6. To generate Fibonacci numbers up to 200 and also to check whether the given number is a prime number.
7. To make a scientific presentation of procedure, data analysis and result of any one experiment from Paper-605 using power point.
8. Calculation of mean, mode, median, co-relation, regression, analysis of variance, χ-square of given data using Excel or SPSS. (Sample size should be large. It may be collected from internet). (**Additional experiment for those Colleges having Star College Scheme).**

Minimum number of experiments to be completed by each student during the semester is five.

Undergraduate Course Syllabus Under semester system

Physics General/Subsidiary

1. The undergraduate General/Subsidiary Course in Physics under the Gauhati University is a three year six semester Course. There are six university examinations during the course, the 1st semester, 2nd semester, 3rd semester, 4th semester, 5th semester and 6th semester held each at the end of every six months.
2. A student who wants to study Physics as General/Subsidiary Course subject should have also Mathematics as one of the Subsidiary Course subject.
3. A student pursuing a General/Subsidiary Course in Physics has to study two other subjects of General/Subsidiary Course (out of these two one should be Mathematics) during the first four semesters along with compulsory subjects English (during 1st and 2nd semester) and Environmental studies (during 2nd and 3rd semester). During last two semesters of the course a student has to study any one of the General/Subsidiary Course subjects studied during the first four semesters along with General/Subsidiary Course of Physics. The structure of detailed syllabus and total number of papers in each semester is given below.

Structure for General/Subsidiary Course under semester system:

Year	Sem	Subjects	**Total Marks (Physics)**	Total Marks (Electives)	**Total Credits (Physics)**	Total Credits (Electives)	Grand Total Credit(C)
1st	1st	**Physics**	**75**		**6**		
		Elective		75		6	
		Elective		75		6	
		English		50		4	
	2nd	**Physics**	**75**		**6**		

		Elective		75		6	
		Elective		75		6	
		English		50		4	
2nd	3rd	**Physics**	**100**		**8**		
		Elective		100		8	
		Elective		100		8	
		Environmental studies		50		4	
	4th	**Physics**	**100**		**8**		
		Elective		100		8	
		Elective		100		8	
		Environmental studies		50		4	
3rd	5th	**Physics**	**200**		**16**		
		Elective		200		16	
	6th	**Physics**	**200**		**16**		
		Elective		200		16	
Total			**750**	1300	**60**	104	164

Yr	Sem	Subjects	Practical Marks (In+ Ex)	Theory Marks (In + Ex)	Total Marks (Physics)	Total Marks in other Elective Subjects	Total Credit (C)
1st	I	**Physics –E101 (Th)**		**15+60**	**75**		**6**
		Elective –E102 (Maths)		15+60		75	6
		Elective -E103		15+60		75	6
		English		10+ 40		50	4
	II	**Physics -E201 (Th)**		**15+60**	**75**		**6**
		Elective-E202		15 +60		75	6
		Elective-E203		15 + 60		75	6
		English		10+ 40		50	4
2nd	III	**Physics -E301 (Th)**		**10+40**	**100**		**8**
		Physics -E302 (Pr)	**10+40**				
		*Elective-E303+E304	10+40	10+ 40		100	4+4
		Elective-E305		20 + 80		100	8
		Environmental Studies		10+ 40		50	4
	IV	**Physics -E401 (Th)**		**10+40**	**100**		**8**
		Physics –E402 (Pr)	**10+40**				
		*Elective-E403+E404	10+40	10 + 40		100	4+4
		Elective-E405		20 + 80		100	8
		Environmental Studies		10+ 40		50	4
	V	**Physics -E501 (Th)**		**20 + 80**	**200**		**16**
		Physics -E502 (Pr)	**20+80**				
		Elective-E503				100	8
		Elective-E504				100	8
		Physics –E601 (Th)		**20 + 80**	**200**		**16**

3rd	VI	**Physics -E602 (Pr)**	**20+80**				
		Elective-E603				100	8
		Elective-E604				100	8
Total					750	1300	164

*** For Electives with Practical. Otherwise Total Marks=20+80=100 and Total Credit=8**

Marks distribution for Physics General Course

Yr	Sem	Paper	Topics	Marks (Ex)	Total Marks (Ex)	Internal Total Marks	Grand Total Marks	Credit (C)
1st	I	101(Th)	(a) Mechanics	25	60	15	75	6
			(b) Properties of Matter	15				
			(c)Waves and oscillations	20				
	II	201(Th)	(a) Current Electricity	35	60	15	75	6
			(b) Electrstatics	15				
			(c) Magnetism	10				
2nd	III	301(Th)	(a) Heat	20	40	10	50	4
			(b)Thermodynamics	20				
		302(Pr)					50	4
	IV	401(Th)	Optics	40	40	10	50	4
		402 (Pr)					50	4
3rd	V	501(Th)	(a) Mathematical Physics	30	80	20	100	8
			(b) Atomic Physics	30				
			(c)Relativity	10				
			(d) Renewable Energy sources	10				
		502(Pr)					100	8
		601(Th)	(a) Nuclear Physics	30	80	20	100	8
			(b) Electronics	30				

	VI		(c) Electromagnetic waves	10				
			(d) Solid-state Physics	10				
		602(Pr)					100	8
Total							750	60

FIRST SEMESTER

PAPER: 101 (Theory) Total Marks: 60

(a) Mechanics and properties of Matter: (Total Marks: 25+15=40)
Total Lectures=36

1. Conservative and non-conservative forces, force as gradient of potential.
2. Rotational motion, torque, angular momentum, conservation of angular momentum, work and power in rotational motion, KE of rotation, moment of inertia, theorems of moment of inertia, moment of inertia of rectangular plate, circular disc, cylinder, sphere (solid and hollow), body rolling without slip.
3. Gravitation: determination of G by Cavendish method, gravitational field and potentials due to solid sphere and spherical shell, Kepler's law of planetary motion, Newton's law of gravitation from Kepler's law, artificial satellites, geostationary satellite, eccentricity of orbit of a satellite, escape velocity.
4. Compound pendulum: equivalent simple pendulum, centers of suspension and oscillation, four points of equal time period, condition for minimum time period.
5. Elasticity: Hook's law, different kinds of elastic constants, work done in deforming a body, Relation among the elastic constants. Bending of beam fixed at one end and loaded at the other end, torsion of a rod.
6. Surface tension, relation between surface tension and surface energy, excess pressure inside soap bubble and liquid drop, rise of liquid in a capillary tube, Determination of surface tension by capillary method.
7. Streamline and turbulent flow, critical velocity, viscosity of fluids, Poiseuille's equation. Bernoulli's equation, its derivation and applications.

(b) Wave and Sound: (Total Marks: 20)
Total Lectures =14

1. Simple harmonic motion, differential equation of S.H.M., total energy of a particle executing S.H.M., oscillation of loaded spring. Free, damped and forced vibrations, resonance, sharpness of resonance, equation of wave motion, principle of superposition of waves, beats, stationary wave and Doppler’s effect.
2. Velocity of sound in a homogeneous medium, effect of temperature and pressure on velocity of sound in air, intensity level of sound and its unit (bel and decibel).
3. Ultrasonic waves – production of ultrasonic waves, application of ultrasonic waves, principle of SONAR system.

Suggested Books:
Mechanics - D.S. Mathur

Physics Part-I - Halliday and Resnick

A Text Book of Sound - N. Subramanyam and Brij Lal

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SECOND SEMESTER

PAPER: 201 (Theory) Total Marks: 60

(a) Current Electricity: (Total Marks: 35) Total Lectures =30

1. Electric current density, continuity equation, Ohm's law as $J = \sigma E$, Applications of Kirchoff's law to solve electrical network problem.
2. Moving coil ballistic galvanometer its sensitivity and uses.
3. Electromagnetic induction: Self and mutual induction, coefficient of coupling, reciprocity theorem, self induction of a long solenoid, mutual induction of two solenoids.
4. Transient growth and decay of current in LR, CR and LCR circuits.
5. Alternating current: Generation of alternating current, current and potential across resistive, inductive and capacitive elements and their phase relationships, power factor, concept of rotating magnetic field. a.c. motor, transformer, reflected impedance in transformer.

(b) Electrostatics: (Total Marks: 15) Total Lectures =12

1. Gauss's theorem and its applications to determine field due to linear, plane and spherical charge distribution, potential due to dipole, derivation of field due to a dipole Mutual potential energy of two dipoles.
2. Capacity of parallel plate capacitor, spherical and cylindrical capacitor, effect of dielectric on capacity of capacitor, mechanical force on charged conductor, energy stored in a charged capacitor.
3. Dielectrics, Electric polarisation of dielectrics, polarizability, Relation between D, E, & P, Gauss's law in dielectric. Electrostatic boundary conditions in dielectric medium.

(c) Magnetism: (Marks: 10) Total Lectures = 8

1. Electric current as source of magnetic field, Equivalent magnetic dipole produced by a current flowing though a circular conductor, magnetic dipole moment, force and couples on dipole placed in a uniform magnetic field, magnetic shell, potential due to magnetic shell, magnetic intensity, induction and intensity of magnetisation, magnetic susceptibility, permeability, hystersis and hystersis loss.
2. Dia, para and ferro magnetism, Atomic dipole moment, Langevin's Classical theory of para magnetism.

Suggested Books:
Electricity and Magnetism - D.Chattopadhyay and P.C.Rakshit.

Electricity and Magnetism –D.N. Vasudeva

Electricity and Magnetism - Berkeley Series

Electrostatics and Magnetostatics - B.B.Laud

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THIRD SEMESTER

PAPER: 301 (Theory) Total Marks: 40

(a) Heat: (Total Marks: 20)
Total Lectures =18

1. Platinum resistance thermometer and thermocouple thermometer.
2. Kinetic theory of gases, expression of Maxwell's law of velocity distribution (deduction not necessary), degree of freedom, law of equipartition of energy, mean free path, Brownian motion.
3. Andrew's and Amagat's experiment, equation of state, Van-der-Waals' equation of state, reduced equation of state, critical constants.
4. Joule-Thomson effect, liquefaction of gases by Joule-Thomson effect.
5. Phase, first order phase transitions, Clausius–Clayperon equation, Gibbs' phase rule, triple point.
6. Radiation: Kirchhoff's law and its applications, relation between radiation pressure and energy density, Black body radiation, expressions of Stefan-Boltzmann law, Wien's displacement law, Rayleigh-Jean's law and Planck's law of black body radiation.

(b) Thermodynamics: (Total Marks: 20)
Total Lectures =18

1. Zeroth law of themodynamics and concept of temperature.
2. Heat and work and their equivalence, First law of thermodynamics and concept of internal energy, Applications of first law of thermodynamics.
3. Inadequacy of first law of thermodynamics, Second law of thermodynamics, reversible and irreversible processes, isothermal and adiabatic processes, work done by perfect gas under isothermal and adiabatic expansion, Carnot engine and Carnot cycle, Thermodynamic scale of temperature.
4. Entropy, change of entropy in reversible and irreversible processes, Clousious inequality relation.
5. Maxwell's thermodynamic relations and their applications.

Suggested Books:

Heat and Thermodynamics - Zemansky and Dittman
A treatise on Heat - Saha and Srivastava

PAPER: 302 (Practical) Total Marks: 50
One experiment to be performed in four hours

1. To study the elongation of a wire by different pulling forces using Searle's apparatus and find the value of Young's modulus.
2. To determine the value of g by bar pendulum.
3. To determine velocity of sound in moist air by resonant air column method.

4. To determine the specific resistance of the material of the given wire by Meter Bridge and then find the length of wire necessary to construct a one ohm coil.
5. To determine the emf of a cell using a cell of known emf with the help of potentiometer.
6. To determine the resistance per unit of the length of meter bridge wire by Carey-Foster method.
7. To convert a given galvanometer into a voltmeter of given range and then calibrate it with standard resistance and ammeter.

Minimum number of experiment to be completed during the semester is five.

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FOURTH SEMESTER

PAPER: 401 (Theory) Total Marks: 40

Optics: (Total Marks: 40)
Total Lectures =36

1. Fermat's principle: application to reflection and refraction at plane and curved boundaries, reflection through combination of two thin lenses, dispersion produced by lens, spherical and chromatic aberration and their remedies, achromatic combination of lenses, spectrometer.
2. Huygen's wave theory: Formula for refraction at a spherical surface, formula for thin convex and concave lenses.
3. Interference of light: Fresnel biprism, colour of thin films, Newton's ring phenomenon.
4. Diffraction of light: Fresnel and Fraunhofer classes of diffraction, diffraction at a straight edge and single slit, diffraction grating.
5. Polarisation of light: plane polarised light, polarisation on reflection, Brewster's law, double refraction, Nicol prism, rotation of plane of polarization by optically active substances, specific rotation, polarimeter.
6. Ramsden's and Huygen's eye piece, aplanatic foci.
7. Michelson interferometer, resolving and dispersive power of grating, production and analysis of polarised light, retarding plates, Babinet's compensator.
8. Laser and its characteristics, stimulated absorption, spontaneous and stimulated emission, population inversion, basic elements of laser, Ruby laser (principle only).

Suggested Books:

Light – K.G. Mazumdar

A Text book of Light - B Gosh and K G Mazumdar.

Optics – A. Ghatak

PAPER: 402 (Practical) Total Marks: 50
One experiment to be performed in four hours

1. To determine the modulus of rigidity of the material of a rod by static method.
2. To determine the moment of inertia of symmetrical body about an axis by torsional oscillation method.

3. To determine the focal length of a convex mirror with the help of a convex lens.
4. To determine the refractive index of a liquid by using plane mirror and convex lens.
5. To determine the electrochemical equivalent of copper by using an ammeter and copper voltameter.
6. To determine the value of a low resistance by drop of potential method using meter bridge.
7. To determine the internal resistance of a cell with the help of a potentiometer.

Minimum number of experiment to be completed during the semester is five.

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FIFTH SEMESTER

PAPER: 501 (Theory) Total Marks: 80

(a) Mathematical methods: (Total Marks: 30)
Total Lectures =24

1. Vector Algebra, scalar and vector product with illustration from physics, vector triple products.
2. Vector calculus: Scalar and Vector fields with example from physics, space curve, differentiation of a vector with respect to a scalar, gradient of scalar, divergence and curl of vector with example from physics.
3. Line integral, surface integral and volume integral. Gauss's theorem, Stoke's and Green's theorem.
4. Curvilinear coordinate system, coordinate line and coordinate surface, unit normal vectors and unit tangent vectors, scale factor, orthogonal curvilinear coordinates, cylindrical polar and spherical polar coordinate systems.

(b) Atomic Physics: (Marks: 30)
Total Lectures =24

1. Positive rays: analysis of positive rays, Aston and Bainbridge mass spectrographs.
2. Bohr's theory of hydrogen spectra, energy level diagram, Ritz combination principle, excitation, critical and ionization potentials, fine structures of the spectral lines, Sommerfeld's extension of the Bohr's theory(Qualitative only).
3. Vector atom model, Bohr magnetron, spinning electron; quantum numbers; Pauli's exclusion principle, source of radiation in external fields- normal Zeeman effect.
4. X-rays: origin and production of x-rays, continuous and characteristic X-rays, Mosley's law; diffraction of X-rays by crystals, Bragg's law, Compton Effect.
5. Frank and Hertz experiment, matter wave, Davisson and Germer experiment.

(c) Relativity: (Marks: 10)
Total Lectures =6

1. Michelson–Morley experiment, postulates of special theory of relativity, Lorentz transformation equations (derivation not necessary), time dilation, length contraction, mass variation, mass energy relation, velocity addition theorem.

(d) Renewable energy sources: (Marks: 10)

Total Lectures =6

1. Need and importance, different renewable energy sources, solar energy, solar constant, instruments for measuring solar radiation, solar heaters (air and liquid), solar radiation concentrators (reflector etc.), solar cooker, photovoltaic effect, solar cells.

Suggested Books:

Vector Analysis - Murray R. Spiegel (Schaum Series)

Atomic & Nuclear Physics - A. B. Gupta & D. Ghosh

Concept of Modern Physics – A. Beiser

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PAPER: 502 (Practical) Total Marks: 100

One experiment to be performed in five hours

1. To determine the value of `H' with the help of a deflection and vibration magnetometer.
2. To determine the surface tension of a liquid by capillary rise method.
3. To draw I-D curve for the given prism with the help of a spectrometer and hence find the angle of minimum deviation.
4. To determine the wavelength of sodium light by Newton's ring.
5. To determine the coefficient of linear expansion of a rod by optical lever method.
6. To determine the constant of a ballistic galvanometer by direct method.
7. To draw the characteristic curve of a photo cell and find the maximum velocity of emitted electron.

Minimum number of experiment to be completed during the semester is five.

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SIXTH SEMESTER

PAPER: 601 (Theory) Total Marks: 80

(a) Nuclear Physics: (Marks: 30)

Total Lectures =24

1. Concept of a Nucleus – its composition, mass, volume, density and temperature, units and dimension.
2. Mass defect and packing fraction, total binding energy, binding energy per nucleon, binding energy curve & its significance, nucleon separation energy, nuclear reactions, Q-value of a reaction, exothermic & endothermic reactions.
3. Type of radioactive decays, radioactive decay law, concept of half life and disintegration constant, natural radioactivity, radioactive dating, Activity of radioactive sources, its unit. Radioisotopes – their production & uses.
4. Need of a particle accelerator, Linear Accelerator – its construction & working principle. Need of nuclear Detectors. Ionization Chamber – its construction & working principle.
5. Primary and secondary cosmic rays and their composition, EAS.

(c) Electronics: (Marks: 30)
Total Lectures =24

1. Semiconductors, P-N junction diode, unbiased and biased P-N junction, depletion layer, barrier potential, junction capacitance, volt-ampere relations (derivation not necessary), photo diode, Zener diode, LED and their uses. OR, AND, NOT, NOR and NAND Gates using diode and transistor.
2. Rectifier: half wave and full-wave, efficiency of rectification, ripple factor, idea of filter circuit.
3. Thevenin's and Norton's theorems, maximum power transfer theorem.
4. Transistor, different configurations and characteristics of transistor, alpha and beta of a transistor, transistor as amplifier.
5. Biasing and Q-point of a transistor, stability factors, biasing circuits.
6. Classification of amplifiers: class A, B, C, voltage and power amplifiers.
7. Two port four terminal device and z, y and h-parameters. Use of h-parameters to find input and output resistances, current, voltage and power gain of a small signal transistor amplifier.
8. Feedback and Barkhausen criterion for sustained oscillations, Tuned collector oscillator.

(c) Electromagnetic waves: (Marks: 10)
Total Lectures = 6

1. Electromagnetic wave spectrum, graphical representation of electromagnetic wave.
2. Maxwell's equations, wave equation in free space from Maxwell's equations, velocity of electromagnetic waves in free space, Pointing vector.

(d) Solid State Physics (Marks: 10)
Total Lectures =6

1. Crystalline and amorphous state of substances, single crystal and polycrystalline substances, basis, crystal lattice, unit cell, primitive unit cell, translation vectors, lattice parameters, directions, lattice planes, Miller indices, inter-planar spacing.
2. Crystallographic axes, Crystal systems and Bravais lattice.
3. Different types of bonding in solids, ionic, covalent, metallic and hydrogen bonding.
4. Classical free electron theory of metals.

Suggested Books:

Atomic and Nuclear Physics – S. N. Ghosal

Atomic & Nuclear Physics - A. B. Gupta & D. Ghosh

A Text Book of Electronics –S.L. Kakani & K.C. Bhandari

Solid State Physics by A J Dekker

Solid State Physics by S O Pillai

College Physics – K. N. Sharma & Neerja

Teach yourself Physics series – (Bharati Bhaban P&D)

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PAPER: 602 (Practical) Total Marks: 100
One experiment to be performed in five hours

1. To determine the value of `g' by Kater's pendulum.
2. To determine the width of a given slit by observing diffraction pattern of monochromatic radiation and verify it using traveling microscope.
3. To determine the value of `J', the mechanical equivalent of heat by Joule's calorimeter.
4. To draw the characteristics of a given transistor with CB and CE configurations and determine the alpha and beta of the transistor.
5. To determine the angle of minimum deviation and angle of the prism with the help of a spectrometer and hence find refractive index of the material of the prism.
6. To assemble OR, AND and NOT gates using diode and transistor and verify their tuth tables.
7. To draw the characteristics of- (i) a forward biased PN diode and (ii) reverse biased Zener diode and hence determine the ac resistance of the PN diode and breakdown voltage of the Zener diode.

Minimum number of experiment to be completed during the semester is five.

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