/litre (iv) percentage (Double titration).
7. To standardize the given approximate $\frac{N}{10}$ $KMnO_4$ solution with the help of primary standard oxalic solution (Redox titration).

C. Experiments based on organic chemistry:

8. To detect foreign elements present in a given organic compounds (N, S and X).
9. To identify the functional group present in the organic compounds (-OH, -COOH, –CHO, –CO–,–NH_2), and –COO–)

10. To test the presence of:

    a) Saturated or unsaturated fats b) Carbohydrates

    c) Proteins d) Phenol

D. Experiments based on thermochemistry:

11. To determine the enthalpy of neutralization of a strong acid and strong base.
12. To determine the molar enthalpy change of ammonium chloride solution

E. Experiments based on chemical kinetics:

13. To study the kinetics of the reaction between sodium thiosulphate and hydrochloric acid.
14. To study the kinetics of the reaction between propanone and iodine

F. Experiments based on salt analysis:

15. To perform complete salt analysis to detect the acid and basic radicals present in the given inorganic salt (at least three salt samples).

G. Experiments based on applied and analytical Chemistry:

16. To separate the components of ink by paper chromatography and determine the Rf values.
17. To determine the contents of acetic acid in the given volume of vinegar by titrimetric analysis.
18. To prepare some common compounds:

    a. Potash alum b. Iodoform c. Fehling's solution d. Tollen's reagent

19. To isolate hippuric acid from given sample of cow urine.
20. To demonstrate the pH value of unknown sample solutions.

d) List of sample project works for grade 12

1. Observe brick industry/chemical industry/old smooky cooking kitchen/use of chemical fertilizers/use of insecticides/ vehicular smokes, etc. and draw the conclusion of environmental impact of the chemical pollution.
2. Visit nearby paper industry if possible or consult e-media and observe the raw materials required, steps of manufacturing and quality endorsement of paper. Also, prepare a complete report.
3. Visit nearby cement industry if possible or consult e-media and observe the raw materials required, steps of manufacturing and quality endorsement of cement. Also, prepare a complete report.
4. Collect different brands of OPC and PPC cement and observe their setting duration.
5. Collect different types of plastics (or synthetic polymers) and study the effect of heat on them.
6. Extraction of essential oils from selected plants using Clevenger's apparatus.
7. Preparation of soap using coconut oil or any vegetable oil.
8. Study of quantity of casein present in different samples of milk.

9. Study of formation of rust in the iron nail in various conditions.
10. Study of the different types of food preservatives used in different food available in the market.
11. Study of common food adulterants in fat, oil, butter, sugar, turmeric powder, chilli powder and pepper.
12. Investigation on the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on them.
13. Study the acidic nature of alcohol and phenol.
14. Study the distinction between aliphatic aldehyde, aromatic aldehyde and aliphatic ketone.
15. Detect the presence of acetic acid in vinegar.
16. Study the nitrous acid test of primary, secondary and tertiary amines.
17. Study the different types of dyes.
18. Study the positive and negative effect of drugs.
19. Study the setting of cement.
20. Study the presence of pesticides residues in fruits and vegetables.
21. Test of protein in various foods.

Note: Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the syllabus. However, repetition of topic should be discouraged.

6. Learning Facilitation Process

Students should be facilitated to learn rather than just accumulation of information. Teacher plays vital role for delivering subject matters although others' role is also important. Student centered teaching-learning process is highly emphasized. Students are supposed to adopt multiple pathway of learning, such as online search, field visit, library work, laboratory work, individual and group work, research work etc. with the support of teacher. Self-study by students is highly encouraged and learning should not be confined to the scope of curriculum. Teacher should keep in mind intra and inter-disciplinary approach to teaching and learning, as opposed to compartmentalization of knowledge. Supportive role of parents/guardians in creating conducive environment for promoting the spirit of inquiry and creativity in students' learning is anticipated.

During the delivery process of science teaching in grade 11 and 12, basically following three approaches will be adopted;

a) Conceptual/Theoretical Approach

Possible theoretical methods of delivery may include the following;

a. lecture
b. interaction
c. question answer
d. demonstrations
e. ICT based instructions
f. cooperative learning
g. group discussions (satellite learning group, peer group, small and large group)
h. debate
i. seminar presentation
j. Journal publishing
k. daily assignment

b) Practical/Application/Experimental approach

Practical work is the integral part of the learning science. The process of lab based practical work comprises as;

a. familiarity with objective of practical work
b. familiarity with materials, chemicals, apparatus
c. familiarity with lab process (safety, working modality etc.)
d. conduction of practical work (systematically following the given instruction)
e. analysis, interpretation and drawing conclusion

c) Project work Approach

Project work is an integral part of the science learning. Students should be involved in project work to foster self-learning of students in the both theoretical and practical contents. Students will complete project work to have practical idea through learning by doing approach and able to connect the theory into the real world context. It is regarded as method/ process of learning rather than content itself. So use of project work method to facilitate any appropriate contents of this curriculum is highly encouraged.

In this approach student will conduct at least one **research work, or an innovative work** under the guidance of teacher, using the knowledge and skills learnt. It could include any of the followings;

(a) Mini research
(b) Survey
(c) Model construction
(d) Paper based work
(e) Study of ethno-science

General process of research work embraces the following steps;

a. Understanding the objective of the research
b. Planning and designing
c. Collecting information
d. Analysis and interpretation
e. Reporting /communicating (presentation, via visual aids, written report, graphical etc.)

General process of innovative work embraces the following steps;

a. Identification of innovative task (either assigned by teacher or proposed by student)
b. Planning
c. Performing the task
d. Presentation of the work
e. Record keeping of the work

Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the Curriculum. However, repetition of topic should be discouraged.

Learning process matrix

Knowledge and understanding	Scientific skills and process	Values, attitudes and application to daily life
• Scientific phenomenon, facts, definition, principles, theory, concepts and new discoveries • Scientific vocabulary, glossary and terminology • Scientific tools, devises, instruments apparatus • Techniques of uses of scientific instruments with safety • Scientific and technological applications	• Basic and integrated scientific process skills <u>Process</u> • Investigation • Creative thinking • problem solving	• Responsible • Spending time for investigation

Basic Science Process Skills includes,

1. Observing: using senses to gather information about an object or event. It is description of what was actually perceived.
2. Measuring: comparing unknown physical quantity with known quantity (standard unit) of same type.
3. Inferring: formulating assumptions or possible explanations based upon observations.
4. Classifying: grouping or ordering objects or events into categories based upon characteristics or defined criteria.

5. Predicting: guessing the most likely outcome of a future event based upon a pattern of evidence.
6. Communicating: using words, symbols, or graphics to describe an object, action or event.

Integrated Science Process Skills includes,

1. Formulating hypotheses: determination of the proposed solutions or expected outcomes for experiments. These proposed solutions to a problem must be testable.
2. Identifying of variables: Identification of the changeable factors (independent and dependent variables) that can affect an experiment.
3. Defining variables operationally: explaining how to measure a variable in an experiment.
4. Describing relationships between variables**:** explaining relationships between variables in an experiment such as between the independent and dependent variables.
5. Designing investigations: designing an experiment by identifying materials and describing appropriate steps in a procedure to test a hypothesis.
6. Experimenting: carrying out an experiment by carefully following directions of the procedure so the results can be verified by repeating the procedure several times.
7. Acquiring data: collecting qualitative and quantitative data as observations and measurements.
8. Organizing data in tables and graphs: presenting collected data in tables and graphs.
9. Analyzing investigations and their data: interpreting data, identifying errors, evaluating the hypothesis, formulating conclusions, and recommending further testing where necessary.
10. Understanding cause and effect relationships: understanding what caused what to happen and why.
11. Formulating models: recognizing patterns in data and making comparisons to familiar objects or ideas.

7. Student Assessment

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Out of 100 full marks Internal evaluation covers 25 marks. Internal evaluation consists of Practical work (16 marks), (b) Marks from trimester examinations (6 marks), and (c) Classroom participation (3 marks)

- **Practical Activities**

Practical works and project works should be based on list of activities mentioned in this curriculum or designed by teacher. Mark distribution for practical work and project work will be as follows:

S. N.	Criteria	Elaboration of criteria	Marks
1.	Laboratory experiment	Correctness of apparatus setup/preparation	2
		Observation/Experimentation	2
		Tabulation	1
		Data processing and Analysis	1
		Conclusion (Value of constants or prediction with justification)	1
		Handling of errors/precaution	1
2.	Viva-voce	Understanding of objective of the experiment	1
		Skills of the handling of apparatus in use	1
		Overall impression	1
3.	Practical work records and attendance	Records (number and quality)	2
4	Project work	Reports (background, objective, methodology, finding, conclusion	2
		Presentation	1
		Total	**16**

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of laboratory experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

- **Marks from trimester examinations**

Total of 6 marks, 3 marks from each trimester.

- **Classroom participation (3 marks)**

Classroom participation includes attendance (1) and participation in learning (2).

(b) External Evaluation

Out of 100 marks theoretical evaluation covers 75 marks. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (such as analyzing, evaluating, creating).

Secondary Education Curriculum
2076
Biology

Grades: 11 and 12 **Subject code:** Bio. 201 **(Grade 11),** Bio. 202 **(Grade 12)**

Credit hrs: 5 **Working hrs: 160**

1. Introduction

This curriculum presumes that the students joining grade 11 and 12 science stream come with diverse aspirations, some may continue to higher level studies in specific areas of science, others may join technical and vocational areas or even other streams. The curriculum is designed to provide students with general understanding of the fundamental scientific laws and principles that govern the scientific phenomena in the world. It focuses to develop scientific knowledge, skill competences and attitudes required at secondary level (grade 11 and 12) irrespective of what they do beyond this level, as envisioned by national goals. Understanding of scientific concepts and their application, in day to day context as well as the process of obtaining new knowledge through holistic approach of learning in the spirit of national qualification framework is emphasized in the curriculum.

In particular, the curriculum aims to provide sufficient knowledge and understanding of science for all learners to recognize the usefulness, and limitations, of laws and principles of biology, and use them in daily lives providing a sound foundation for students who wish to study biology or related professional or vocational courses in higher education. It helps to strengthen science process skills that are relevant to the study and application of biological science in daily life. It also provides opportunity for the learners who have deeper interest in the subject to delve into the more advanced contents so that the study of biology becomes enjoyable and satisfying to all. Moreover, it helps the students to build up capacity to identify, gather, manipulate and process information in the context of scientific endeavors including field investigations in various formats on biological issues.

The curriculum prepared in accordance with National Curriculum Framework is structured for two academic years in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Level-wise competencies

In completion of this course, students are expected to demonstrate the following competencies:

1. relate natural and biological phenomena in the scientific manner of knowledge, understanding and investigating problems pertaining to the living world
2. use scientific instruments, apparatus and methods to collect, evaluate and communicate information accurately and precisely with biological reasoning

3. use their practical and problem-solving skills in different disciplines of biology, including those in medical, veterinary, food, agriculture, biotechnology, biosecurity, quarantine, conservation and eco-tourism and so on
4. carryout simple experiment, simple scientific research on issues related to biological phenomena
5. apply biological concepts as well as general science knowledge and skills for the wise use of the available natural resources to promote care for the environment, indigenous knowledge, social values and ethics and overall development
6. develop new biotechnological concepts and use of technology in living world.

3. Grade-wise learning outcomes

Grade 11	Grade 12
Part A : Botany	
1. Biomolecules & Cell Biology (15) 1.1 Describe the structure and functions of biomolecules. 1.2 Differentiate between prokaryotic and eukaryotic cell. 1.3 Explain structure and functions of cell organelles 1.4 Analyze the cell cycle and types of cell division with significances. 1.5 Demonstrate an understanding of the basic processes of cellular biology.	**1. Plant Anatomy (8)** 1.1 Explain about the concept of tissues 1.2 Classify types of plant tissues 1.3 Expalin about anatomical structure of root, stem and leaf of monocot and dicot plants. 1.4 Define meaning and mechanism about secondary growth of dicot stem. 1.5 Investigate the structures and functions of plant tissues, and factors affecting plant growth; 1.6 Demonstrate an understanding of the diversity of vascular plants, including their structures, internal transport systems, and their role in maintaining biodiversity.
2. Floral Diversity (30) 2.1 Demonstrate an understanding of the diversity of living organisms in terms of the principles of taxonomy and phylogeny. 2.2 Investigate, through laboratory and/or field activities or through simulations, the principles of scientific classification using appropriate sampling and classification techniques; 2.3 Explain three domains of life, system of	**2. Plant Physiology (20)** 2.1 Describe the terms diffusion, osmosis, and plasmolysis, ascent of sap, transpiration and guttation with significances 2.2 Define photosynthesis and explain about pigments, mechanism of photosynthesis, C_3 and C_4 plant as well as factors affecting photosynthesis. 2.3 Explain about respiration, types of respiration and mechanism as well as

classification and status of flora of Nepal. 2.4 Classify fungi upto different classes. 2.5 Explain the structure and reproduction of Mucor and yeast. 2.6 Distinguish between poisonous and nonpoisonous mushroom 2.7 Describe the economic importance of fungi. 2.8 Explain characteristic features and economic importance of lichen. 2.9 Classify algae into different groups with basic characters 2.10 Explain the structure and reproduction of Spirogyra. 2.11 Describe economic importance of algae. 2.12 Classify bryophytes into different groups with basic characters 2.13 Explain the structure and reproduction of Marchantia. 2.14 Describe economic importance of bryophytes. 2.15 Explain introduction and characteristics features of pteridophytes. 2.16 Explain the structure and reproduction of Dryopteris. 2.17 Describe economic importance of pteridophytes. 2.18 Explain introduction and characteristics features of Gymnosperms 2.19 Explain the structure and reproduction of Pinus. 2.20 Describe economic importance of gymnosperm. 2.21 Describe the morphology of root, stem, leaves, inflorescences, flowers and fruit 2.22 Define taxonomy and classification system 2.23 Describe the families -Brassicaceae, Fabaceae, Solanaceae, and Liliaceae in taxonomic term with economic	factors affecting respiration. 2.4 Define phytohormone and physiological role of auxins, gibberellins and Cytokinins. 2.5 Describe the terms seed germination, dormancy, photoperiodism, vernalization, senescence; plant movements. 2.6 Analyse the role of metabolic processes in the functioning of biotic and abiotic systems, and evaluate the importance of an understanding of these processes and related technologies to personal choices made in everyday life; 2.7 Investigate the products of metabolic processes such as cellular respiration and photosynthesis; 2.8 Demonstrate an understanding of the chemical changes and energy conversions that occur in metabolic processes.

importance. 2.24 Analyze the effects of various human activities on the diversity of plants.	
3. Introductory Microbiology (5) 3.1 Explain structure, mode of nutrition and growth of bacteria as well as cyanobacteria (blue green algae). 3.2 Explain introduction, structure and importance of virus. 3.3 Demonstrate an understanding of the diversity of microorganisms (Bacteria and Virus) and the relationships that exist between them. 3.4 Assess the effects of microorganisms (Bacteria and Virus) in the environment, and analyze ethical issues related to their use in biotechnology;	**3. Genetics (21)** 3.1 Define genetics, genetic material and their composition. 3.2 Draw the structure of DNA and RNA 3.3 Describe the mechanism of DNA replication 3.4 Define genetic code 3.5 Describe the terminology of genetics, Mendel experiment as well as complete and incomplete dominance. 3.6 Explain about linkage, distinguish between complete and incomplete linkage, sex linked inheritance with reference of Drosophila, crossing over and its significances. 3.7 Describe about mutation, its importance as well as the concept of polyploidy. 3.8 Evaluate the importance of some recent contributions to our knowledge of genetic processes, and analyse social and ethical implications of genetic and genomic research; 3.9 Investigate genetic processes, including those that occur during meiosis, and analyse data to solve basic genetics problems involving monohybrid and dihybrid crosses; 3.10 Demonstrate an understanding of concepts, processes, and technologies related to the transmission of hereditary characteristics.
4. Ecology (11) 4.1 Define ecology, ecological factors and structural and functional concept of ecosystem. 4.2 Explain the concept of food chain, food web and ecological pyramid.	**4. Embryology (8)** 4.1 Explain about sexual and asexual reproduction of angiosperms, pollination and fertilization process. 4.2 Describe the developmental process of male and female gametophyte

4.3 Explain the term trophic level, productivity. 4.4 Explain the process of bio-geochemical cycle and succession. 4.5 Define adaptation, hydrophytes and xerophytes. 4.6 Define greenhouse effect, ozone layer, acid rain and biological invasion 4.7 Explain and illustrate with examples how living systems interact with the biotic and abiotic environment 4.8 Analyse and investigate the roles of plants in ecosystems, and assess the impact of human activities on the balance of nature within those ecosystems;	4.3 Demonstrate developmental process of dicot and monocot embryos. 4.4 Describe an endosperm and importance.
5. Vegetation (3) 5.1 Describe the vegetation types of Nepal 5.2 Illustrate the concept of In-situ (protected areas) and Ex-situ (botanical garden, seed bank) conservation with examples 5.3 Demonstrate an understanding of the structure and physiology of plants and their role in the natural environment.	**5. Biotechnology (7)** 5.1 Define biotechnology, tissue culture, plant breeding, disease resistance plant, green manure and bio-fertilizer. 5.2 Analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology; 5.3 Investigate, through laboratory activities, the structures of cell components and their roles in processes that occur within the cell; 5.4 Demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture.
Part B : Zoology	
6. Introduction to Biology (2) 6.1 Describe the importance and scope of biology 6.2 Analyze biology and its relation with other sciences	**6. Animal Tissues (8)** 6.1 Describe the types of animal tissues: epithelial, connective, muscular and nervous and their functions and how is that function associated with the features of the tissue. 6.2 Describe structure, functions & location of different sub-types of four main animal tissues. 6.3 Describe the nervous tissue with their structures and functions.

	6.4 Explain what type of tissue composes cartilage and bones. 6.5 Explain the structure of a striated muscle. 6.6 Discuss the structure of a neuron.
7. Evolutionary Biology (15) 7.1 Explain different theories for origin of life. 7.2 State and explain evolution as the process of biological change over time with biological evidences and theories of evolution. 7.3 Describe and explain the evolution of modern man from anthropoid ancestor. 7.4 Investigate evolutionary processes, and analyze scientific evidence that supports the theory of evolution; 7.5 Demonstrate an understanding of the theory of evolution, the evidence that supports it, and some of the mechanisms by which it occurs.	**7. Developmental Biology (6)** 7.1 Define and explain the process of spermatogenesis & oogenesis. 7.2 State the biochemical changes taking place during fertilization of frog. 7.3 Describe the development of frog up to formation of three germ layers. 7.4 Discuss the importance of gastrulation in frog's egg. 7.5 Explain the effects of yolk on gastrulation in the development of frog. 7.6 Explain the formation of notochord, nerve cord and coelom in the development of frog.
8. Faunal Diversity (34) 8.1 Understand protista and classify Protozoa upto class with examples and characteristic features. 8.2 Explain the habits and habitat, structure, reproduction, life-cycle and economic importance of Paramecium caudatum, Plasmodium vivax and P. falciparum. 8.3 Explain level of organization, body plan, body symmetry, body cavity and segmentation in animals. 8.4 Give the diagnostic features and classify different phyla (up to class) with examples. 8.5 Describe the morphology, different systems and physiological processes of earthworm and frog. 8.6 Investigate, through laboratory and/or field activities or through simulations, the principles of scientific classification, using appropriate sampling and classification techniques;	**8. Human Biology (28)** 8.1 Describe alimentary canal and digestive glands of human and discuss physiology of digestion. 8.2 Explain how digestion is completed in small intestine. 8.3 Discuss the role of salivary glands, liver and pancreas in digestion of food. 8.4 Explain respiratory organs and respiratory mechanism in human. 8.5 Explain the exchange of gases, transport of gases and regulation of respiration. 8.6 Explain how CO2 is transported from tissues to lungs. 8.7 Describe the exchange of gases that take place between the alveolus and blood capillary. 8.8 Explain how hemoglobin is

		associated with respiration.
	8.9	Define double circulation and describe the structure of human heart.
	8.10	Explain origin and conduction of heart beat, cardiac cycle, cardiac output
	8.11	Describe the arterial and venous systems (major arteries and veins) in human.
	8.12	State blood grouping and blood pressure.
	8.13	Mention briefly the modes of excretion.
	8.14	Describe the excretory organs and discuss the process of urine formation in human.
	8.15	Mention the types of nervous system
	8.16	Give the structure and function of human brain
	8.17	Discuss how nerve impulse travels in and across an axon.
	8.18	Describe the structure and functions of various parts of human eye and ear.
	8.19	Differentiate between exocrine and endocrine glands.
	8.20	Differentiate between hormones and enzymes.
	8.21	Describe the various endocrine glands, their location, structure, hormones secreted and their functions.
	8.22	Mention the disorders/diseases caused by deficiency or over-secretion of various hormones.
	8.23	Describe male and female reproductive organs.
	8.24	Explain various stages of the ovarian cycle.
	8.25	Explain that the ovarian cycle governs the preparation of endocrine tissues and release of eggs,

		while the menstrual cycle governs the preparation and maintenance of the uterine lining. These cycles occur concurrently and are coordinated over a 22–32 day cycle, with an average length of 28 days.
	8.26	Analyse the social or economic impact of a technology used to treat systems in the human body, and the impact of lifestyle choices on human health;
	8.27	Investigate, through laboratory inquiry or computer simulation, the anatomy, physiology, and response mechanisms of mammals;
	8.28	Demonstrate an understanding of the structure, function, and interactions of the circulatory, digestive, and respiratory systems of mammals.
	8.29	Evaluate the impact on the human body of selected chemical substances and of environmental factors related to human activity;
	8.30	Investigate the feedback mechanisms that maintain homeostasis in living organisms;
	8.31	Demonstrate an understanding of the anatomy and physiology of human body systems, and explain the mechanisms that enable the body to maintain homeostasis.
	8.32	Analyse the relationships between changing societal needs, technological advances, and our understanding of internal systems of humans;
	8.33	Investigate, through laboratory inquiry or computer simulation, the functional responses of the respiratory and circulatory systems of animals, and the relationships between their respiratory, circulatory, and digestive systems;
	8.34	Demonstrate an understanding of animal anatomy and physiology, and

	describe disorders of the respiratory, circulatory, and digestive systems.
9. Biota and Environment (10) 9.1 Define and explain different types of adaptations in animals 9.2 Identify different types of animal behavior and explain reflex action, taxes, dominance and leadership. 9.3 State and explain migration in fish and birds 9.4 Analyze air, water and soil pollution, its causes, effects and find out the ways out to protect oneself and the environment from the adverse effects of these pollution 9.5 Analyze the pesticides & their effects on environment.	**9. Human Population and Health Disorders (6)** 9.1 List various reasons for human population growth and how can it be controlled. 9.2 Explain human population growth curve 9.3 Describe in brief demographic cycle. 9.4 Explain in brief cardiovascular, respiratory & renal disorders common in Nepal. 9.5 Explain substance abuse: drug, alcohol and smoking abuse. 9.6 Analyse the relationships between population growth, personal consumption, technological development, and our ecological footprint, and assess the effectiveness of some Canadian initiatives intended to assist expanding populations; 9.7 Investigate the characteristics of population growth, and use models to calculate the growth of populations within an ecosystem; 9.8 Demonstrate an understanding of concepts related to population growth, and explain the factors that affect the growth of various populations of species.
10. Conservation Biology (3) 10.1 State the concept and importance of biodiversity to maintain viable ecosystems and identify its causes of extinction and its effect for human beings. 10.2 Find out the ways of biodiversity conservation focusing on wildlife, national parks, conservation areas, biodiversity hotspots, wetland and Ramsar sites 10.3 Explain IUCN Red list categories and discuss endangered species in Nepal.	**10. Applied Biology (16)** 10.1 Explain tissue and organs transplantation. Organs that have been successfully transplanted are the heart, kidneys, brain, liver, lungs, pancreas, intestine, and thymus. Tissues include bones, tendons (both referred to as musculoskeletal grafts), corneae, skin, heart valves, nerves and veins. 10.2 Explain in-vitro fertilization (IVF), which is an assisted reproductive technology (ART).

	10.3	Explain amniocentesis, (also referred to as amniotic fluid test or AFT) which is a medical procedure used in prenatal diagnosis of chromosomal abnormalities and fetal infections, and also for sex determination.
	10.4	Describe genetically modified organisms (transgenic animals). These animals (most commonly mice) that have had a foreign gene deliberately inserted into their genome.
	10.5	Describe poultry farming and fish farming and their prospects in Nepal.
	10.6	Enumerate risk and hazard group of microorganisms.
	10.7	
	10.8	Write introduction, causative agents, symptoms, prevention and control measures of selected human diseases: typhoid, tuberculosis and HIV infection, cholera, influenza, hepatitis, candidiasis.
	10.9	Explain basic concepts of immunology–vaccines.
	10.10	Enumerate the application of microorganisms in dairy and beverage industries, microbial contamination of water, sewage and drinking water treatment, bio-control agents and bio-fertilizers.
	10.11	Analyse technological applications of enzymes in some industrial processes, and evaluate technological advances in the field of cellular biology;
	10.12	Investigate the chemical structures, functions, and chemical properties of biological molecules involved in some common cellular processes and biochemical reactions;
	10.13	Demonstrate an understanding of the structures and functions of biological molecules, and the biochemical reactions required to maintain normal

	cellular function. 10.14 Evaluate some social, ethical, and environmental implications of genetic research and related technologies; 10.15 Investigate the process of meiosis, and analyse data related to the laws of heredity; 10.16 Demonstrate an understanding of the process of meiosis, and explain the role of genes in the transmission of hereditary characteristics

4. Scope and Sequence of Contents

Grade 11		Grade 12	
Contents	**T H**	**Contents**	**T H**
Part A: Botany			
1. Biomolecules & Cell Biology 1.1 **Biomolecules:** Introduction and functions of: carbohydrates, proteins, lipids, nucleic acids, minerals, enzymes and water. **1.2 Cell:** Introduction of cell, concepts of prokaryotic and eukaryotic cells, detail structure of eukaryotic cells (composition, structure and functions of cell wall, cell membrane, mitochondria, plastids, endoplasmic reticulum, golgi bodies, lysosomes, ribosomes, nucleus, chromosomes, cilia, flagella and cell inclusions. **1.3 Cell division :** Concept of cell cycle, types of cell division (amitosis, mitosis and meiosis) and significances	**4** **8** **3**	**1. Plant Anatomy** **1.1 Plant anatomy:** Concept of tissues, types of plant tissues (meristems and permanent tissues), Anatomy of dicot and monocot root, stem and leaf Secondary growth of dicot stem.	**8**
2. Floral Diversity **2.1 Introduction:** Three domains of life, binomial nomenclature, five kingdom classification system (Monera, Protista, Fungi, Plantae and Animalia); status of flora in Nepal and world representation **2.2 Fungi:** General introduction and characteristic features of phycomycetes, ascomycetes, basidiomycetes and	1 3	**2. Plant Physiology** **2.1 Water relation**: Introduction and significance of - diffusion, osmosis, and plasmolysis, ascent of sap, transpiration and guttation. **2.2 Photosynthesis:** Introduction and	**4** 5

deuteromycetes; structure and Reproduction of *Mucor* and Yeast, introduction of Mushrooms, poisonous and non-poisonous mushrooms, economic importance of fungi. **2.3 Lichen:** General introduction, characteristic features and economic importance of lichen **2.4 Algae:** General introduction and characteristic feature of green, brown and red algae; structure and reproduction of *Spirogyra*. Economic importance of algae **2.5 Bryophyta:** General introduction and characteristic features of liverworts, hornworts and moss; morphological structure and reproduction of *Marchantia*. Economic importance of bryophytes **2.6 Pteridophyta:** General introduction and characteristic features of pteridophytes; morphological structure and reproduction of *Dryopteris*. Economic importance of pteridophytes **2.7 Gymnosperm:** General introduction and characteristic features of Gymnosperms; morphology and reproduction of *Pinus*. Economic importance of gymnosperm **2.8 Angiosperm:** Morphology (root, stem, leaves, inflorescences, flowers and fruit); Taxonomic study: Definition, taxonomic hierarchy, classification systems (artificial, natural and phylogenetic) of angiosperms, taxonomic description of the families – Brassicaceae, Fabaceae, Solanaceae, and Liliaceae with economic importance	1 2 2 2 3 16	significance of photosynthesis, photosynthetic pigments, mechanism of photosynthesis (photochemical phase and Calvin-Benson cycle), C_3 and C_4 plants, photorespiration, factors affecting photosynthesis. **2.3 Respiration:** Introduction and significance of respiration, types of respiration, mechanism of respiration (glycolysis, Kreb cycle, electron transport system), factors affecting respiration. **2.4 Plant hormones:** Introduction, physiological effects of auxins, gibberellins and Cytokinins. **2.5 Plant growth and movement:** Concept on seed germination, dormancy, photoperiodism, vernalization, senescence; plant movements (tropic and nastic).	5 3 3
3. Introductory Microbiology **3.1 Monera:** General introduction, structure of bacterial cell, mode of nutrition, bacterial growth; cyanobacteria (blue green algae). **3.2 Virus:** General introduction, structure and importance of virus, bacteriophage **3**.3 Impacts of biotechnology in the field of microbiology.	3 1 1	**3. Genetics** **3.1 Genetic Materials:** Introduction to genetics and genetic materials, composition, structure and function of DNA and RNA, DNA replication, introduction of genetic code. **3.2 Mendelian genetics:** General terminology, Mendel's experiment and	5 6 5

		laws of inheritance, gene interactions (incomplete dominance, co-dominance). **3.3 Linkage and crossing over:** Concept and types of linkage (complete and incomplete), sex-linked inheritance (colour blindness in man and eye colour of *Drosophila*), concept and significances of crossing over. **3.4 Mutation and polyploidy:** Concept, type (gene and chromosomal mutation), importance of mutation (positive and negative), polyploidy (origin and significance).	5
4. Ecology **4.1 Ecosystem ecology: C**oncept of ecology, biotic and abiotic factors, species interactions; concept of ecosystem, structural and functional aspects of pond and forest ecosystem, food chain, food web, trophic level, ecological pyramids, productivity, biogeochemical cycle - carbon and nitrogen cycles, concept of succession. **4.2 Ecological Adaptation:** Concept of adaptation, hydrophytes and xerophytes. **4.3 Ecological Imbalances:** Green house effects and climate change, depletion of ozone layer, acid rain and biological invasion.	7 2 2	**4. Embryology:** Asexual and sexual reproductions in angiosperms, pollination, fertilization, development of male and female gametophytes, development of dicot and monocot embryos, concept of endosperm	8
5. Vegetation a. Vegetation: Introduction, types of vegetation in Nepal, concept of *In-situ* (protected areas) and *Ex-situ* (botanical garden, seed bank) conservation. Natural environment-vegetation and human activities	2 1	**5. Biotechnology:** Introduction, tissue culture, plant breeding, disease resistance plants, green manure and bio-fertilizer, bio-pesticide, genetic engineering and GMOs (genetically modified organisms) and	7

		application, bio-engineering, food safety and food security.	
Part B: Zoology			
6. Introduction to Biology **6.1 Introduction to Biology:** Scope and fields of biology. Relation with other science.	1	**6. Animal Tissues** **6.1 Animal Tissues:** Introduction; Types of animal tissues: epithelial, connective, muscular and nervous (structure, functions & location of different sub-types).	8
7. Evolutionary Biology **7.1 Life and its Origin:** Oparin-Haldane theory, Miller and Urey's experiment. **7.2 Evidences of evolution**: Morphological, Anatomical, Paleontological, Embryological and Biochemical. **7.3 Theories of evolution:** Lamarckism, Darwinism & concept of Neo Darwinism. **7.4 Human evolution:** Position of man in animal kingdom. Differences between new world monkeys & old world monkeys, apes & man. Evolution of modern man starting from anthropoid ancestor.	2 5 3 5	**7. Developmental Biology** **7.1 Gametogenesis:** Spermatogenesis & Oogenesis. **7.2 Development of frog:** Fertilization & its effects, cleavage, morulation, blastulation, gastrulation, organogenesis – formation of notochord, nerve cord & coelom.	 2 4
8. Faunal Diversity **8.1 Protista**: Outline classification. Protozoa: diagnostic features and classification up to class with examples; *Paramecium caudatum, Plasmodium vivax* - habits and habitat, structure, reproduction, life-cycle and economic importance of *P. falciparum*. **8.2 Animalia:** Level of organization, body plan, body symmetry, body cavity and segmentation in animals. Diagnostic features and classification of the following phyla (up to class) with examples:Porifera, Coelenterata (Cnidaria), Platyhelminthes, Aschelminthes (Nemathelminthes), Annelida, Arthropoda, Mollusca,	4 10 10	**8. Human Biology** **8.1 Digestive system:** Alimentary canal and digestive glands, physiology of digestion. **8.2 Respiratory System:** Respiratory organs, respiratory mechanism - exchange of gases, transport of gases and regulation of respiration. **8.3 Circulatory System:** Double circulation (concept), heart (structure	 **2** **2** **4**

Echinodermata and Chordata. **Earthworm** (*Pheretima posthuma*): Habit and habitat, External features; Digestive system (alimentary canal & physiology of digestion), Excretory system (types of nephridia, structure and arrangement of septal nephridia), Nervous system (central & peripheral nervous system, working mechanism) & Reproductive systems (male & female reproductive organs), Copulation, Cocoon formation and Economic importance. **Frog** (*Rana tigrina*): Habit and habitat, External features, Digestive system (alimentary canal, digestive glands & physiology of digestion), Blood vascular system (structure & working mechanism of heart), Respiratory system (respiratory organs & physiology of respiration) and Reproductive system (male & female reproductive organs).	10	and working mechanism), origin and conduction of heart beat, cardiac cycle, cardiac output, arterial and venous systems (major arteries and veins), blood grouping, blood pressure. **8.4 Excretory System:** Concept of modes of excretion (ammonotelism, ureotelism, uricotelism), Excretory organs, mechanism of urine formation. **8.5 Nervous system:** Types of nervous system (central, peripheral & autonomous), structure and function of brain, Origin and conduction of nerve impulse. **8.6 Sense organs:** Structure and functions of eye and ear. **8.7 Endocrinology:** Endocrine glands and hormones – structure & functions of hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads; hypo- and hyper-activity and related disorders. **8.8 Reproductive System:** Male and female reproductive organs, ovarian & menstrual cycle.	**3** **3** **2** **9** **3**
9. Biota and Environment **9.1 Animal adaptation:** Aquatic (Primary & Secondary), Terrestrial (Cursorial, Fossorial & Arboreal) and Volant adaptation. **9.2 Animal behavior:** Reflex action, taxes, dominance and leadership. Fish and bird Migration.	3 4 3	**9. Human Population and Health Disorders** **9.1 Human Population:** Growth problem and control strategies, Concept of demographic cycle. **9.2 Health disorders:** Concept	2 4

9.3 Environmental Pollution: Sources, effects and control measures of air, water and soil pollution. Pesticides & their effects.		of cardiovascular, respiratory & renal disorders; Substance abuse: Drug, alcohol and smoking abuse.	
10. Conservation Biology **10.1 Conservation Biology:** Concept of biodiversity, biodiversity conservation, national parks, wildlife reserves, conservation areas, biodiversity hotspots, wetland & Ramsar sites. **Wildlife**-Importance, causes of extinction and conservation strategies. IUCN categories of threatened species- meaning of extinct, endangered, vulnerable, rare, and threatened species. Endangered species in Nepal.	2 2	**10. Applied Biology** **10.1 Application of Zoology:** Tissue and organs transplantation, in-vitro fertilization (IVF), amniocentesis, concept of genetically modified organisms (transgenic animals). Poultry farming and fish farming. **10.2 Microbial diseases and application of microbiology:** Risk and hazard group of microorganisms. Introduction, causative agents, symptoms, prevention and control measures of selected human diseases: Typhoid, Tuberculosis and HIV infection, cholera, influenza, hepatitis, candidiasis. Basic concepts of immunology–vaccines. Application of microorganisms in dairy and beverage industries, microbial contamination of water, sewage and drinking water treatment, bio-control agents and bio-fertilizers.	6 10

5. Practical Courses [32 Hours]

The practical work that students do during their course is aimed at providing them learning opportunities to accomplish competency of the curriculum as well as reinforcing their learning of the theoretical subject content. This part of the curriculum focuses more on skill development than knowledge building. Students must spend lots of time for working with biological materials. Observations and investigations can enhance student learning. Project work may consist of activities designed to demonstrate the concepts and ideas through collecting, processing, analyzing and communicating data.

Students should learn to,

- collect and identify
- preserve
- dissect
- draw figure, chart, preparing models, slides etc
- handle the equipment, instruments and laboratory handling with experimentation
- draw conclusion

Students should perform at least 10 experiments, either listed below or designed by teacher, so that no more than three experiments come from the same unit and students should perform at least 5 experiments from botany and 5 experiments from zoology part of this curriculum.

a) Practical Activities for Grade 11

The following are the list of practical activities for Grade 11 in Biology

Botany

Unit 1: Biomolecules and Cell Biology

1. Study of tissues and diversity in shapes and sizes of plant cells (e.g. palisade cells, guard cells, parenchyma, collenchyma, sclerenchyma, xylem, phloem,) through temporary/permanent slides.
2. Study of mitosis in onion root tips cells by preparing temporary slides and permanent slides.

Unit 2: Floral Diversity

3. Collect, identify different types of plants from your nearby locality and preserve them with appropriate method.
4. Collect, preserve and identify some available mushrooms. Distinguish poisonous and edible mushrooms.
5. Study and describe three locally available common flowering plants from each of the following families (Solanaceae, Fabaceae and Liliaceae) including dissection and display of floral whorls and anther and ovary to show number of chambers. Types of root (Tap and Adventitious); Stem (Herbaceous and woody); Leaf (arrangement, shape, venation, simple and compound).
6. Study and identification of different types of inflorescence.

Unit 3: Introductory Microbiology

7. Culture the given sample of soil and study the microorganisms present in it.

Unit 4: Ecology

8. Study the biotic and abiotic factors of a pond as an ecosystem.
9. Determine the population density of plants of given area by quadrate method.
10. Collect and study soil from at least two different sites and study them for texture, moisture content, pH and water holding capacity of soil. Correlate with the kinds of plants found in them.
11. Study of plant population density by quadrate method.

Unit 5: Vegetation

12. Study of the specimens and identification with reasons- Bacteria, Oscillatoria, Spirogyra, Rhizopus, mushroom, yeast, liverwort, moss, fern, pine, one monocotyledonous plant and one dicotyledonous plant and one lichen.

Zoology

Unit 6: Introduction to Biology

13. Study parts of a compound microscope.

Unit 7: Evolutionary Biology

14. Study of the evidences of evolution through fossils (for example *saligram*).

Unit 8: Faunal Diversity

15. Study of specimens and identification with reasons- Amoeba, Hydra, Liverfluke, Ascaris, leech, earthworm, prawn, silkworm, honeybee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit.
16. Dissect and study the alimentary canal of the earthworm, frog and rabbit.

Unit 9: Biota and Environment

17. To study the biotic and abiotic components of pond or any other ecosystems nearby you

Unit 10: Conservation Biology

18. . Find out the new strategies for conserving biodiversity in the context of Nepalese development.

b) Sample project work for grade 11 in Biology

1. Collect the sample of cryptogams (Algae, Bryophytes, Pteridophytes) and study their characteristics.
2. Observe and compare the morphological adaptation of hydrophytes, xerophytes and xerophytes.
3. Prepare a report on local varieties and improved varieties of crops and vegetables in your area.
4. Visit the forest or vegetation types in your nearby area and prepare a report on it.
5. Prepare a report on the role of botanical garden in conservation of plants in Nepal
6. Survey any locality regarding any topics related to theory course of Biology (visit to zoological museum/zoo/protected areas/natural habits- forest/lake or river) and writing a report of it.

7. Prepare a report on causes and consequences of environmental pollution in your locality.
8. Observe different cultivation methods of Mushroom and prepare a report on it.
9. Look for resources like library, journals, web surfing, field observations etc and study present status and scope of Biotechnology in Nepal.

c) Practical activities for grade 12 in Biology

Botany

Unit 1: Plant Anatomy

1. Preparation and study of T.S. of dicot and monocot roots and stems (primary).
2. Prepare a temporary mount of onion root tip to study mitosis.

Unit 2: Plant Physiology

3. Study of osmosis by potato osmometer.
4. Study of plasmolysis in epidermal peels (e.g. Rhoeo leaves)
5. Study of distribution of stomata in the upper and lower surface of leaves.
6. Comparative study of the rates of transpiration in the upper and lower surface of leaves.
7. Study the rate of respiration in flower buds/leaf tissue and germinating seeds.
8. Observation and comments on the experimental set up for showing:
   a. Anaerobic respiration
   b. Phototropism
   c. Apical bud removal
   d. Suction due to transpiration

Unit 3: Genetics

9. Study, Observe and Comments upon the Mendelian Inheritance suing seeds of different colours/sizes of any plants.

Unit 4: Embryology

10. Study of imbibition in seeds/raisins.

Unit 5: Biotechnology

11. Preparation of bio-fertilizer and analyze the significances.

Zoology

Unit 6: Animal Tissues

12. Study of tissues and diversity in shapes and sizes of animal cells (e.g. squamous epithelium, muscle fibers and mammalian blood smear) through temporary/permanent slides.
13. Study of mitosis in animal's cells (grasshopper) from permanent slides.

Unit 7: Developmental Biology

14. Study of permanent slides of different developmental stages (fertilized egg, cleavage, blastula and gastrula) of frog.

Unit 8: Human Biology

15. Detect the presence of starch in the given sample.
16. Detect the presence of protein in the given sample.
17. Study the effect of the different temperatures and pH on the activity of salivary amylase on starch.
18. Detect the presence of urea, sugar, albumin and bile salts in urine
19. Detect the presence of sugar in human blood.
20. Study of Human skeleton and different types of joints.

Unit 9: Human Population and Health Disorders

21. Study of human skeleton and different types of joints.
22. Study of external morphology of cockroach through models.

d) Sample project works for grade 12 in Biology

Botany

1. Prepare a report on the topic "significances of the biology and biology education with different sectors i.e. industrial development, medicine, bio-technology, agriculture etc".
2. Prepare a report on "recent development of genetic field and their implications in human life"
3. Prepare model of DNA and RNA
4. Visit the human beings and observe the dominant and recessive characteristics of human beings and prepare a report on it.

Zoology

5. Measure the blood pressure (BP) of human bodies and predict the trends of age wise BP.
6. Visit the poultry farming or fish farming in local area and prepare a report by including the place, farming method, marketing etc.
7. Conduct the survey on common communicable diseases prevailing in local area. Prepare a report by including the disease, causes, preventing measures.
8. Prepare a report on trends, causes and consequences of migration in local level.
9. Prepare functional models of different system of human body.

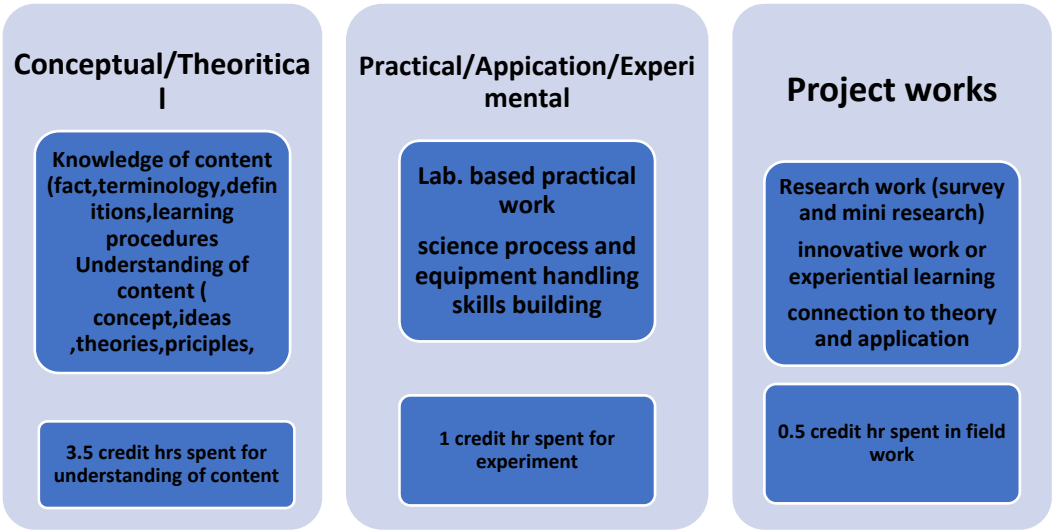
Note: The above are only the specimens of activities. In order to arouse creativity, the students must be encouraged to take up new activities (other than mentioned above) in consultation with the teacher concerned.

6. Learning Facilitation Process

Students should be facilitated to learn rather than just accumulation of information. Teacher plays vital role for delivering subject matters although others' role is also important. Student centered teaching-learning process is highly emphasized. Students are supposed to adopt multiple pathway

of learning, such as online search, field visit, library work, laboratory work, individual and group work, research work etc. with the support of teacher. Self-study by students is highly encouraged and learning should not be confined to the scope of curriculum. Teacher should keep in mind intra and inter-disciplinary approach to teaching and learning, as opposed to compartmentalization of knowledge. Supportive role of parents/guardians in creating conducive environment for promoting the spirit of inquiry and creativity in students' learning is anticipated.

During the delivery process of science teaching in grade 11 and 12, basically following three approaches will be adopted;



a) Conceptual/Theoretical Approach

Possible theoretical methods of delivery may include the following;

- lecture
- interaction
- question answer
- demonstrations
- ICT based instructions
- cooperative learning
- group discussions (satellite learning group, peer group, small and large group)
- debate
- seminar presentation
- Journal publishing
- daily assignment

b) Practical/Application/Experimental approach

Practical work is the integral part of the learning science. The process of lab based practical work comprises as;

- familiarity with objective of practical work
- familiarity with materials, chemicals, apparatus
- familiarity with lab process (safety, working modality etc.)
- conduction of practical work (systematically following the given instruction)
- analysis, interpretation and drawing conclusion

c) Project work Approach

Project work is an integral part of the science learning. Students should be involved in project work to foster self-learning of students in the both theoretical and practical contents. Students will complete project work to have practical idea through learning by doing approach and able to connect the theory into the real world context. It is regarded as method/ process of learning rather than content itself. So use of project work method to facilitate any appropriate contents of this curriculum is highly encouraged.

In this approach student will conduct at least one **research work, or an innovative work** under the guidance of teacher, using the knowledge and skills learnt. It could include any of the followings;

- Mini research
- Survey
- Model construction
- Paper based work
- study of ethno-science

General process of research work embraces the following steps;

- Understanding the objective of the research
- Planning and designing
- Collecting information
- analysis and interpretation
- Reporting /communicating (presentation, via visual aids, written report, graphical etc.)

General process of innovative work embraces the following steps;

- identification of innovative task (either assigned by teacher or proposed by student)
- planning
- performing the task
- presentation of the work
- Record keeping of the work

Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the Curriculum. However, repetition of topic should be discouraged.

Learning process matrix

Knowledge and understanding	Scientific skills and process	Values, attitudes and application to daily life
• Scientific phenomenon, facts, definition, principles, theory, concepts and new discoveries • Scientific vocabulary, glossary and terminology • Scientific tools, devises, instruments apparatus • Techniques of uses of scientific instruments with safety • Scientific and technological applications	• Basic and integrated scientific process skills **Process** • Investigation • Creative thinking • problem solving	• Responsible • Spending time for investigation

Basic Science Process Skills includes

1. Observing: using senses to gather information about an object or event. It is description of what was actually perceived.
2. Measuring: comparing unknown physical quantity with known quantity (standard unit) of same type.
3. Inferring: formulating assumptions or possible explanations based upon observations.
4. Classifying: grouping or ordering objects or events into categories based upon characteristics or defined criteria.
5. Predicting: guessing the most likely outcome of a future event based upon a pattern of evidence.
6. Communicating: using words, symbols, or graphics to describe an object, action or event.

Integrated Science Process Skills includes,

1. Formulating hypotheses: determination of the proposed solutions or expected outcomes for experiments. These proposed solutions to a problem must be testable.
2. Identifying of variables: Identification of the changeable factors (independent and dependent variables) that can affect an experiment.
3. Defining variables operationally: explaining how to measure a variable in an experiment.
4. Describing relationships between variables**:** explaining relationships between variables in an experiment such as between the independent and dependent variables.
5. Designing investigations: designing an experiment by identifying materials and describing appropriate steps in a procedure to test a hypothesis.

6. Experimenting: carrying out an experiment by carefully following directions of the procedure so the results can be verified by repeating the procedure several times.
7. Acquiring data: collecting qualitative and quantitative data as observations and measurements.
8. Organizing data in tables and graphs: presenting collected data in tables and graphs.
9. Analyzing investigations and their data: interpreting data, identifying errors, evaluating the hypothesis, formulating conclusions, and recommending further testing where necessary.
10. Understanding cause and effect relationships: understanding what caused what to happen and why.
11. Formulating models: recognizing patterns in data and making comparisons to familiar objects or ideas.

7. Student Assessment

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Out of 100 full marks, internal evaluation covers 25 marks. Internal evaluation consists of Practical Activities (Practical works and projects works) (16 marks), (b) Marks from trimester examinations (6 marks), and (c) Classroom participation (3 marks)

- **Practical Activities**

Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for practical work and project work will be as follows:

S. N.	Criteria	Elaboration of criteria	Marks
1.	Laboratory experiment	Correctness of apparatus setup/preparation	2
		Observation/Experimentation	2
		Tabulation	1
		Data processing and Analysis	1
		Conclusion (Value of constants or prediction with justification)	1
		Handling of errors/precaution	1
2.	Viva-voce	Understanding of objective of the experiment	1

		Skills of the handling of apparatus in use	1
		Overall impression	1
3.	Practical work records and attendance	Records (number and quality)	2
4	Project work	Reports (background, objective, methodology, finding, conclusion	2
		Presentation	1
		Total	**16**

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of laboratory experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

- **Marks from trimester examinations**

Total of 6 marks, 3 marks from each trimester.

- **Classroom participation (3 marks)**

Classroom participation includes attendance (1) and participation in learning (2).

(b) External Evaluation

Out of 100 marks theoretical evaluation covers 75 marks. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (such as analyzing, evaluating, creating).