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BUILDING VIBRANT PERSONALITIES

COURSE STRUCTURE

DEPARTMENT OF APPLIED SCIENCE AND HUMANITIES

NAAC CRITERIA 1.2.2

Invertis Village, Highway NH-24,
Bareilly, U.P.-243123
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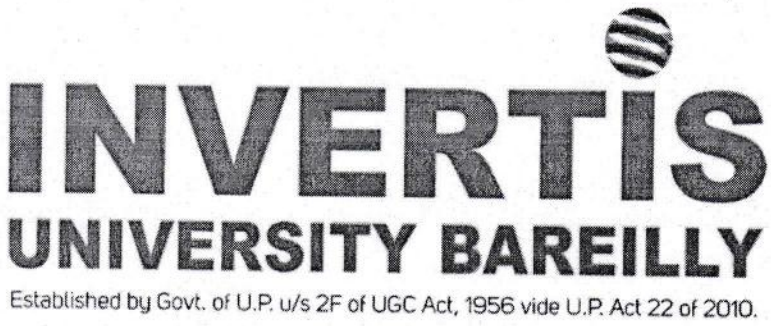
SYLLABI AND EVALUATIONSCHEME

for

Master of Science in Mathematics

TWO-YEARSFULL-TIME PROGRAMME
(Effective from session 2016-2017)



Department of Applied Sciences& Humanities

INVERTISUNIVERSITY

InvertisVillage

Bareilly-LucknowNH-24

Bareilly-243123, Uttar Pradesh,India

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Programme Outcome

PO1. Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.

PO2. Equip the student with skills to analyze problems, formulate an hypothesis, evaluate and validate results, and draw reasonable conclusions thereof.

PO3. Prepare students for pursuing research or careers in industry in mathematical sciences and allied fields

PO4. Imbibe effective scientific and/or technical communication in both oral and writing.

PO5. Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematical sciences.

PO6. Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges.

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Year								
Isemester			**Teaching Scheme**			**Marks Distribution**		
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	MMA101	Algebra	3	1	0	70	30	100
Paper 2	MMA102	Analysis	3	1	0	70	30	100
Paper 3	MMA103	Theory of ODE	3	1	0	70	30	100
Paper 4	MMA104	Fundamental of Computer and C Programming	3	1	0	70	30	100
Paper 5	MMA105	Numerical Methods	3	1	0	70	30	100
	MMA151	C-Programming Lab	0	0	2	70	30	100
Total			15	5	2	420	180	600
IISemester								
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 6	MMA201	Linear Algebra	3	1	0	70	30	100
Paper 7	MMA202	Complex Analysis	3	1	0	70	30	100
Paper 8	MMA203	Topology	3	1	0	70	30	100
Paper 9	MMA204	Algorithm & Data Structures	3	1	0	70	30	100
Paper 10	MMA205	Tensors & Riemannian Geometry	3	1	0	70	30	100
	MMA251	Data Structure Lab	0	0	2	70	30	100
Total			15	5	2	420	180	600

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III Semester			Teaching Scheme			Marks Distribution		
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	MMA301	Operation Research	3	1	0	70	30	100
Paper 2	MMA302	Functional Analysis	3	1	0	70	30	100
Paper 3	MMA303	Mathematical Methods	3	1	0	70	30	100
Paper 4	MMA304	Discrete Mathematics	3	1	0	70	30	100
Paper 5	MMA305	Elective- I	3	1	0	70	30	100
MMA351 Mat lab			0	0	2	70	30	100
Total			15	5	2	420	180	600
IV Semester								
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 6	MMA401	Mathematical Modelling	3	1	0	70	30	100
Paper 7	MMA402	Fluid Mechanics	3	1	0	70	30	100
Paper 8	MMA403	Elective- II	3	1	0	70	30	100
Paper 9	MMA404	Elective-III	3	1	0	70	30	100
Paper 10	MMA451	Project work*/Dissertation	0	0	4	100	0	100
	MMA452	Mat lab	0	0	2	70	30	100
Total			12	4	6	480	120	600

L–Lecture

T– Tutorial

P – Practical

ESM– End Semester Marks

MSM – Max Sessional Marks

* Project will begiven in III semester&submitted inIV semester.

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Established by Govt. of U.P. u/s 2F of UGC Act, 1956 vide U.P. Act 22 of 2010

Syllabus

Of

Pre-Ph.D. Course Work

In

Chemistry

Department of
Applied Sciences & Humanities

Invertis Institute of Engineering & Technol.

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PhDCY 191: *Computer Fundamentals and Numerical Analysis*

Fundamentals of computers

Computer fundamentals, hardwares and softwares, different operating systems, application programmes, some tips on PC maintenance and servicing of PC.

Common Applications: Working in a Linux environment, basic Linux commands, writing scientific documents with Latex, graphic and visualization, gnuplot; introduction to other useful software tools e.g. mathematica

Basic Numerical Methods: Numerical integration (trapezoidal and Simpson's method), numerical differentiation; Diagonalization and inverse of symmetric and non-symmetric matrices, Eigenvalues and eigenvectors.; Root finding (bisection and Newton-Raphson method); Interpolation techniques; Solution of ordinary differential equations (Euler and Runge-Kutta methods).

Statistics and treatment of experimental data: Data acquisition system, error propagation, curve fitting, Least square method, Sampling and parameter estimation, the maximum likelihood method. Analysis of a time series and search for periodicity. FFT (Fast Fourier transformation) and power spectrum and any other topics used in physics researches.

Simulation and Monte Carlo Method: Simulation of Random variables, discrete and continuous. Calculation of integrals. Monte Carlo evaluation of pi. Simulation of simple processes: coin tossing or dice throwing game. Examples and applications.

Reference Books :

1. Numerical methods for Scientific and Engineering Computation: M.K.Jain, S.R.K.Iyengar and R.K.Jain. (Wiley Eastern Limited),

2. Techniques for Nuclear and Particle Physics Experiments, A How to approach: W.R.Leo (Narosa Publishing House)

3. Numerical Recipes: W.Press et.al., (Cambridge University Press). 4. Data reduction and error analysis for the Physical Sciences, 3e, Philip R

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(PhDCY-102) GENERAL CHEMISTRY

Colloids:

Colloids, the colloidal state, preparation and purification of colloids and their characteristic

properties, lyophilic and lyophobic colloids and coagulation, protection of colloids, gels,emulsions, surfactants and micelles.

Surface phenomenon

Surface tension of liquids-capillary action, experimental determination of surface tension, temperature effect on surface tension. Viscosity of liquids, experimental determination of viscosity coefficient, its variation with temperature.

Kinetc theory of gases, ideal gas laws based on kinetic theory. Collision in a gas-mean free path, collision diameter, collision number. Behaviour of real gases-the van der Waal's equation. Critical phenomena-critical constants of a gas and their determination.

Hardness:

Chemistry of Hydrogen, Hydrogen peroxide including manufacturing and structure, Heavy

Hydrogen, Heavy water, ortho and Para Hydrogen. Hardness of water, removal & estimation of hardness

Organic Compounds:

Classification, and Nomenclature, Hybridization, Shapes of molecules.

Electronic Displacements: Inductive, Electromeric, Resonance effects and Hyperconjugation. Homolytic and Heterolytic fission. Electrophiles and Nucleophiles. Types, shape and relative stability of intermediates (Carbocations, Carbanions, Free radicals and Carbenes). Introduction of organic reactions : Addition, Elimination and Substitution reactions.

Recommended Books:

1. B. R. Puri, L. R. Sharma, and M. S. Pathania.37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
2. P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
3. I. L. Finar , Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.

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PhDCY 103(3 to 11) Chemistry: OPTIONAL

Note: Student has to choose one of the following papers. There is provision to add more optional papers subject to the availability of manpower in concerned field.

1. Surfactants (PhDCY-103)
2. Conducting polymers (PhDCY-104)
3. Coordination chemistry (PhDCY-105)
4. Thermodynamics(PhDCY-106)
5. Chemistry of natural products. (PhDCY-107)
6. polymers(PhDCY-108)
7. Electrochemistry(PhDCY-109)
8. Chemical kinetics(PhDCY-110)
9. Heterocyclic Compounds (PhDCY-111)

Surfactants (PhDCY-103)

Surfactants and their classifications; Surface and interfacial tensions and free energies; Colloidal interactions in water; Colloidal stability; Adsorption and adhesion. Kinetics of adhesion/adsorption; Surface properties of clays and other minerals; Biosurfaces; Association colloids formed by surfactants: micelles, bilayers, microemulsions, surfactant phase behavior; Detergency & emulsions; Polymer structure and properties in solid state & solution; Applications of surfactants and polymers in paints & coatings; Characterization of colloids and surfaces; Colloid & surface phenomena in product design; Nanotechnology. enhanced oil recovery

Books:

1. W. Adamson & A. P. Gast: "Physical Chemistry of Surfaces", 6th ed., Wiley, 1997.
2. J. N. Israelachvili: "Intermolecular and Surface Forces", 2nd ed., Academic Press, 1992.
3. P. C. Hiemenz & R. Rajagopalan: "Principles of Colloid and Surface Chemistry", 3rd ed., Marcel Dekker, 1997.

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Syllabus

Of

Pre-Ph.D. Course Work

In

Physics

Department of Physics
Invertis Institute of Humanities & Applied Sciences

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DPY-191 GENERAL PHYSICS

Mathematical Physics

Legendre equation: Generating function, recurrence relations and special properties, Orthogonally, Legendre polynomials. Bessel function of first and second kind, Generating function, recurrence relations for Bessel's functions Linear differential equation of first and second order and its applications (Electrical Circuits, SHM, Simple pendulum and oscillations of spring- free, forced and damped), Partial differential equations and its applications (Laplace, wave and heat equations).

Classical Mechanics

Newton's Laws and their meaning, simple applications conservation laws, Constraints and constraint forces, Principle of virtual work and D'Alembert's principle, Lagrange's equations, Integrals of motion, Rotating frames of reference and terrestrial applications.

Quantum Mechanics

Origin of quantum mechanics, de-Broglie matter waves, Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Wave function and its significance, Schrödinger's wave equation, Motion of particle in one dimensional box: Normalisation of wave function, Energy Eigen value of a particle.

Recommended Books:

1. Artken & Weber, *Mathematical methods for Physicist*, Academic Press- N.Y.
2. J. W. Brown, R.V .Churchill, *Complex Variables and Applications,* Mc-Graw Hill.
3. Classical Mechanics – Rana – Joag. TMH.
4. Mathematical Methods of Classical Mechanics – V. I. Arnold. Springer.
5. Quantum Mechanics: L.I. Schiff (McGraw Hill)
6. P. M. Mathews and K. Venkatesan, *A Text-book of Quantum Mechanics,* Tata mcgraw- Hill.

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DPY 192 (1 to 9) PHYSICS: OPTIONAL

Note: Student has to choose one of the following papers. There is provision to add more optional papers subject to the availability of manpower in concerned field.

1. Atoms and Molecules
2. Classical Mechanics
3. Electrodynamics
4. Mathematical Methods in Physics
5. Nuclear Physics
6. Quantum Mechanics
7. Statistical Mechanics
8. Solid State Physics
9. Electronics

ATOMS AND MOLECULES

Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment;

Spectrum of Hydrogen, helium and alkali atoms;

Relativistic corrections for energy levels of hydrogen; Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling; Zeeman, Paschen Back & Stark effect;

X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift;Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank – Condon principle and selection rules;

Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length.

Books:

1. Quantum Physics of Atoms, Molecules, Solids, Nuclei and particles by R. Eisberg and R. Resnick (John Wiley)
2. The elements of Physical Chemistry by Atkins (Oxford)
3. Quantum Chemistry, by I. N. Levine (Prentice Hall)
4. Atomic and Molecular Physics by H. E. While (East-West Press).

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PHD184 - STATISTICAL INFERENCE

Approved 10.8.17

Ph. D. Course Work (Statistics)

Paper -2

STATISTICAL INFERENCE

Unit 1: Extension of Cramer-Rao inequality for multi-parameter case, Bhattacharya bounds, information in data about the parameters as variation in likelihood function. Ideas of sufficient and minimal complete-sufficient statistics, sufficiency when the range of variate depends on parameter, minimum variance unbiased estimators, Rao-Blackwell and Lehman-Scheffe theorems, examples based on some standard distributions.

Unit 2: Consistent Asymptotic normal estimators and their properties, CAN estimators obtained by ML method in one parameter exponential case. Invariant estimators, location and scale invariant estimators, Pitman's method for obtaining location and scale invariant estimators.General decision problems, loss function, risk function, estimation and testing viewed as general decision problems, minimax decision, Bayes decision.

Unit 3: Neyman-Pearson lemma, generalized Neyman-Pearson lemma, monotone likelihood ratio families, UMP tests for one and two sided alternatives, admissibility and unbiasedness of tests, type A and type A1 tests, similar tests, tests having Neyman structure, likelihood ratio test (LRT) asymptotic distribution of LRT statistic.Interval estimation, confidence level, construction of shortest expected length confidence interval, Uniformly most accurate one-sided confidence Interval and its relation to UMP tests for one-sided null against one-sided alternative hypotheses.

Unit 4: Prior distribution, subjective determination of prior distribution. Improper priors, non-informative (default) priors, invariant priors. Conjugate prior families, construction of conjugate families using sufficient statistics,mixtures of conjugate priors, hierarchical priors, Bayes estimation under squared error loss, some simple illustrations based on binomial, Poisson, and normal distributions, procedure for obtaining minimax estimators from Bayes estimators.

Unit 5: Bayes sufficiency, summary through posterior, predictive inference. Bayesian decision theory: Bayes solutions for practical decision problems. Point estimation, credible sets, testing of hypotheses. Comparison with classical procedures. Admissibility and minimaxity of Bayes and generalized Bayes procedures. Ideas on Bayesian robustness

References:

1. Berger, J.O. : Statistical Decision Theory and Bayesian Analysis, Springer Verlag.
2. Robert, C.P. and Casella, G. : Monte Carlo Statistical Methods, Springer Verlag.
3. Leonard, T. and Hsu, J.S.J. : Bayesian Methods, Cambridge University Press.
4. Bernando, J.M. and Smith, A.F.M. : Bayesian Theory, John Wiley and Sons.
5. Robert, C.P. : The Bayesian Choice: A Decision Theoretic Motivation, Springer.
6. Gemerman, D. : Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference, Chapman Hall.
7. Box, G.P. and Tiao, G.C.: Bayesian Inference in Statistical Analysis, Addison-Wesley.

PHD185 - DESIGN OF EXPERIMENT & RELIABILITY

Approved
10.8.17

Ph. D. Course Work (Statistics)

Paper-3

DESIGN OF EXPERIMENT & RELIABILITY

Unit 1: Review of linear estimation and basic designs, missing plot technique: General theory and applications, Analysis of Co-variance for CRD and RBD. Incomplete block design: Balanced incomplete block designs, simple lattice designs.

Unit 2: General factorial experiments, factorial effects; best estimates and testing the significance of factorial effects; study of 2^n and 3^r factorial experiments in randomized blocks; complete and partial confounding, construction of symmetrical confounded factorial experiments, fractional replications for symmetrical factorials, split plot and strip-plot experiments.

Unit 3:Reliability concepts and measures; components and systems; coherent systems; Reliability of coherent system; cuts and paths; modular decomposition; bounds on system reliability; structural and reliability importance of components. Life distributions; reliability function; hazard rate; common life distributions – exponential, Weibull, gamma, normal, etc.; Estimation of parameters and tests in these models.

Unit 4: Non parametric Test: Testing of hypotheses under nonparametric setup. Review of single sampling problems(Tests of randomness, tests of goodness of fit, the problem of location). Two sample problems: Sign test, Wald Wolfowitz run test. Mann Whitney Wilcoxon test, median test, K-S test, Kendall's Tau, Rank Correlation, Kruskal Wallis test, Friedman's two way ANOVA by ranks, Asymptotic relative efficiency.

References :

1. AlokDey (1986): Theory of Block Designs, Wiley Eastern.
2. Angela Dean and Daniel Voss (1999): Design and Analysis of Experiment, Springer.
3. Das, M. and Giri, N. (1979): Design and Analysis of Experiments, Wiley Eastern.
4. Joshi, D.D. (1987): Linear Estimation and Design of Experiments, Wiley Eastern.
5. Saunders, S.C. (2007): Reliability, Life testing &the Prediction of Service Lives, Springer.
6. Lawless, J. (2003): Statistical Model & Methods for life time data. Wiley Interscience.

(Dr. Gaurav Shukla)

Anwheel
Dr. Anwheel Mishra

Santosh.

With effect from the session from 2015 - 2016

Paper I: Algebra, Differential Geometry and Modeling

Time: 03 hrs **Subject Code: Phd-062** **3+1+0**

Max. Marks: 100

Module I

Algebra: Number theory, Division algorithm, Euclidean algorithm, Euler's phi function, farmat's theorem, willson's theorem, linear congruences, Chinese remainder theorem,
Group Theory: Sub group, permutation group, cyclic group, quotient group, normal subgroup, Finite group: lagrange theorem, sylows therems, Ring, Field, reducible and irreducible polynomial,
Linear Algebra: Vector Spaces, Sub spaces, basis and dimension, linear transformation, rank-nullity theorem, matrix of a linear transformation, transition matrix, inner-product space, norm space, gramme-schmidt orthogonalization process.

Recommended Books

1. Kenneth M Hoffman & Ray Kunze, *Linear Algebra* (2nd Edition), Prentice Hall publications
2. Joseph A. Gallian, *Contemporary Abstract Algebra* (4th Edition), Narosa Publishing House, New Delhi, 1999.
3. I. N. Herstein, Topics in Algebra, Wiley Eastern, 1975.

Module-II

Differential Geometry: Tensor calculus, Curves in space R^3, curvature and torsion of smooth curves, Frenet-Serret formulae, osculating circle, osculating sphere, spherical indicatrices, involutes and evolutes, fundamental theorem of space curves, second and third fundamental forms, surfaces in $R3$, regular surfaces, level sets of smooth functions on $R3$, surfaces of revolution, tangent vectors, tangent plane. geodesics, geodesics on a surface of revolution, geodesic curvature of a curve, Gauss-Bonnet Theorem (statement only).

Mathematical Modeling Simple situations requiring mathematical modeling, Characteristics and limitations of mathematical models, linear growth and decay models, Non linear growth and decay models, Compartment models, Mathematical models through difference equations Basic theory of linear difference equations with constant coefficients, economic and finance, population dynamic and genetics. Situations that can be modeled through graphs, Directed graphs, signed graphs, and weighted digraphs.
Mathematical modeling through linear programming, Transportation and assignment models, Game Theory, Network Model, Goal Programming, Non linear programming problems, Kuhn- Tucker conditions.

Approved 5.2.16

Recommended Books

1. C. E. Weatherburn, *An Introduction to Riemannian Geometry and the Tensor Calculus*, Cambridge University Press, 2008.
2. P.K. Nayak, *A Book on Tensor Calculus and Riemannian Geometry*, Narosa publication
3. J. N. Kapur, *Mathematical Modeling*, Wiley Eastern.
4. D. N. Burghes, *Mathematical Modeling in the Social Management and Life Science*, Ellie Herwood and John Wiley.
5. H. A. Taha, *Operations Research –An Introduction*, Macmillan.
6. G. Hadley, *Nonlinear and Dynamic Programming*, Addison Wesley

6/02/16

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With effect from the session from 2015 - 2016

Time: 03 hrs **3+1+0**
Max. Marks: 100

Paper II: Analysis and Differential Equations
Subject Code: Phd-063
Module I:

Real Analysis: Real number system and its order completeness, sequences and various tests of convergence and divergence of series of real numbers. Continuity and differentiability (single and several variables)

Complex Analysis: - Analyticity, Cauchy's residue theorem, evaluation of definite and improper integrals using contour integration, meromorphic functions, argument principle, Rouche's theorem, open mapping theorem, singularity and residue at ∞. Conformality, Möbius transformations, the group of Möbius transformations, Cauchy's therems on Integrabilty and differentialbilty of complex functions,

Metric spaces: completeness, connectedness, compactness, Basic topology.
Functional Analysis Inner product Spaces, Normed Spaces, Banach Spaces, Linear operators Linear Functionals and Hilbert Spaces.

Recommended Books:

1. Walter Rudin, *Principle of Mathematical Analysis*, Mcgraw Hill, Third Edition
2. Erwin Kreyszig, *Introduction to Functional Analysis with Applications*, John Wiley & Sons.
3. H.S. Kasana, *Complex Variables: Theory and Applications*, PHI Learning Pvt. Ltd.

Approved
6-2-16

Module II

Differential Equations
ODE:- Initial value problems, Existence and Uniqueness theorem, Series solution around an ordinary point and a regular singular point, Method of Frobenius, Bessel, Legendre and Hypergeometric equations, Confluent Hyper geometric equation, Self adjoint eigen value problems, Green's functions, Second order boundary value problems, Sturm Liouville problems.

PDE:- Linear and quasi linear equations, Partial Differential Equations of second order with constant and variable coefficients, Classification and reduction of second order equations to canonical form, Cauchy's, Neumann and Dirichlet's problems, Solution of Laplace and Poisson's equations in two- and three-dimensions by variable separable method, Solutions of homogeneous and non-homogeneous wave and heat equations.

Recommended Books

1. B.Rai, D.P.Choudhary, H.I.Freedman, *A Course in Ordinary Differential Equations*, Narosa Publishing House, New Delhi
2. K.Sankara Rao, *Introduction to Partial Differential Equations*, Prentice – Hall of India, New Delhi - 110001

DRM-101 RESEARCH METHODOLOGY for Engineering Stream

UNIT I

Research Topic: selection of problems, stages in the execution of research, preparation of manuscript and report writing. Search engines: google, pubmed, google scholar, EMBL, etc. Publication of Report in Journals: Standard of research journals, impact factor, citation index, H index, and more. Proof reading, reading journals and review.

UNIT II

Introduction of computer science- Database management systems, presentation graphics, management of data by office applications: MS-office, MS-Word, MS-Excel, and MS-PowerPoint. Generation and analysis of data, basics of softwares: Matlab and Labview.

LaTeX overview – document classes, Packages, document environment, Block structure, and special pages.

UNIT III

Measures of dispersion: sampling methods: random sampling - types of variables: qualitative and quantitative variables - continuous and discontinuous variables - scaling method – mean - standard deviation-standard error - coefficient of variation. Comparison of means: chi square test, student's t test and ANOVA.

UNIT IV

Spectrophotometer: principle and applications, Ultra violet, Infra Red, 1H, Nuclear magnetic resonance (NMR), fundamental and procedure of chromatography. Principle and application of electron microscopy, scanning electron microscopy, transmission electron microscopy, X-ray diffraction.

REFERENCE BOOKS

- Statistical methods, Snedecor, G, W. and W.G. Cohran, 1978. Oxford and IBH publishing CO Pvt. Ltd.
- Biometry, Sokal, R.R. and F.J.Rohlf, 1981. W.H. Freeman, NewYork.
- Authoring a PhD, thesis: how to plan, draft, write and finish a doctoral dissertation, Duncary, P. 2003. Macmillan, pp 256.
- Biostatistical analysis, Zar, J.H., 1996. Prentice Hall, Uppar Saddle River, newjersy, USA.
- Scientific courses and presentations, Martha Davis, 2005. Academic press, Tokyo.pp.356

16.1.14

16.1.2014