

NATIONAL UNIVERSITY



Second Year Syllabus Department of Mathematics

Four Year B.Sc. Honours Course
Effective from the Session : 2013–2014

National University
Subject: Mathematics
Syllabus for Four Year B.Sc. Honours Course
Effective from the Session: 2013-2014

Year wise Papers and marks distribution

SECOND YEAR

Paper Code	Paper Title	Marks	Credits
223701	Calculus –II	100	4
223703	Ordinary Differential Equations	100	4
223705	Computer Programming (Fortran)	100	4
223706	Math Lab (Practical)	100	4
Any two of the following :			
222707	Physics-III (Electricity and Modern Physics)	100	4
222708		50	2
222807	General Chemistry-II	100	4
222809		50	2
223609	Methods of Statistics	100	4
223610		50	2
	Total =	700	28
221109	English (Compulsory)	100	Non-credit

Detailed Syllabus

Paper Code	223701	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Calculus- II			Exam Duration: 4 Hours

1. **Vector valued functions of a single variable:** Limits, derivatives and integrals of vector valued functions. Tangent lines to graphs of vector-valued functions. Arc length from vector view point. Arc length parametrization.
2. **Curvature of space curves:** Definition. Curvature from intrinsic equations, Cartesian equations and parametric equations. Radius of curvature. Centre of curvature.
3. **Functions of several variables:** Graphs of functions of two variables. Limits and continuity. Partial derivatives. Differentiability, linearization and differentials. The Chain rule. Partial derivatives with constrained variables. Directional derivatives; gradient vectors and tangent planes, Extrema of functions of several variables, Lagrange multipliers. Taylor's formula.
4. **Multiple Integration:** Double integrals and iterated integrals. Double integrals over nonrectangular regions. Double integrals in polar coordinates. Area by double integrals. Triple integrals and iterated integrals. Volume as a triple integral. Triple integral in cylindrical and spherical coordinates. General multiple integrals. Change of variables in multiple integrals. Jacobians.
5. **Topics in Vector Calculus:** Scalar and vector fields, Gradient, divergence and curl and their properties. Line integrals, Green's theorem. Surface integrals. Stokes' theorem, Divergence theorem.

Books Recommended:

1. H. Anton et al, Calculus with Analytic Geometry.
2. E. Swokowski, Calculus with Analytic Geometry.
3. L. Bers & P. Karal, Calculus with Analytic Geometry.
4. S. Lang, Calculus of Several Variables.

Paper Code	223703	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Ordinary Differential Equations			Exam Duration: 4 Hours

1. **Ordinary differential equations and their solutions:** Classification of differential equations. Solutions. Implicit solutions. Singular solutions. Initial value problems. Boundary value problems. Basic existence and uniqueness theorems (statement and illustration only). Direction fields. Phase line.
2. **Solution of first order Differential equations :** Separable equations. Linear equations. Exact equations. Special integrating factors. Substitutions and transformations. Homogeneous equations. Bernoulli equation. Riccati equation. First order higher degree equation-solvable for x, y and p . Clairaut's equation.
3. **Modelling with first order differential equations:** Construction of differential equations as mathematical models (exponential growth and decay, heating and cooling, mixture of solution. Series circuit, logistic growth, chemical reaction, falling bodies). Model solutions . and interpretation of results. Orthogonal trajectories.
4. **Solution of higher order linear equations:** Linear differential operators. Basic theory of linear differential equations. Solution space of homogeneous linear equations. Fundamental solutions of homogeneous solutions. Reduction of orders, Homogeneous linear equations with constant coefficients. Non-homogeneous equation. Method of undetermined coefficients. Variation of parameters. Euler-Cauchy differential equation.
5. **Series solutions of second order linear equations :** Taylor series solutions. Frobenius series solutions. Series solutions of Legendre, Bessel, Laguerre and Hermite equations and their solutions.

Books Recommended:

1. S.L. Ross- *Differential Equations*.
2. Denis Gill-*Introduction to Differential Equations*.
3. Frank Ayres, J R. *Theory and Problems of Diffrential Equations*.
4. Martin Braun. *An introduction to Differential Equations and their Applications*.

Paper Code	223705	Marks: 100	Credits: 4	Class Hours: 60
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Paper Title:	Computer Programming (Fortran)	Exam Duration: 4 Hours
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1. Problem-solving techniques using computers: Flowcharts, Algorithms.
2. Programming in Fortran: Syntax and semantics, data types and structures, input/output, loops, decision statements, arrays, user-defined functions, subprograms and recursion.
3. Subprogram: function, subroutine, recursion.
4. Computing using Fortran: Construction and implementation of FORTRAN programs for solving problems in mathematics and sciences.

Books Recommended :

1. Gordon B Davis, Thomas R Hoffmann. *Fortran 77: A structured, Disciplined Style*.
2. Schaum's Outline Series- *Programming with Fortran 77*.
3. Ian D Chivers, Jane Sleightholme. Introduction to programming with FORTRAN.

Paper Code	223706	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Math Lab (Practical)			Exam Duration: 4 Hours

Problem-solving using Mathematica: Running the package. Numerical computation. Algebraic computation. Mathematical functions. Derivatives and integrals. Limits and series. Lists and matrices. Graphics. Standard packages. Solving problems in Algebra, Geometry, Calculus, differential equations and Computing. Problems will be selected from Papers studied in the first and second years.

Students are required to work on their assignments in the sessions.

Books Recommended:

1. Schaum's Outline Series - *Mathematica*
2. Worlfarm's Research (Student edition) - *Mathematica*

Paper Code	222707	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Physics-III (Electricity and Modern Physics)			Exam Duration: 4 Hours

1. **Change and Matter:** Concept of charge, Conservation of charge. Coulomb's law.
2. **The Electrostatic Field:** The Electric field strength due to a point charge, a dipole, Group of charged and uniformly distributed charged bodies.
3. **The electrostatic potential:** Potential due to a point charge, a dipole, a group of charged and a continuous distribution of charged bodies. Notion of gradient: Relation between potential and electric field strength. Electric potential energy. Van de Graff generator.
4. **Flux of electrostatic field:** Gauss's law. Concept of solid angle. Flux due to a point charge, group of charge. Conservation of flux. Application of Gauss's law.
5. **Capacitor and Dielectrics:** Capacitance, Parallel plate and cylindrical capacitor. Dielectrics and Gauss's law. Energy storage in an electric field.
6. **Electric Current (D.C):** Electromotive force, Current and current density. Resistance, Resistivity and conductivity, Ohm's law, Atomic view of resistivity, Energy transfer in an electric circuit, Kirchhoff's laws and their applications. Potentiometer. Meter bridge and Post office box.
7. **The Magnetic field:** Magnetic Induction B. Motion of a charge field. Magnetic force on a current, Torque on a current loop, the Hall effect, Circulating charges. Dead beat and ballistic galvanometers, Thomson's experiment, Ampere's law, B near a long wire, Ampere's circuital law, B due to a solenoid, the Biot-Savart law and its applications.
8. **Electromagnetic induction:** Faraday's law of induction, Lenz's law, Self and mutual inductance. Time-varying magnetic fields, Energy density in a magnetic field.
9. **Magnetic Properties of matter:** Magnetic dipole, Gauss's Law for magnetism, Paramagnetism, Diamagnetism and ferromagnetism, Nuclear magnetism, Energy in a magnetic field, Hysteresis.
10. **Varying current:** Growth and decay of currents in LR, CR and LCR circuits.
11. **Alternating Currents:** AC generator, Concept of r.m.s and average values of current and voltage, Resistive circuit, CR, LR and LCR circuits in series and parallel, Resonance, Phase and Power transformer.

12. **Electronics:** Vacuum diodes and triodes, P-type, n-type semiconductors, p-n junctions, Transistors, Transistor biasing, Transistor amplifiers, Transmitters and Receivers.
13. **Special Theory of Relativity:** Inertial frame, Galilean transformation, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformation equations space contraction, Time dilation, Relativity of mass, Mass and energy.
14. **Light and Quantum Physics:** Planck's radiation formula, Photoelectric effect, Einstein's Photon theory, The Compton effect, The hydrogen atom and The correspondence principle.
15. **Waves and particles:** Matter waves, atomic structure and standing waves, Mechanics, Uncertainty principle.
16. **The atomic nucleus:** The nuclear constituents, The nuclear force, Nuclear radius, Stable nuclei, The binding energy of stable nuclei mass defect and Packing fraction.
17. **Radioactivity:** Meaning of radioactivity, Unstable nuclei, Exponential decay law, Half life, Mean life and units of radioactivity, Basic ideas of nuclear reactor, Nuclear fission and Nuclear fusion.

Books Recommended:

1. Halliday, D, Resnick, R and Walker, J : Fundamentals of Physics
2. Halliday, D and Resnick, R. : Physics
3. Husain, A & Islam, S : Parmanabik Bijnan
4. Emran, M, Ishaque, M & Islam, A.M.Z. : A Text Book of Magnetism, Electricity & Modern Physics.
5. Besier, A. : Concepts of Modern Physics
6. Semat, H. : Introduction to Atomic and Nuclear Physics.

Paper Code	222708	Marks: 50	Credits: 2	Class Hours: 30
Paper Title:	Physics-IV (Physics Practical)			Exam Duration: 6 Hours

To perform two experiments (one from each group) each of three hours duration.

i) Experiments (3 hours each)	2 x 20 =	40
ii) Laboratory note book		05
iii) Experimental Viva-voce		05
	Total Marks =	50

Marks for each experiment shall be distributed as follows:

a) Theory	3
b) Data collection and Tabulation	8
c) Calculation, graphs and result	6
d) Discussion	3
	Total Marks = 20

Group – A

1. Determination of 'g' by compound pendulum.
2. Determination of Young's and rigidity moduli by Searle's dynamic method.
3. Rigidity modulus by static method.
4. Surface tension of water by capillary tube method.
5. To determine the spring constant and effective mass of a given spiral spring and hence to calculate the rigidity modulus of the material of the spring.
6. To determine the Young's modulus by the flexure of a beam (bending method).
7. To determine the moment of inertia of a fly-wheel about its axis of rotation.
8. Determination of surface tension of mercury by Quincke's method.
9. To determine the specific heat of solid by method of mixture, with radiation correction.
10. To determine the specific heat of a liquid by the method of cooling.
11. To determine the thermal conductivity of a bad conductor by Lee's method.]
12. To determine 'J' with radiation correction.
13. To verify the laws of transverse vibration of a stretched string with a sonometer (n-1, and n-T curves only)
14. To find the frequency of a tuning fork by Melde's experiment.
- 15.

Group – B

1. Comparison of e.m.f.s of two cells by potentiometer.
2. Determination of galvanometer resistance by half deflection method.
3. Determination of low resistance by fall of potential method.
4. Determination of figure of merit of a galvanometer.
5. To determine ECE of copper/silver.
6. Determination of the refractive index of a glass prism by a spectrometer.
7. Determination of Cauchy's constant and the resolving power of a prism using a spectrometer.
8. Determination of wavelength of light by Newton's rings.
9. Determination of wavelength of light using a bi-prism.
10. Specific rotation of plane of Polarization in sugar solution by polarimeter.

Books Recommended:

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|-------------------------------------|---|----------------------------|
| 1. Ahmed, G.U. and Uddin, M.S. | : | <u>Practical Physics</u> |
| 2. Chawdhury, S.A. and Bashak, A.K. | : | <u>Practical Physics</u> |
| 3. Din, K. and Matin, M.A. | : | Advanced Practical Physics |
| 4. Worsnop and Flint | : | Advanced Practical Physics |

Paper Code	222807	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	General Chemistry – II			Exam Duration: 4 Hours

1. **Nonmetals:** General properties of nonmetals, ortho and para hydrogen molecules, structure of water and ice, allotropy of carbon, catenation, nitrogen fixation, halogens and their basic properties, noble gases, chemistry of noble gases.
2. **Metals:** Metallic bond, electron sea theory of metallic bond, characteristics of metals, band theory of conductivity, conductors, semiconductors and insulators, transition metals and inner transition metals, colour and magnetism in transition metal chemistry.
3. **Energy Changes in Chemical Reactions:** System and surroundings, open system and closed system, thermodynamics, state functions, the first law of thermodynamics, the concept of internal energy and enthalpy; measurement of enthalpy changes, enthalpy of formation, Hess's law, lattice enthalpy, Born-Haber cycle, second law of thermodynamics, entropy and free energy.
4. **Rates of Chemical Reactions:** Reaction rate, rate constant, rate law, order of reactions, first order reaction, half life, elementary and complex reactions, order and molecularity, effect of temperature on the rate of reaction, collision theory and reaction rates, activation energy, Arrhenius equation.
5. **Electrochemistry:** Redox reactions, electrolytic and galvanic cells, cell notation, standard reduction potentials, e.m.f of cells, the effect of concentration on cell e.m.f, batteries, corrosion.
6. **Catalysis:** Catalyst, homogeneous and heterogeneous catalysis, enzyme catalysis, auto catalysis.
7. **Solids:** Properties of solids, crystalline and amorphous solids, distinction between crystalline and Amorphous solids, isomorphism, polymorphism and allotropy, crystal lattice, unit cell, unit cell volume, crystal systems, X-rays, generation of X-rays, diffraction of X-rays by crystals, Bragg's equation.
8. **Coordination Chemistry:** Coordination compounds, ligands, coordination number, nomenclature, structures of complex compounds: Werner's primary and secondary valency concept, Sidwick's electronic concept, valence bond theory, stability of coordination compounds, isomerism in coordination compounds, coordination compounds in biological systems.
9. **Aromatic Compounds:** Aromaticity, aromaticity of benzene, Electrophilic aromatic substitution reactions with reference to nitration, halogenation, sulphonation and alkylation, Heterocyclic compounds: Pyrrole, furan, thiophene and pyridine.
10. **Organic Reactions:** Brief study on Electrophilic addition, Nucleophilic addition, Elimination reaction, condensation reaction, oxidation and reduction reactions of organic compounds. Mechanism and application of the reactions: Friedel-Craft reaction, Clemmenson reduction, Wolf Krishner reduction, Perkin reaction, Claisen reaction, Cannizzaro reaction and Aldol condensation.
11. **Carbohydrates:** Definition, classification, structure and reactions of monosaccharides. Polysaccharide; cellulose and starch.
12. **Amino Acids:** Structures, classification, synthesis, physical and chemical properties of amino acids.
13. **Polymer Chemistry:** Polymers, homopolymer, heteropolymer, low density and high density polymer, copolymers, studies of some polymers - polyvinylchloride, nylon - 66, silk and wool.

Books Recommended:

1. General Chemistry, D. D. Ebbing, Houghton Mifflin Co.
2. Chemistry – The Molecular Nature of Matter and Change, M. Silberberg, WCB/McGraw-Hill.
3. Introduction to Modern Inorganic Chemistry, S. Z. Haider, Friends International.
4. Selected Topics on Advanced Inorganic Chemistry, S. Z. Haider, Students' Publications.
5. Modern Inorganic Chemistry, R. D. Madan, S. Chand & Co. Ltd.
6. Selected Topics in Inorganic Chemistry, W. U. Malik, G. D. Tuli and R. D. Madan, S. Chand & Co. Ltd.
7. Organic Chemistry R. T. Morison and R. N. Boyd, Prentice Hall.
8. Fundamental of Organic Chemistry T. W. G. Solomons, John Wiley Z Sons.
9. Organic Chemistry (Vol. I & II), I. L. Finar, longman Publishing Group.
10. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, and P. L. Gaus, John Willey & Sons.
11. Principles of Physical Chemistry, M. M. Huque and M. A. Nawab, Students' Publications.

Paper Code	222809	Marks: 50	Credits: 2	Class Hours: 30
Paper Title:	Environmental Chemistry			Exam Duration:2.5Hours

1. **Environment:** Introduction components of environment, factors affecting environment, environmental management, environment and health, environmental chemistry, segments of environment – atmosphere hydrosphere, lithosphere and biosphere, structure of atmosphere.
2. **Pollution and Pollutants:** Pollution, environmental pollution, pollutant, classification of pollutants, types of pollution PCBS and their sources and hazards, Detection & estimation of PCBS. Biomultification.
3. **Air Pollution:** Introduction air quality, major sources of air pollution, gaseous pollutants, acid rain- how acid rain is formed, adverse effects of acid rain, greenhouse effect- how the greenhouse effect is produced, consequences of greenhouse effect and global warming EL Nino phenomenon and its effect, ozone depletion, mechanism of ozone depletion, effects of ozone depletion.
4. **Water Pollution:** Introduction, classification of water pollutants, physical, chemical and biological characteristics of wastewater, industrial wastewater treatment, municipal water treatment, water quality parameters and standards, measurements of important parameters such as PH, DO, BOD, COD and temperature for water quality assessments.
5. **Soil Pollution:** Composition of soil, importance of soil to the biosphere, sources of soil pollution, effects of soil pollution- synthetic fertilizer and pesticides, effects of industrial effluents, effects of urban wastes, control of soil pollution.
6. **Heavy metals in the Environment:** trace metals, light metals and heavy metals, deadly heavy metals, sources of heavy metals, biochemical effects, toxicity, toxicology, control and treatment of mercury, chromium, arsenic and lead.

Books Recommended:

1. Environmental Chemistry, B.K. Sharma, Goel Publishing House.
2. Environmental Chemistry, AK. De New Age International Publishers.
3. Environmental Chemistry, S.E. Manahan, CRC Press.
4. A Textbook of Environmental Chemistry and Pollution Control, S.S. Bara S. Chand & Company Ltd.

Paper Code	223609	Marks: 100	Credits:4	Class Hours: 60
Paper Title:	Methods of Statistics			Exam Duration: 4 Hours

1. **Sampling Distribution:** Concept of sampling distribution of Statistics and its standard error, χ^2 , t and F statistics and their distributions, properties and uses of these distributions.
2. **Design of Experiment:** Principles of experimental design and analysis of variance, Meaning of experiments and randomization, Replication and local control, Basic designs: CRD, RBD and LSD, Analysis of these designs, Estimation of parameters, Missing plot estimation and analysis, Factorial experiment, 2_2 , 2_3 factorial experiments, Analysis and interpretation of these designs.

3. **Survey Methods:** Concept of population, Sample, Sampling, Types of sampling, Principles of random sampling, Census and surveys, Advantages and limitations of sample survey over census, Sampling frame. Sampling and non-sampling errors, Detailed study of simple random sampling, Stratified random sampling, Systematic sampling and cluster sampling, Concept of quota sampling, Multistage sampling.
4. **Test of Hypothesis:** Concept of test of hypothesis, Logic behind tests of hypothesis, Neyman Pearson's approach of testing hypothesis, Preliminaries of tests: Hypothesis, Null and alternative hypotheses, Simple and composite hypotheses, Concept of test of significance, Procedures of testing a hypothesis, Test errors, 2 Level of significance, One-tailed and two-tailed tests, P-value. Concept of test statistics: Normal, χ^2 , t and F statistics.
5. Testing the significance of a single mean, Single variance, Single proportion, Difference of two means and two proportions, Ratio of two variances and their confidence intervals, Confidence intervals concerning simple correlation coefficient and regression coefficient for single and double sample, Paired t-test, Testing the homogeneity of several population means, Variance and proportions, Test of goodness of fit.

Books Recommended :

1. David F.N. : Probability theory for statistical Methods
2. Levy H, and Roth L : Elements of Probability
3. Mostafa M.G. : Methods of Statistics
4. Islam M.N. : Introduction to Statistics and probability.
5. Kapoor; Saxena : Mathematical Statistics
6. Ali A. : Theory of statistics Vol. I
7. Mood, Graybill and Boes : Introduction to the Theory of Statistics 3rd Ed.
8. Hogg,R.V.and Craig,A.T. : An introduction to Mathematical Statistics.
4. Federer : Experimental Design; Theory and Applications.
5. Mallick S .A. : Parikkaneer Design.
6. Bhuiyan M.R. : Fundamentals of Experimental Design.
7. Anderson, R.L. and Bancroft. T.A. : Statistical Theory in Research
8. Mood and Graybill : Introduction to the Theory of Statistics
9. Weather Burn C.E. : A First Paper in Mathematical Statistics
10. Cochran G.W. : Sampling Techniques

Paper Code	223610	Marks: 50	Credits:2	Class Hours: 30
Paper Title:	Statistics Practical-II (Introduction to Statistics + Methods of Statistics)			Exam Duration: 2.30 Hours

1. **Introduction to Statistics:** Condensation and tabulation of data, Graphical representation of data, Frequency table, Measures of location, Dispersion, Moments, Skewness and Kurtosis, Measures of correlation coefficient, Rank correlation, Fitting of simple regression lines, Fitting of Binomial, Normal and Poisson distributions, Finding trend values and seasonal variation from time series data by different methods, Calculation of index numbers and test of index number, Use of Newton's forward and backward formula, Solution of numerical integration.
2. **Methods of Statistics:** Analysis of basic designs, Missing plot estimation and analysis of these designs, Measures of relative efficiency, Analysis of factorial designs, Drawing of SRS, Estimation of mean and properties with standard error in SRS, Drawing of stratified random samples and estimation of mean and variance of population from samples of stratified random samples, Cluster samples, Systematic samples and determination of relative efficiency.
3. **Test of Hypothesis:** Common tests of significance of Mean, Variance, Proportion, Correlation coefficient and Regression coefficient, Fitting of theoretical distributions and testing of goodness of fit, tests of large samples, Tests of homogeneity, Construction of confidence intervals.

Paper Code	221109	Marks: 100	Non-Credit	Class Hours: 60
Paper Title:	English (Compulsory)			Exam Duration: 4 Hours

Aims and objectives of this Paper:

To develop students' English language skills, to enable them to benefit personally and professionally. The four skills – listening, speaking, reading and writing will be integrated to encourage better language use.

1. **Reading and understanding** 5×4=20

Students will be expected to read passages they might come across in their everyday life, such as newspapers, magazines, general books etc. Simple stories will also be included to give students a familiarity with different uses of the language.

[N.B. : 5 Questions are to be answered. Each question will carry 4 marks. There may be division in each question]

- a) Understanding different purposes and types of readings
- b) Guessing word-meaning in context.
- c) Understanding long sentences
- d) Recognizing main ideas and supporting ideas.
- e) Answering comprehension questions.
- f) Writing summaries.

2. **Writing**

40

- a) Writing correct sentences, completing sentences and combining sentences. 5
- b) Situational writing : Posters, notices, slogans, memos, advertisements etc. 4
- c) Paragraph writing : Structure of a paragraph; topic sentences; developing ideas; writing a conclusion; types of paragraphs (narrative, descriptive, expository, persuasive); techniques of paragraph development (such as listing, cause and effect, comparison and contrast). 8

Or,

- d) Newspaper writing : Reports, press releases dialogues etc.
- e) Writing resume©s. **Or,** 8
- f) Writing letters : Formal and informal letters, letters to the editor, request letters, job applications, complaint letters etc.
- g) Essay : Generating ideas; outlining; writing a thesis sentence; writing the essay: writing introductions, developing ideas, writing conclusions; revising and editing. 15

3. **Grammar**

25

- a) Word order of sentences.
- b) Framing questions.
- c) Tenses, articles, subject-verb agreement, noun-pronoun agreement, verbs, phrasal verbs, conditionals, prepositions and prepositional phrases, infinitives, participles, gerunds. (Knowledge of grammar will be tested through contextualised passages).
- d) Punctuation.

4. **Developing vocabulary** : Using the dictionary, suffixes, prefixes, synonyms, antonyms, changing word forms (from verb to noun etc.) and using them in sentences. 10

5. **Translation from Bengali to English.**

1×5=5

6. **Speaking skills** : Speaking skills should be integrated with writing and reading in classroom activities.

The English sound system; pronunciation skills; the IPA system; problem sounds, vowels, consonants and diphthongs; lexical and syntactic stress.

(Writing dialogue and practising it orally students can develop their speaking skill. Dialogue writing can be an item in writing test.)