COURSE STRUCTURE

AND

DETADJED SYLLABUS OF

Applied Science & Life Science

FOR

M.Sc TWO YEAR DEGREE COURSE

(1,11,111&IVSem.)

BHAGWANT UNIVERSITY

SIKAR ROAD, AJMER - 305001

RAJASTHAN, INDIA

BHAGWANT UNIVERSITY

Faculty of Applied Science & Life Science

ORDINANCES GOVERNING

PG-M.Sc.

Course for semester Scheme

2016-17

DEPARTMENT VISION

We inspire and enable a better world through our scholarship and teaching about management and organizations. To achieve academic excellence in Applied by imparting in depth knowledge to the students, facilitating research activities and cater to the ever changing industrial demands and societal needs.

To educate the students in the recent developments of Applied Science in Mathematics, Physics and Chemistry, encourage research activities and innovative techniques, develop employability skills so as to equip them excel globally.

DEPARTMENT MISSION

1. To build a vibrant and supportive community of scholars by markedly expanding opportunities to connect and explore ideas.
2. To provide quality PG education to the students through state of art education.
3. To provide a learning environment that helps students to enhance problem solving skills, be successful in their professional.
4. To establish Industry Institute Interaction to make students ready for the industrial environment.
5. To promote research based projects/activities in the emerging areas of Mathematics, Physics and Chemistry.
6. To bring out the students as committed and employable technocrats in the field of Electrical and Electronics Engineering.
7. To prepare the students for addressing societal challenges through competitive and innovative research. To ensure the graduates acquire leadership qualities and commitment towards lifelong learning.

PROGRAM EDUCATIONAL OBJECTIVES

Promote the education of mathematics, science, and general education. Strengthen academic research and academic exchange. Improve industry-academia cooperation and community service. Demonstrate a breadth and depth of knowledge in the discipline of Mathematics, Physics and Chemistry.

Program Educational Objectives are broad statements that describe the carrier and professional accomplishment that the program is preparing PG to achieve after PG.

The **Program Education Objectives** (PEO's) of Mathematics, Physics and Chemistry Programme are:

1. To equip the students with knowledge in design and control of emerging Mathematics, Physics and Chemistry systems and create a scope for addressing the industrial and societal needs.
2. To instill computing skills for multi-disciplinary approach, team work and ethical attitude
3. To empower the students for meaningful research, innovation and lifelong learning.

PROGRAM OUTCOMES

1. **Engineering Knowledge:** Apply the knowledge of Mathematics, Physics, Chemistry, Science, Engineering fundamentals, and an Applied Science specialization to the solution of Mathematics, Physics, Chemistry, Science.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principle of mathematics, natural science and engineering science.
3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modem engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assist societal, health, safety, legal and cultural issues and consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solution in societal and environmental contexts, and demonstrates the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with the society at large such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

1. Analyze, design and provide an Applied Science & Life Science solution in the areas of Mathematics, Physics, Chemistry, and Science.
2. Analyze, design and provide an Applied Science & Life Science solution in the areas of Science and Engineering.

Ordinances Governing PG courses

(Applied Science & Life Science)
2 Years leading to Post Graduate Course

1. **APPLICABILITY:**
   This Ordinance shall apply to Post Graduate - M.Sc. for semester scheme
2. **DEFINTIONS:**
   a) **Academic Programme /Programmes** shall mean a programme of course and /or any other Component leading to the degree of PG courses.
   b) **Academic Year** is a period of 12 months devoted to completion of requirements specified in the scheme of teaching and the related examinations.
   c) **Board of Studies (BOS)** shall mean the Board of Studies of the Faculty / Institute concerned.
   d) **Course** means a component of the academic programme, carrying a distinctive code no. and specific Marks assigned to it.
   e) **Three hour** lecture each theory Paper /2 hour lab/ per week.
   f) **University** shall mean Bhagwant University.
   g) **Faculty** shall mean Faculty of Applied Science & Life Science.
   h) **Examiner** shall mean an examiner who is not in the employment of the University.
   i) **Semester System** - A programme wherein each academic year is apportioned into two parts known as semesters.
   j) **Student** shall mean a person admitted and registered for degree programme in the Faculty of Applied Science & Life Science.
3. **ADMISSION**
   Admission to 2 years (PG) course leading to degree programmes will be made as per the mles prescribed by the Academic Council of the University.

ELIGIBILITY FOR ADMISSION

(a) No candidate shall be eligible for admission unless he/she has passed as per detail given below

Course	Name of Faculty	Duration in Year		Eligibility
		Min	Max	
M.Sc.	Faculty of Life Science & Applied Science	2 -PG	3	Graduate with B.Sc. (Science Stream)

(b) Has cleared the eligibility test such as University Entrance Exam/Any other National or State examination which is considered to be equivalent.

(c) Rules for student migrated from other university/ Board-
Student pursuing PG courses of recognized state university/ board may be permitted to migrate to this university in accordance of this university. For such case student admitted upto 3rd semester has to reappear in the subject in the university exam hack paper for which for which equivalence standard has not been met as per standard of Bhagwant University. University shall make an

Equivalence Committee for the determining purpose of equivalence and decision of Vice-Chancellor shall be final.

DURATION OF COURSE

(a) Total duration of the Course leading to degree programmes shall be 2Year for P.G. Course, each year comprising of two semesters.

(b) The Maximum permissible period for completing a programmes for which the prescribed PG Programme duration is n (number of semester) semesters, shall be (n+2) semester. Under very special circumstances, the total period may further be extended by 2 semesters with the approval of the Vice-Chancellor. This excludes the period of expulsion or suspension by the University/medical leave.

4. MINIMUM REQUIREMENT TO PASS A SUBJECT

The student should prepare two assignment / quiz submitted to respected HOD's as per Academic calendar to pass the sessional + Theory part of the subject 40% Marks with Complete continuous evaluation.

5. MINIMUM REQUIREMENT TO GET PROMOTED IN NEXT SESSION

a. The student should clear at least 25 % subject (Theory + Practical) of studying year to get promoted in next year, (this includes fail and absent subject) even after missing or not appear in any semester.

[Example Sem -I Comprising 6 Theory and 4 Practical's, Sem-2 comprising 6 Theory and 2 Practical total 18 subjects. Candidate to pass at least 25% of 18 equal 4.5 =5 total courses to pass in both sem I & II]

All the student will be promoted to next academic year provided they have fulfilled attendance and Examination requirement, **b.** Grace

1% of Grand Total Marks of a semester distributed up to 25% of total subjects.

6. CURRICULAM AND MINIMUM MARKS REQUIREMENT.

2 Semester per Year	Total 4 Semester for P.G.
Time	16-18 Week / semester
Class hours per week	24 Class Hours

A candidate for a pass at each of the semester examination shall be required to obtain

a) At least 40 % marks in the aggregate of each papers with Continuous Evaluation through Assignment / Quiz Viva, Seminar, Test prescribed for the examination

Paper	Max Marks	Total Marks	Min Pass Marks
Theory	70	100	40
Continuous Assignment / quiz/ test/ Viva/ Seminar	30		
Practical (Internal =50, Extemal=50)	100	100	40

b) Provided that if a candidate fails to secure at least 40% marks in each individual paper in the examination and also in the project work/seminar.

c) The minimum Marks requirement for Graduate/ Post Graduate degree should be 40% marks aggregate.

7. **ATTENDANCE**

All Students are normally expected to have and attendances of 75% in each subject. The Vice-Chancellor may give relaxation up to 15% on account of illness and other pre-approved occasion. However, under no circumstances. A student with an attendance of less than 60% in a subject, shall be allowed to appear in the semester-end examination of that subject

In case any student appears in the examination by default, who infect has been detained by the institute on account of attendance shortage his or her result shall be treated as null and void.

8. **CANCELLATION OF ADMISSION**

The admission of a student at any stage of study shall be cancelled if:

a) He/She is not found qualified as per UGC/State Govemment/university norms and guidelines or the eligibility criteria prescribed.

or

b) He / She is involved in ragging.

or

c) He / She is found unable to complete the course within the stipulated time as prescribed.

d) He/She is found involved in creating indiscipline in the Faculty/College or in the University.

e) Fee Arrears

9. **BOARD OF STUDIES**

The constitution of the Board of Studies shall be :

(a) The HOD's of the Faculty (Chairperson)

(b) All Professors

(c) Two Associate Professors

(d) One Assistant Professors

(e) One Expert Member from outside University

(f) One external member from within University.

10. **ACADEMIC PROGRAMME COMMITTEE**

(a) There shall be an Academic Programme Committee in the Department / Faculty of the University.

(b) All the teachers of an Faculty of Study shall constitute the Academic Programme Committee of which the HOD'S of the Faculty shall act as its Chairperson. This Committee shall coordinate the implementation of the courses for optimum utilization of resources and shall also take care of the coordination of the PG

programmes with the other programmes run by the different Faculty of the University.

(c) The Academic programmes Committee shall meet as and when required. But at least once every semester. The Chairperson of the Committee will convene the meetings.

11. **EVALUATION**

The examination of the university will be open to all regular/ re-admitted / ex-student who have undergone a course of study in the university for a period specified for the programmed of study in the teaching and evaluation scheme and are not debarred from appearing in the end - semester examinations as provided in the applicable ordinance of the university.

(a) The overall weightage of a course in the Syllabi shall be determined in terms of marks assigned to the course.

(b) The distribution of weightage for various components of evaluation shall be as defined in the Teaching & Evaluation Scheme.

(c) Conduct of Semester-End Examination :-

(i) All semester - end examination shall be conducted by the Controller of Examinations.

(ii) The schedule of examination shall be notified by the Controller of Examination at least 10 days prior to the first day of the commencement of semester - end examination.

(iii) For theory as well as practical examination as viva-voce, the concerned subject teacher (s) shall be the Internal Examiners. In case any External Examiners are desired, then the same shall be appointed by the Controller of Examinations the recommendations of the Head of the Department and approval of ViceChancellor of the university.

(d) Assessment:

All courses undertaken by students are evaluated during the semester using internal system of continuous assessment. The students are evaluated on Seminar, Viva ,class , tutorial participation, lab work, assignment, quiz and end semester examinations, which contribute to the final marks awarded for the subject. Students will be notified at the commencement of each courses about the evaluation methods being used for the courses and weightage given to the different assignments and evaluated activities.

In order to make the evaluation system as similar and transparent with any of the globally reputed educational institutions like MDS & Rajasthan University. Here marks obtained in the continuous assessment(Assignment / Quiz etc) and end semester examination are added together.

Distribution of Marks

Courses Theory & Assignment/quiz components

Assignment / Quiz/ Seminar/Test/Viva	= 30
End - Term Examination	= 70
Total	= 100

Course with Practical Components

Internal Practical (Exam Continuous evaluation, Record)	= 50
External (Practical Exam, Viva Voce)	= 50
Total	= 100

The students, who are not satisfied with the mark awarded, may opt for re- evaluation of the mark in the subject not more than 25% of total subject. For this he has to submit the prescribed application with fee to examination with ini 5 days of the declaration of result.

13. **IMPROVEMENT:**

If the student whishes to improve his final division he may he permitted to apply for improvement is permitted for candidate who wish to improve them division from pass / II division. Students having overall percentage such that they are awarded less then 1st Division will he permitted to appear for improvement with in a years of declaration of result. They will be permitted to appear in any paper / subject in which score is less 60 (below 1st Division Marks). Improvement examination will be conducted in that subject for which regular/ back examination is being conducted in that period, for conducting special / Improvement examination a special fee to cover incidental expanses will be charged.

14. **DETERMINATION OF DIVISION ON DEGREE:**

S.No	Division	Equivalent percentage %
1	1“ Division with Distinction	75.00 but less than 100
2	1“ Division	60.00 but less than 75.00
4	2"[a] Division	48.00 but less than 60.00
5	Pass	40.00 but less than 48.00

Note:

(a) 1st Division with Distinction: 75% or more in the total aggregate all semester.

(b) 1st Division: 60% or More in the total aggregate all semester.

(c) 2nd Division: 48% or more in the total aggregate all semester.

(d) Pass: 40% or more in the total aggregate all semester.

15. **USE OF UNFAIR MEANS:**

All reported cases for use of unfair means in the examination shall be placed before a Standing 'Unfair Means Hearing Committee' for decision on case basis. The actions under the category of 'Use of Unfair Means' and procedure for dealing with such cases of suspected/alleged/reported use of unfair means shall be specified by the Academic Council.

The following would be considered as unfair means adopted during examinations and other contexts:

a) Communicating with the fellow students for obtaining help.
b) Copying lfom the other student's script/report/paper etc.
c) Possession of any incriminating document whether used or not.
d) Any approach in direct or indirect form to influence teacher/ invigilator.
e) Unruly behavior, which disrupts academic environment.

16. **STUDENTS GRIEVANCE COMMITTEE:**

In case of any written representation /complaints received from the students within seven days after completion of the examination regarding setting up of the question paper etc. along with specific recommendations of the course Co-ordinators & HOD's of the Institute, the same shall be considered by the Students Grievance Committee to be constituted by the Vice-Chancellor The Vice Chancellor shall take appropriate decision on the recommendations of the Students Grievance Committee, before the declaration of result (s) of the said examination.

17. **AWARD OF DEGREE**

A student shall be awarded a degree if:

a) He / She has registered himself/herself, undergone the course of study, fulfilled the all requirements and secured the minimum Marks prescribed for award of the concerned degree.
b) Completion of all prescribed courses.
c) Passing of all courses individually with minimum Overall marks with 40 %.
d) There are no dues outstanding in his/her name of a Faculty of the University/constituent Institution And
e) No disciplinary action is pending against him/her.

18. Not withstanding anything stated in this Ordinance, for any unforeseen issues arising, and not covered by this Ordinance, or in the event of differences of interpretation , Vice Chancellor may take a decision after obtaining, if necessary, the opinion/ advice of a Committee consisting of any or all the Directors of the Institutes. The Decision of the Vice-Chancellor shall be final.

Course Category

PSTA : Post Graduate (M.Sc) in Statistics

CCC: Compulsory Core Course ECC: Elective Core Course

Contact Hours:

L: Lecture T: Tutorial

P: Practical or Other

Marks Distribution:

IA: Internal Assessment (Attendance/Classroom Participation/Quiz/Home Assignment etc.)

EoSE: End of Semester Examination

First Semester:-

S. No.	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	01PSTA101	Real Analysis	CCC	3	0	3	0	30	70	100
2	01PSTA102	Linear Algebra	CCC	3	0	3	0	30	70	100
3	01PSTA103	Measure Theory & Probability	CCC	3	0	3	0	30	70	100
4	01PSTA104	Sample Survey	CCC	3	0	3	0	30	70	100
5	01PSTA201	Statistics Lab	CCC	0	6	0	6	50	50	100
									Total	500

Second Semester:-

S. No.	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	02PSTA101	COMPLEX ANALYSIS,TRANSFORM & SPECIAL FUNCTIONS	CCC	3	0	3	0	30	70	100
2	02PSTA102	THEORY OF PROBABILITY & LIMIT THEOREMS	CCC	3	0	3	0	30	70	100
3	02PSTA103	LINEAR MODEL & REGRESSION ANALYSIS	CCC	3	0	3	0	30	70	100
4	02PSTA104	MULTIVARIATE ANALYSIS	CCC	3	0	3	0	30	70	100
5	02PSTA201	Statistics Lab	CCC	0	6	0	6	50	50	100
									Total	500

Third Semester:-

S. No.	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	03PSTA101	SART	CCC	3	0	3	0	30	70	100
2	03PSTA102	INFERENCE	CCC	3	0	3	0	30	70	100
3	03PSTA103	BLOCK DESIGNS &THEIR ANALYSIS	CCC	3	0	3	0	30	70	100
4	03PSTA104	ECONOMETAICS	CCC	3	0	3	0	30	70	100
5	03PSTA201	Statistics Lab	CCC	0	6	0	6	50	50	100
									Total	500

Fourth Semester:'

S. No.	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	04PSTA101	Asymptotic Inference	CCC	3	0	3	0	30	70	100
2	04PSTA102	Stochastic Processes	CCC	3	0	3	0	30	70	100
3	04PSTA103	Decision Theory and Bayesian Analysis	CCC	3	0	3	0	30	70	100
4	04PSTA104	Factorial Experiments and Response surfaces	CCC	3	0	3	0	30	70	100
5	04PSTA201	Statistics Practical & Project	CCC	0	6	0	6	50	50	100
									Total	500

First Semester:

01PSTA101 **Real Analysis**

UNIT-I

Metric Space and examples, open sets, closed sets, neighbourhood, unitary space, Euclidean space, Sequences in Metric spaces and convergence.

UNIT-II

Cauchy sequences, complete metric spaces and examples, Baire's theorem, Continuity, spaces of continuous functions, monotonic functions.

UNIT-ra

Compactness, sequential compactness, functions continuous on compact sets, Bolzano-Weierstrass property, connectedness, components, Uniform continuity, totally disconnected.

UNIT-IV

Functions of Bounded variation, Total variations, functions of bounded variations expressed as difference of increasing functions, continuous function of bounded variations, Riemann and Riemann-Stieltjes integral.

Text Books:

1. Tom M. Apostol, Mathematical Analysis, Addition -Wesley.
2. G. F. Simmons, Introduction to Topology and Modem Analysis, McGraw-Hill Ltd.

Reference Books:

1. Walter Rudin, Principles of Mathematical Analysis, 3rd edition, McGraw-Hill, Kogakusha, 1976, International Student Edition.
2. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International Publishers.
3. H. L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
4. D. Somasundram and B. Chaudhary, A first course in Mathematical Analysis, Narosa Publishing House, New Delhi. 5. Terence Tao, Analysis n, Hindustan Book Agency, 2006.

01PSTA102 Linear Algebra

UNIT-I

Vector Spaces: Definition and Examples, Subspaces, Linear dependence, Basis and Dimension, Sum and Direct Sum, Quotient spaces, Linear Transformations: Kernel and Image of a Linear Transformation, Rank and Nullity of a Linear Transformation, Matrix Mappings.

UNIT-n

Linear Mappings and matrices: Matrix representation of Linear Transformation, Change of Basis, Similarity. Polynomial of matrices, Characteristic polynomial, Cayley Hamilton Theorem, diagonalization, minimal polynomial, companion matrix.

UNIT-in

Canonical and Bilinear Forms: Triangular form, invariance, Primary decomposition, Jordon canonical form, Rational canonical Form, Bilinear and Quadratic forms.

LNIT-IV

Inner Product Space, examples and properties, Norms and Distances, Orthonormal basis, The GramSchmidt Orthogonalization, Orthogonal complements. The Adjoint of a Linear operator on an inner product space, Normal and self-Adjoint Operators, Unitary and Normal Operators.

Text Books:

1. Seymour Lipschutz, Marc Lipson: Linear Algebra, Third Edition, Tata McGraw-Hill. Reference

Books:

1. K. Hoffman and R. Kunze: Linear algebra, Second Edition, Prentice Hall.
2. S. Axler: Linear Algebra Done Right, Second Edition, Springer-Verlag, 2004.
3. S. Lang: Undergraduate Texts in Mathematics, Third Edition, Springer-Verlag, NewYork, 2004.

01PSTA103 **Measure Theory & Probability**

UNIT-I

Sets and sequences of sets. Fields, sigma field, minimal sigma field. Borel field in R^k, Monotone classes, Set function, Measure, Probability measure, Properties of measure, Caratheodory extension theorem (without proof). Lebseque measure, Lebesgue-Stieljes measure, Measurable functions and properties.

UNIT-II

Sequence of random variables, convergence in probability, convergence in r-th mean, almost sure convergence, convergence in distribution, Interrelationship among different modes of convergences.

UNIT-in

Integral with respect to a measure and dominated convergence theorems, Product spaces, Fubini Theorem (without proof), Signed measure, Absolute continuity.

UNIT-IV

Radon-Nikodym Theorem (without proof). Lebesgue decomposition theorem. HellyBray theorem, Expectation of random variables, Conditional expectation, Martingales and simple properties, Jensen, Holder, Schwartz Minkowski's Liapounov's inequalities.

REFERENCES

1. Dudewicz, EJ. and Mishra, S.N. (1988): Modem Mathematical Statistics, Wiley, Inti Students' Edition.
2. Rohatgi, V.K. (1984): An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
3. Rao C.R. (1973): Linear Statistical Inference and its Applications, *lie,* Wiley

Eastern. ADDITIONAL REFERENCES

1. Pitman, J. (1983) : Probability, Narosa Publishing House. Johnson, S. and Kotz, (1972) : Distributions in Statistics, Vol. I, II and HI,
2. Houghton and Miffin. Cramer H. (1946): Mathematical Methods of Statistics, Princeton.

UNIT-I

Unequal probability sampling: pps wr and wor methods (including Lahiri's scheme) and related estimators of a finite population mean (Hansen-Hurwitz and Desraj estimators for general sample size and Murthy's estimator for a sample of size 2).

UNIT-II

Horvitz-Thompson estimator, its variance and unbiased estimator of variance, IPPS schemes of sampling due to Midzuno-Sen, Rao-Hartley-Cochran and Samphord.

UNIT-m

The Jackknife and Bootstrap : estimate of bias, estimate of variance. Ratio Estimation in reference to Jackrite and bootstraps, Relationship between the jackknife and the bootstrap. Interpenetrating sub sampling.

UNIT -IV

Non-sampling errors. Randomized Response techniques (Warner's method : related and unrelated questionnaire methods).

REFERENCES

1. Chaudhuri, A. and Mukeijee, R. (1988) : Randomized Response : Theory and Techniques, New York:
2. Marcel Dekker Inc. Cochran, W.G.: Sampling Techniques (3rd Edition, 1977).
3. Wiley. Des Raj and Chandak (1998): Sampling Theory,
4. Narosa. Murthy, M. N. (1977) : Sampling Theory & Methods, Statistical Publishing Society, Calcutta.
5. Sukhatme et al (1984): Sampling Theory of Surveys with Applications.
6. Iowa state University Press & IARS. Singh, D. and Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey Designs. New Age International Publishers.
7. Gray, H.L., and Schucany(1972): The generalized jackknife statistic. New York. Marcel Dekker, Inc.

01PSTA201 **Statistics Lab**

STATISTICAL COMPUTING/STATISTICS PRACTICAL

1. Microsoft Excel: i) Spread sheet ii) Descriptive Statistics (Univariate) iii) Regression iv) Different kinds of charts including histogram, pie charts & bar charts. Frequency curves.
2. Calculation of bases
3. Gram-Smidt orthonormalization
4. Inverse of matrix 5. Solution of a set of non-homogeneous equations
5. g-inverse of matrix
6. Characteristics roots and vectors S. Reduction and classification of quadratic forms
7. Practical on pps. a. to draw samples by cumulative total method/Lahiri method b. to estimate population mean/population total of the characteristics under study using ordered and unordered samples : Desraj, Murthy and H-T estimators.

Second Semester

02PSTA101 **COMPLEX ANALYSIS,TRANSFORM & SPECIAL FUNCTIONS**

UNIT-I

Functions of a complex variable, limit, Continuity, differentiation, Candy-Riemann equations, Power series, Analytic functions.

UNIT-II

Cauchy's theorem and integral formula, Taylor's and Lauret's series, Residue theorem, Evaluation of standard integrals by contour integration.

UNIT-m

Laplace transform and its properties, Laplace transforms of important functions, Inverse Laplace transforms, Convolution theorem, Solution of ordinary differential equations.

UNIT-IV

Gamma, Hypergeometric Legendre's and Bessel's functions, Elementary properties of these functions.

REFERENCES

1. E.T. Copson: An introduction to the theory of functions of a complex variable.
2. G.F. Simmons : Differential Equations, Tata McGraw Hill.

02PSTA102 **THEORY OF PROBABILITY & LIMIT THEOREMS**

UNIT-I

Weak and strong law of large numbers for independent random variables, Kolmogorov's inequality and theorm, Hazek-Renyi inequality, Levy's inequality and theorem, Uniform integrability.

UNIT - II

Central limit theorems , Lindberg-Levy theorem, Liapounoff theorem, Lindberg-Feller theorem (without proof), Glivenko-Cantelli Theorem.

UNIT - HI

Distribution function, Stieltjes integrals and Riemann Integral, Characteristic function and moments, Inversion theorem, continuity theorem and its applications (CLT for iid random variables and Khintechine's weak law etc.).

UNIT -IV

Infinitely divisible distributions, Convergence of infinitely divisible distributions, Borel- Cantellilemma, borel-zero one law.

REFERENCES

1. Ash, Robert (1972): Real analysis and Probability, Academic Press. Billingsley,
2. P. (1986): Probability and Measure, Wiley. Dudley,
3. R.M. (1989): Real Analysis and Probability, Wadsworth and Brooks/Cole. Kingman,
4. J.F.C. and Taylor, S.J. (1966): Introduction to Measure and Probability, Cambridge University Press.
5. Chow, Y.S. & Teicher, H. (1979) : Probability Theory, Narosa Publishing House, New Delhi
6. Bhat, B.R. (1985): Modem Probability Theory, Wiley Eastern Limited.

02PSTA103 LINEAR MODELS & REGRESSION ANALYSIS

UNIT -I

Generalized inverse, Moore-Penrose generalized inverse. Important results on g-inverse, Use of generalized inverse of matrices, Distribution of quadratic forms for multi-variate normal random vector, Cochran Theorem.

UNIT-II

Linear models of full rank and not of full rank, Normal equations and least squares estimates, BLUE, Gauss-Markov Theorem, Error and estimation spaces, variance and covariances of least squares estimates, estimation of error variance.

UNIT-m

Models containing function of the predictors, including polynominal models, Use of orthogonal models, Hypotheses for one and more than one linear parametric functions, Confidence regions, Analysis of Variance, Power of F-test. Multiple comparison tests due to Tukey and Scheffe, Simultaneous confidence intervals.

UNIT-TV

Selecting the best regression equation : Stepwise regression, backward elimination. Criteria for evaluating equations, residual mean square, Cp and its use, Residuals and their plots. Tests for departure from assumptions of linear models such as normality, homogeneity of variances, Detection of outliers & its remedies, Transformation: Box - Cox transformation. Introduction to non-linear models.

REFERENCES

1. Cook, R.D. and Weisberg, S. (1982): Residual and Influence in Regression.
2. Chapman and Hall. Draper, N.R.and Smith, H. (1998): Applied Regression Analysis, Third Edition Wiley.
3. Guest, R.F. and Mason, R.L. (1980): Regression analysis and its Applications - A Data Oriented Aproach.
4. Marcel and Dekker. Rao, C.R. (1973): Linear statistical inference and its Applications. Wiley Eastern. Weisberg, S. (1985): Applied Linear Regression. Wiley.

02PSTA104 **MULTIVARIATE ANALYSIS**

UNIT -I

Wishart matrix - its distribution and properties, Distribution of sample generalized variance, Null and non-null distribution of simple correlation coefficient, Null distribution of partial and multiple correlation coefficient, Distribution of sample regression coefficients, Application in testing and interval estimation.

UNIT-II

Null distribution of Hotelling's T2 statistic, Application in tests on mean vector for one and more multivariate normal populations and also on equality of the components of a mean vector in a multivariate normal population.

UNIT-m

Classification and discrimination procedures for discrimination between two multivariate normal populations-sample discriminant function, test associated with discriminant functions, probabilities of misclassification and their estimation, classification into more than two multivariate normal populations, Fisher Behren Problem.

UNIT-TV

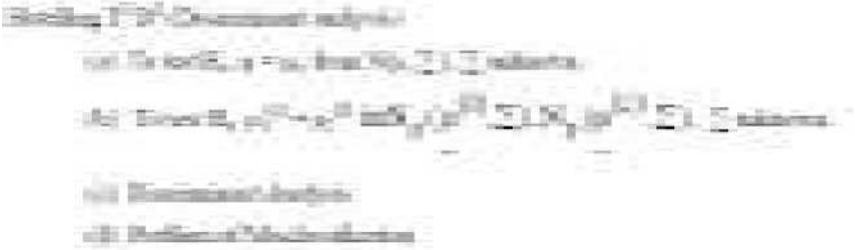
Multivariate Analysis of variance (MANOVA) for one way classified data only, Principal components, dimension reduction, Canonical variables and canonical correlations: definition, use, estimation and computation.

REFERENCES

1. Anderson T.W. (1983) : An Introduction to Multivariate Statistical Analysis (Second Edition) Wiley.
2. Giri, N.C. (1977) : Multivariate Statistical Inference. Academic Press. Khsirsagar A.M. (1972): Multivariate analysis.
3. Marcel Dekker. Morrison, D.F. (1976) : Multivariate Statistical methods. 2nd. Ed. McGRAW Hill. Muirhead, R.J. (1982) Aspects of multivariate statistical theory,
4. J.Willey. Rao CR (1973) : Linear Statistical Inference and its Applications 2nd. Ed. Wiley. Seber, G.A.F. (1984): Multivariate observations.
5. Wiley Sharma, S. (1996): Applied multivariate techniques.
6. Wiley. Srivastava M.S. & Khatri C.G. (1979): An Introduction to Multivariate Statistics.
7. North Holland. Johnson, R. and Wychem (1992) : Applied multivariate Statistical analysis, prentice-Hall, 3rd. Ed.

02PSTA 201 **STATISTICS PRACTICAL**

1. Experiments based on multivariate analysis.

2. 

3. Multivariate Analysis of variance (One way classified data only).

4. Principal components

5. Canonical correlations

6. Factor Analysis

Third Semester

03PSTA101 SEQUENTIAL ANALYSIS AND RELIABILITY THEORY

UNIT -I

Need for sequential procedures, SPRT and its properties. Wald's equation and identity, OC and ASN functions optimality of SPRT.

UNIT-II

Sequential estimation, Stein's two stage procedure. Anscombe Theorem. Chow-Robbin's procedure, Asymptotic consistency and risk efficiency, Estimation of normal mean.

UNIT-m

Reliability concepts and measures, components and systems, coherent systems, reliability of coherent systems cuts & paths, Bounds on system reliability. Life distributions, reliability functions, hazard rate, Common life distributions : Exponential, gamma and Weibull, estimation of parameters and tests in these models.

UNIT-IV

Notion of aging IFR, IFRA, NBU, DMRL and NBUE classes. Different types of redundancy and use of redundancy in reliability improvement, Problem of life testing, censored and truncated experiments for exponential models.

REFERENCES

1. James O Berger (1985) : Statistical Decision Theory and Bayesian analysis. Springer
2. Fergusion T.S. (1967) : Mathematical Statistics - A decisions theoretic Approach. Academic Press
3. Rohtagi, V.K. : An Introduction to Probability Theory and Mathematical Analysis, John Wiley.
4. Wald, A.: Sequential Analysis.
5. Whetherill, G.B. : Sequential Methods in Statistics, Methuen & Co. Ltd., New York, John.
6. DeGroot, M.H.: Optimal Statistical Decisions. McGraw Hill
7. Leonard T and Hsu J.S.J.: Bayesian Methods. Cambridge University Press.
8. Bernardo, J.M. and Smith AFM : Bayesian Theory. John willey.
9. Raiffa, h. & Schlaifer, r. (1961): Applied Statistical Decision Theory.
10. Barlow R E and Proschen F (1985) : Statistical Theory of Reliability and Life Testing, Holt,
11. Lawless J F (1982): Statistical models and methods of life Time Data. John Wiley.
12. Bain L J and Engelhardt (1991) : Statistical Analysis of Reliability and life testing models.

03PSTA102 INFERENCE

UNIT -I

Likelihood function, Sufficiency, Factorization Theorem, Minimal sufficient statistics, Completeness Exponential families of distributions and their properties. Distribution admitting sufficient Statistics, Extension of results to multiparameter case.

UNIT-II

Cramer-Rao bounds, Bhattacharya bounds. Minimum variance unbiased estimators, Rao- Blackwell Theorem. Lehman-Scheffe theorem and their applications.

UNIT - III

Non-randomized and randomized tests. Size, power functions, unbiasedness. NP-Lemma and its applications in construction of MP tests for simple null hypotheses. MLR families.

UNIT-IV

UMP tests for one sided null hypotheses against one-sided composite alternative. Generalized NP lemma, Locally best test, UMPU tests, Similar tests, Neyman structure, UMPU tests against one-sided and two-sided alternatives, Confidence set estimation, Relation with hypothesis testing, optimum parameters confidence sets.

REFERENCES

1. Kale, B. K.(1999) : A first course on parametric inference, Narosa Publishing House.
2. Rohatagi, V. (1988): An Introduction to probability and mathematical Statistics . Wiley
3. Eastern Ltd. New Delhi (Student Edition)

ADDITIONAL REFERENCES

1. Lehmann, E.L.(1986): Theory of point. Estimation (Student Edition)
2. Lehmann, E.L.(1986) : Testing statistical hypotheses (Student Edition).
3. Rao, C.R. (1973) : Linear Statistical inference.
4. Dudewicz, E.J. and Mishra, S.N. (1988) : Modem Mathematical Statistics. Wiley Series in
5. Prob. Math. Stat., John Wiley and sons, New Yark (International Student Edition).
6. Ferguson T. S. (1967): Mathematical Statistics. Academic press.
7. Zacks, S. (1971) : Theory of statistical Inference, John Wiley & Sons, New Yark.

03PSTA103 BLOCK DESIGNS AND THEIR ANALYSIS

UNIT-I

Fixed, mixed and random effects models; Variance components estimation : study of various methods, Tests for variance components.

UNIT-II

General block design and its information matrix (C), criteria for connectedness, balance design and orthogonality: Intrablock analysis (estimability, best point estimates/Interval estimates of estimable linear parametric functions and testing of linear hypotheses).

UNIT-m

BIBD - recovery of interblock information, Youden design - intrablock analysis, Analysis of covariance in a general Gauss-Markov model and its applications to standard designs, Missing plot technique - general theory and applications.

UNIT-IV

Finite group and finite field, Finite geometry: projective and Euclidean, Construction of complete set of mutually orthogonal latin square (mols), Construction of BIBD's using mols and finite geometries, Symmetrically repeated differences, Steiner Triples and their use in construction of BIBD, Lattice Design, Split plot design.

REFERENCES

1. Raghava Rao D. (1971): Construction and Combinatorial problems in Design of experiment.
2. Wiley Aloke Dey (1986): Theory of Block Designs, Wiley Eastern.
3. Angela Dean and Daniel Voss (1999): Design and Analysis of Experiments, Springer.
4. Das, M.N. & Giri, N.(1979): Design and Analysis of experiments, Wiley Eastern.
5. Giri, N. (1986): Analysis of Variance, South Asian Publishers.
6. John P.W.M.(1971): Statistical design and analysis of experiments, Me Millan.
7. Joshi, D.D. (1987): Linear Estimation and Design of Experiments, Wiley Eastern.
8. Montgomery, C.D.(1976): Design and analysis of experiments, Wiley, New York.
9. Meyer, R.H.(1971) : Response surface methodology. Allyn & Bacon.
10. Pearce, S.C.(1984): Design of experiments Wiley, New York.
11. Rao, C.R. and Kleffe, J.(1988) : Estimation of Variance Components and applications, NorthHolland.
12. Searle, S.R., Casella, G. and McCulloch, C.E. (1992) : Variance Components, Wiley.
13. Nigm, Puri & Gupta (1987-88) : Characterisation and Analysis of Block Design, WileyEastem.
14. V.K. Gupta & A.K. Nigam (1978-79) : Handbook an analysis of Agricutture Experiment, IASRI Publication.

03**PSTA**104 **ECONOMETRICS**

UNIT -I

Natute of econometrics, The general linear model (GLM) and its extensions, Use of dummy variables and seasonal adjustment, Generalized least squares (GLS) estimation and prediction, Heteroscedastic disturbances, Pure and mixed estimation, Grouping of observations and of equations.

UNIT-II

Auto correlation, its consequences and tests, Theil BLUS procedure: estimation and prediction, Multicollinearity problem, its implications and tools for handling the problem, Ridge regression.

UNIT-III

Linear regression with stochastic regressors, Instrumental variable estimation, Errors in variables, Autoregressive linear regression, Distributed lag models, Simultaneous linear equations model, Examples, Identification problem, Restrictions on structural parameters - rank and order conditions, Restrictions on variances and covariances.

UNIT-IV

Estimation in simultaneous equations model, Recursive systems, 2 SLS Estimators. Limited information estimators, k - class estimators. 3 SLS estimation, Full information maximum likelihood method, Prediction and simultaneous confidence intervals, Monte Carlo studies and simulation.

REFERENCES

1. Apte PG (1990): Text book of Econometrics. Tata McGraw Hill.
2. Cramer, J.S. (1971): Empirical Econometrics, North Holland.
3. Gujarathi D. (1979): Basic Econometrics, McGraw hill.
4. Intrulligator, MD (1980) : Econometric models - Techniques and applications, Prentice Hall of India.
5. Johnston, J (1984): Econometric methods, 3rd Ed. Me Graw Hill.
6. Klein, L.R. (1962): An introduction to Econometrics, Prentice Hall of India.
7. Koutsoyiannis, A (1979): Theory of Econometrics, Macmillan Press.
8. Malinvaud, E (1966): Statistical methods of Econometrics, North Holland.
9. Srivastava V.K. and Giles D.A.E. (1987): Seemingly unrelated regression equations models.
10. Theil, H. (1982): Introduction to the theory and practice of Econometrics, john Wiley.
11. Walters, A (1970) : An introduction to Econometrics, McMillan & Co.
12. Watherill, G.B. (1986): Regression analysis with applications, Chapman Hall.

03PSTA 201 **STATISTICS PRACTICAL**

1. Experiments based on BIBD
2. Experiment based on Lattice
3. Analysis of Covariance
4. Missing plot techniques
5. Split plot designs
6. Experiment based on system of Reliability
7. ASN & OC functions for SPRT
8. OLS estimation and prediction in GLM.
9. Use of dummy variables (dummy variable trap) and seasonal adjustment.
10. GLS estimation and prediction.
11. Tests for heteroscdasticity; pure and mixed estimation.
12. Tests for autocorrelation. BLUS procedure.
13. Ridge regression.
14. Industrumental variable estimation.
15. Estimation with lagged dependent variables.
16. Identification problems - checking rank and order conditions.
17. Estimation in recursive systems.
18. Two SLS estimation.
19. Simulation studies to compare OLS, 2SLS, LISE and FIML methods.

Fourth Semester

04PSTA101 **ASYMPTOTIC INFERENCE**

UNIT -I

Consistency (mean squared and weak), invariance of consistency under continuous transformation, consistency for several parameters, generating consistent estimators using weak law of large numbers, CAN estimators (single as well as multi-parameter cases), invariance of CAN estimators under differentiable transformations, generation of CAN estimators using central limit theorem.

UNIT-II

Consistency of estimators by method of moments and method of percentiles, Minimum Chi square estimators and their modification and their asymptotically equivalence to maximum likelihood estimators.

UNIT-m

Method of maximum likelihood: special cases as k-parameters exponential family of distribution and multinomial distributions, Computational routines : Newton - Raphson method, method of scoring, Consistency and inconsistency, Cramer Huzurbazar Theorem, Asymptotic efficiency of ML estimators, Best Asymptotically normal estimators. Concept of super efficiency.

UNIT-IV

Large Sample tests : Likelihood ratio (LR) test, asymptotic distribution of LR statistic, Tests based on ML estimators, Wald Test, Score Test. Pearson's chi-square test for goodness of fit and its relation to LR Test, Test consistency, Asymptotic power of test, Generalized likelihood ratio test, special cases such as multinomial distribution and Bartlett's test for homogeneity of variances.

REFERENCES

1. Kale, B.K. (1999) : A First Course on Parametric Inference, Narosa Publishing House.
2. Rohatgi V. (1988) : An Introduction to probability and Mathematical Statistics. Wiley Eastern Ltd. New Delhi (Student Edition)

ADDITIONAL REFERENCES

1. Lehmann, E.L. (1986): Testing Statistical hypotheses (Student Edition)
2. Rao, C.R. (1973) : Linear Statistical Inference.
3. Dudewicz, EJ. and Mishra, S.N. (1988) : Modem Mathematical Statistics. Wiley series in
4. prob. Math. Stat., john Wiley and Sons, New Yark (International Student Edition)
5. Ferguson, T.S. (1996): A course on Large Sample Theory, Chapman and Hall, London.

04PSTA102 STOCHASTIC PROCESSES

UNIT-I

Introduction to stochastic processes (sp's) : Classification of sp's according to state space and time domain, Countable state. Markov chains (MC's), Chapman-Kolmogorov equations, calculation of nstep transition probability and its limit, Stationary distribution, classification of states, transient MC, random walk and gambler's ruin problem.

UNIT-II

Discrete state space continuous time, Markov Chains: Kolmogorov-Feller differential equations. Poisson process, birth and death process, application to queues and storage problems, Wiener process as a limit of random walk, first-passage time and other problems.

UNIT-m

Renewal theory: Elementary renewal theorem and applications, Statement and uses of key renewal theorem, study of residual life time process, Stationary process, weakly stationary and strongly stationary process, Moving average and auto regressive processes.

UNIT-IV

Branching process: Galton-Watson branching process, probability of ultimate extinction, distribution of population size, Martingale in discrete time, inequality, convergence and smoothing properties. Statistical inference in Markov Chains and Markov processes.

REFERENCES

1. Adke, S.R. and Munjunath, S.M. (1984): An Introduction to Finite Markov Processes, Wiley Eastern.
2. Bhat, B.R. (2000): Stochastic Models : Analysis and Applications, New Age International, India.
3. Cinlar, E. (1975): Introduction to Stochastic Process, Prentice Hall.
4. Feller, W. (1968): Introduction to probability and its Applications, Vol.l, Wiley Eastern.
5. Harris, T.E. (1963): The Theory of Branching Processes, Springer - Verlag.
6. Hoel, P.G.. Port, S.C. and stone, C.J. (1972) : Introduction to Stochastic Process, Houghton Mif&n & Co.
7. lagers, P. (1974) : Branching Processes with Biological Applications, Wiley.
8. Karlin, S. and Taylor H.M. (1975) : A First course in stochastic processes, Vol. I Academic press.
9. Medhi, J. (1982): Stochastic Processes, Wiley Eastern.
10. Paizen E. (1962): Stochastic Processes. Holden -Day.

04PSTA103 DECISION THEORY AND BAYESIAN ANALYSIS

UNIT-I

Decision problem and two person game, Utility theory, loss functions, Randomized and nonrandomized decision rules, Optimal decision rules - unbiasedness, invariance, Bayes Rule, Minimax rule, concept of admissibility and completeness Bayes rules, Admissibility of Bayes and minimax rules.

UNIT-II

Supporting and separating hyper plane theorems, complete class theorem. Minimax estimators of Normal and Poisson means.

UNIT-m

Subjective interpretation of probability in terms of fair odds, Evaluation of (i) subjective probability of an event using a subjectively unbiased coin (ii) subjective prior distribution of a parameter, Bayes theorem and computation of the posterior distribution, Natural Conjugate family of priors for a model, Hyper parameters of a prior from conjugate family, Bayesian point estimation as a prediction problem from posterior distribution, Bayes estimators for (i) absolute error loss (ii) squared error loss (iii) 0 -1 loss.

UNIT-IV

Bayesian interval estimation : credible intervals, Highest posterior density regions, Interpretation of the confidence coefficient of an interval and its comparison with the interpretation of the confidence coefficient for a classical confidence interval, Bayesian testing Hypothesis : Specification of the appropriate from of the prior distribution for a Bayesian testing of hypothesis problem, Prior odds, Posterior odds, Bayes factor.

REFERENCES

1. James O Berger (1985) : Statistical Decision Theory and Bayesian analysis. Springer.
2. Fergusion T.S. (1967): Mathematical Statistics - A decisions theoretic Approach. Academic Press.
3. DeGroot. M.H.: Optimal Statistical Decisions. McGraw Hill.
4. Leonard T and Hsu J.S.J.: Bayesian Methods. Cambridge University Press.
5. Bernardo, J.M. and Smith AFM : Bayesian Theory. John willey.

04PSTA104 FACTORIAL EXPERIMENTS AND RESPONSE SURFACES

UNIT -I

General factorial experiments, factorial effects, symmetric factorial experiments, best estimates and testing the significance of factorial effects; analysis of 2n.

UNIT-II

3n factorial experiments in randomized blocks, Complete and partial confounding, Fractional replication for symmetric factorials.

UNIT-m

Response surface experiments, first order designs and orthogonal designs.

UNIT-IV

Clinical trials, longitudinal data, treatment- control designs, Model validation and use of transformation, Tukey's test for additivity.

REFERENCES

1. Raghava Rao D. (1971): Construction and Combinatorial problems in Design of experiment.
2. WileyAloke Dey (1986): Theory of Block Designs, Wiley Eastern.
3. Angela Dean and Daniel Voss (1999): Design and Analysis of Experiments, Springer.
4. Das, M.N. & Giri, N.(1979): Design and Analysis of experiments, Wiley Eastern.
5. Giri, N. (1986): Analysis of Variance, South Asian Publishers
6. John P.W.M.(1971): Statistical design and analysis of experiments, Me Millan.
7. Joshi, D.D. (1987) : Linear Estimation and Design of Experiments, Wiley Eastern.
8. Montgomery, C.D.(1976): Design and analysis of experiments, Wiley, New York.
9. Meyer, R.H.(1971) : Response surface methodology. Allyn & Bacon.
10. Pearce, S.C.(1984): Design of experiments Wiley, New York.
11. Rao, C.R. and Kleffe, J.(1988) : Estimation of Variance Components and applications, NorthHolland.
12. Searle, S.R., Casella, G. and McCulloch, C.E. (1992) : Variance Components, Wiley.

04PSTA 201 **STATISTICS PRACTICAL AND PROJECT**

(a). Practical based on Factorial Experiment, Response surfaces & Bayesian Inference.

AND

Other practical based on the topics of papers - 101,102,103 & 104.

(b). **Project.**

M.SC. (MATHEMATICS')

FIRST SEMESTER

Subject Code	Subject Name	Teaching hours			Distribution of marks					
					Theory Papers			Practical		
		L	T	P	Internal	External	Total	internal	External	total
01PMAT101	Abstract Algebra	3	1	-	30	70	100	-	-	-
01PMAT102	Complex Analysis	3	1	-	30	70	100	-	-	-
01PMAT103	Tensor	3	1	-	30	70	100	-	-	-
01PMAT104	Metric Space	3	1	-	30	70	100	-	-	-
01PMAT105	Special Functions	3	1	-	30	70	100	-	-	-
Total		15	5	-	150	350	500	-	-	-

SECOND SEMESTER

Subject Code	Subject Name	Teaching hours			Distribution of marks					
					Theory Papers			Practicals		
		L	T	P	Internal	External	Total	internal	External	total
02PMAT101	Linear Algebra	3	1	-	30	70	100	-	-	-
02PMAT102	Measure Theory	3	1	-	30	70	100	-	-	-
02PMAT103	Differential Geometry	3	1	-	30	70	100	-	-	-
02PMAT104	Topology	3	1	-	30	70	100	-	-	-
02PMAT105	Integral Transform	3	1	-	30	70	100	-	-	-
Total		15	5	-	150	350	500	-	-	-

THIRD SEMESTER

Subject Code	Subject Name	Teaching hours			Distribution of marks					
					Theory Papers			Practicals		
		L	T	P	Internal	External	Total	internal	External	total
03PMAT101	Functional Analysis & Integration Theory	3	1	■	30	70	100	■	"	■
03PMAT102	Calculas of Variations & Integral Filiations	3	1	-	30	70	100	-	-	-
Optional Papers any three										
03PMAT103	Numerical Analysis	3	1		30	70	100	-	-	-
03PMAT104	Operations Research	3	1		30	70	100	-	-	-
03PMAT105	Relativity & Cosmology	3	1	-	30	70	100	-	-	-
03PMAT106	Graph Theory	3	1	-	30	70	100	-	-	-
03PMAT107	Mathematical Statistics	3	1	-	30	70	100	-	-	-
Total		15	5	-	150	350	500	-	-	-

FOURTH SEMESTER

Subject Code	Subject Name	Teaching hours			Distribution of marks					
					Theory Papers			Practical		
		L	T	P	Internal	External	Total	internal	External	total
04PMAT101	Ordinary Differential Equations	3	1	■	30	70	100	■	"	■
04PMAT102	Discrete Mathematics	3	1	-	30	70	100	-	-	-
Optional Papers any three										
03PMAT103	Mathematical Programming	3	1		30	70	100	■	"	■
03PMAT104	Fluid Dynamics	3	1		30	70	100	-	-	-
03PMAT105	Fuzzy Mathematics	3	1	-	30	70	100	-	-	-
03PMAT106	Mechanics	3	1	-	30	70	100	-	-	-
03PMAT107	Partial Differential Equations'	3	1	-	30	70	100	-	-	-
Total		15	5	-	150	350	500	-	-	-

M.SC. (MATHEMATICS˙)

FIRST SEMESTER

ABSTRACT ALGEBRA

Paper Code: 01PMAT101 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Groups: Normal and subnormal series, composition series, theorems on isomorphism of groups, class equation for finite group, Burnside theorem.

UNIT-n

abelian groups, C -groups, solvable groups, Jordan-Holder theorem, nilpotent groups.

UNIT-in

Euclidean rings: Polynomial rings, field theory-extension fields, algebraic and transcendental extensions, separable and inseparable extensions, normal extensions, perfect fields, finite fields, primitive elements, algebraically closed fields, automorphisms of extensions.

INIT-IV

Galois extensions, fundamental theorem of Galois theory, solution of polynomial equations by radicals, insolvability of the general equation of degree 5 by radicals. Euclidean and polynomial rings, polynomials over rational fields, the Einstin criterion, polynomial rings over commutative ring, unique factorization domain, chain conditions on rings.

UNIT-V

Modules, sub modules, quotient modules, cyclic modules, simple module, semi simple modules, s emma, free Modules.

Reference Books:

1. Algebra Maclane and Birkhoff Macmillan Company.
2. Topics in Algebra I.N.Herstein Wiley Eastern Ltd.
3. Abstract Algebra D.Chatteqi PHI
4. Modem Algebra A.R.Vasistha KPM

COMPLEX ANALYSIS

Paper Code: 01PMAT102 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Complex integration, Cauchy's Goursat theorem, Cauchy's integral formula, higher order derivatives, Morera's theorem, Cauchy's inequality and Liouville's theorem.

UNIT-n

The fundamental theorem of algebra, Taylor's theorem, maximum modulus principle, Schwarz lemma, Laurent's series, Isolated singularities, meromorphic functions, the argument principle, Rouche's theorem, inverse function theorem.

UNIT-in

Residues, Cauchy's residue theorem, evaluation of integrals, branches of many valued functions with special reference to arg z, log z and zn.

UNIT-IV

Spaces of analytic functions, Hurwitz's theorem. Montel's theorem , Riemann mapping theorem, Weierstrass factorization theorem.

UNIT-V

Gamma function and its properties, Riemann- Zeta function. Riemann's functional equation, Runge's theorem, Mittag-Leffler's theorem, analytic continuation, uniqueness of direct analytic continuation.

Reference Books:

1. Complex Analysis R. V. Churchil
2. The Elements of Compex Analysis B. Choudhry
3. Functions of One Complex Variable John B. Conway

TENSORS

Paper Code: 01PMAT103 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Transformation of co-ordinates, covariant, contravariant and mixed tensors, invariants, addition, subtraction and multiplication of tensors, contraction of tensors.

UNIT-n

quotient law of tensors, fundamental tensors, length of curve, associated tensors.

UNIT-in

Christoffel symbols, covariant differentiation of tensors , law of covariant differentiation, geodesics, null geodesics, geodesics co-ordinates, parallelism.

UNIT-IV

Covariant derivative, Riemann-Christoffel tensor, curvature tensor, Ricci tensor.

UNIT-V

Bianchi identities, Riemann curvature, flat space, space of constant curvature.

Reference Books:

1. Tensor Calculus B. Spain
2. Advanced Tensor Analysis Raj Bali
3. Cartesin Tensor A.M.Goodbody

METRIC SPACE

Paper Code: 01PMAT104 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Metric Spaces: Definition, Euclidean spaces, inequalities, bounded and unbounded metric spaces.

UNIT-II

Basic concepts of spheres, open sets, equivalent metrics, closed sets, neighborhoods, accumulation points, adherent points, closure interior exterior, frontier and boundary of a set, bases, subspaces of a metric spaces, product spaces.

UNIT-III

Complete Metric Spaces: Sequence and subsequences in metric spaces Cauchy sequences, complete metric space, Baire category theorem, completeness and contracting mappings, complete metric spaces, completion of a metric space.

UNIT-TV

Connectedness: Separated sets, connected and disconnected sets, connectedness on the real line, components, totally disconnected spaces, locally connected spaces.

UNIT-V

Compactness: Hausdroff axiom, compact spaces, Lindelof spaces, locally compact spaces, product of two compact spaces.

Continuity and homeomorphism: Preliminary limits and continuity, homomorphism, continuity and connectedness, continuity and compactness projection mappings, connectedness of the product of two spaces uniform continuity, extension theorems.

Book Recommended:

1. Metric spaces : Q.H. Ansari
2. First course in Metric spaces: B.K. Tyagi Cambridge
3. Metric spaces: Micheal Springer
4. Real Variables with Basic Metric space topology: R.B.Ash Dover
5. Metric Spaces: J.N. Sharma Krishna Prakashan Mandir

SPECIAL FUNCTIONS

Paper Code: 01PMAT105 Maximum Marks: 100

External Marks: 70 Internal Marks: 30

UNIT-I

Hypergoemetric functions: Series solution of Gauss hypergeometric equation, Gauss hypergeometric function and its properties, integral representation, linear and quadratic transformation formulas, contiguous function relations, differentiation formulae, linear relation between the solutions of Gauss hypergeometric function and its properties, I transformation.

UNIT-n

Bessel function and Legendre polynomial: Generating function for Jn (x), alternative forms of generating functions, trigonometric expansions involving Bessel functions, modified Bessel function, orthogonality of Bessel functions, some integral involving Bessel functions, polynomial, a generating function.

UNIT-in

Rodrigues formula, hypergeometric form, Laplace first and second integral of Pn(x) and related properties, expansion involving Legender polynomial, Legender function of second kind and its properties.

UNIT-IV

Hermite polynomial : Definition of Hermite polynomials Hn(x), pure recurrence relations, differential recurrence relations, Rodrigue's formula, other generating functions, orthogonality, expansion of polynomials, more generating functions, hypergeometric representations, integral representation of Hermite polynomial, differential equation and its solution.

UNIT-V

Laguerre Polynomials: The Laguerre Polynomials Ln(X), generalized Laguerre polynomial, generating functions, pure recurrence relations, differential recurrence relation, Rodrigue's formula, orthogonal, expansion of polynomials, special properties, other generating functions integral relations.

Reference Books:

1.Special Functions: Earl D. Rainville, Chelsea Pub Co.
2.Special Functions with application: Saran, Sharma and Trivedi, Pragati rakashan
3.Special Functions: R. Askey and R. Roy, Cambridge
4.Special Functions & Their Applications: N. N. Lebdev,Prentice Hall, Englewood Cliffs, NJ.

M.SC. (MATHEMATICS!

SECOND SEMESTER

LINEAR ALGEBRA

Paper Code: 02PMAT101 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Vector Spaces: Bases and co-ordinates, dimensions, Sylvester law of nullity, linear transformations and their representation as matrices, change of basis, dual space, dually paired vector spaces.

UNIT-n

Eigen values and Eigen vectors of a linear transformation, diagonalisation, bilinear,quardric and Hermitian forms.

UNIT-in

Inner product spaces: Cauchy-Schwarz inequality, orthogonal vectors, orthogonal Complements.

LNIT-IV

Orthonormal sets and bases, for finite dimensional spaces, Gram-Schmidt orthogonalization process.

UNIT-V

Normal and self adjoint matrices and transformation, unitary matrices and transformations, Principal axis theorem.

Reference Books:

(1) Linear Algebra S.Lang Addision Wesley
(2) Linear Algebra Hofmann and Kunz Prentice Hall
(3) Linear Algebra Friedberg,Insel and Spence
(4) Linear Algebra A.G.Hamilton Cambridge

MEASURE THEORY

Paper Code: 02PMAT102 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Countable and non-countable sets, the Lebesgue measure of sets of real number,

UNIT-n

Measurable functions, structure of measurable functions, Weirestrass theorem on the approximation of continuous functions by polynomials.

UNIT-in

Lebesgue integral of measurable functions, properties of Lebesgue integrals.

LNIT-IV

Summable functions, the space of square summable functions, functions of finite Variation.

UNIT-V

The Stieltjes integral, the indefinite Lebesgue integral.

Reference Books:

(1) Lebesgue Measure and Integration P.KJain&V.P.Gupta
(2) Theory of functions of Real Variable Vol. 11. P. Natanson
(3) Measure Theory K.P.Gupta KPM
(4) An Introduction to Measure and Integration I.K.Rana Narosa

DIFFERENTIAL GEOMETRY

Paper Code: 02PMAT103 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Curves in space (ftl): Space curves, path ,arc length, tangent line, contact of a curve and surface, inflexinal tangent, the osculating plane, tangent at any point of a surface f (x,y,z)=0, normal plane, principal normal and binomial, curvature, torsion and skew curvature, Serret-Frenet formulae, Helices, fundamental theorems for space curves, circle of curvature, osculating sphere.

UNIT-n

Concept of surface and fundamental forms: Definition of surface, regular point and singularities on a surface, tangent plane and normal.

UNIT-in

first fundamental form, relation between E,F,Q and H, second fundamental form, Weingarton equations, angle between parametric curves, direction coefficients.

UNIT-IV

Curves on a surface: Curvature of normal section, Meusnier theorem, principal directions and principal curvatures, mean curvature, first curvature and total curvature,

UNIT-V

Minimal surface, navel point, lines of curvature, envelope, edge of regression, ruled surfaces, developable surface, asymptotic lines.

Reference Books:

(1 differential Geometry C.E.Weatherbum
(2) Differential Geometry H.C.Sinha
(3) Coordinate Geometry of the three dimensions Robert, L., Bell J. T.

TOPOLOGY

Paper Code: 02PMAT104 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Topological spaces: Topology, T-open sets, weaker and stronger topology, Indiscrete and discrete topology, co-finite topology, usual topology, open sets, closed sets, neighborhood, closure, interior, limit point, relative topology, upper limit topology, intersection of topological spaces, Kuratowski-Space, theorems on metric spaces, equivalent metrics.

UNIT-n

Bases, sub-bases and countability: Base, sub-base, local base, first countable, second countable, theorems, hereditary property, theorems related to metric space, sequence in a topological space.

UNIT-in

Continuous functions: Continuity, sequentially continuous, homeomorphism, topological property, open and closed maps, uniform continuity, product invariant, theorems.

Separation axioms: *TO, Tl, T2,* spaces, normal spaces, Hausdorff space, regular spaces, T3, T4- spaces, completely regular spaces, Tychnoff space, completely normal, TO-Space.

UN **I T-1** V

Compactness: Cover, open cover, finite sub-cover reducible, compact sets, finite intersection property, Heine-Borel, Lindeloff space, locally compact, Bolzano Weierstrass property, sequentially compact, Lebesgue number, totally bounded set.

Connectedness: Separated sets, disconnectedness, totally disconnected, maximal connected set, component, path, arc wise connected, locally connected, theorems on connectedness

UNIT-V

Product spaces: Product topology, projection maps, problems related to product invariant, topology for the cartesian product of arbitrary collection, Tychonoff topology.

Nets and convergence: Binary relation, directed set, residual subset, cofinite subset, net, sequence convergence of a set, cluster point, subnet, isotones map.

Filters and ultra filters: Filter, cofinite filter, Nbd filter, filter base, ultrafilters.

Books Recommended:

1. Point set Topology Munkres Pearson
2. Basic topology : M.A. Armstrong Sringer
3. Topology of Metric spaces (second edition): S.Kumaresan Narosa

INTEGRAL TRANSFORM

Paper Code: 02PMAT105 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Laplace Transform: Definition and its properties, rules of manipulation, Laplace transform of derivatives and integrals, inverse Laplace transform, complex inversion formula, theorems of Laplace transform, convolution theorem for Laplace transforms

UNIT-n

Application of Laplace transform to solution of differential equations, solving boundary value problem using Laplace transforms.

UNIT-in

Fourier transform: Definition and properties of Fourier sine, cosine and complex transforms, convolution theorem, inversion theorems, Fourier transform of derivatives, sine and cosine Fourier transforms, solving differential equations and interal equations using Fourier transform.

UNIT-IV

Hankel Transform: Definition and elementary properties , inversion theorem, Hankel transform of derivatives, parseval theorem.

UNIT-V

Mellin Transforms : Definition, properties and evaluation of transforms, convolution theorem for Mellin transforms.

Reference Books:

1. Use of Integral Transforms: I. N. Sneddon, McGraw-Hill Inc.
2. Integral Transforms and Their Applications: Davies, Brian, Springer-Verlag.
3. Integral Transforms Sharma & Vasistha
4. Theory and problems of Laplace Transformation:M.R.Spegal

M.SC. (MATHEMATICS)

THIRD SEMESTER

FUNCTIONAL ANALYSIS AND INTEGRATION THEORY

Paper Code: 03PMAT101 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

Unit I

Normed linear spaces, Banach Spaces and their examples, Continuous linear transformations.

Unit II

The open mapping theorem, Closed graph theorem, Uniform boundedness theorem, Continuous linear functionals, Hahn- Banach theorem.

Unit IH

Inner product spaces, Hilbert spaces and their examples, Cauchy Schwarz's inequality, Parallelogram law, Orthogonal complements, Orthonormal sets, Bessel's inequality, Gram- Schmidt orthogonalization process, Riesz representation theorem, Operators and projections.

Unit IV

Signed measure. Hahn decomposition theorem, mutually singular measures. Radon-Nikodym theorem. Labesgue decomposition.

UnitV

Riesz representation theorem. Extension theorem (Caratheodory), Lebesgue-Stieltjes integral, product measures, Fuhini's theorem, Differentiation and Integration.

References:

1. Introduction to Topology : G.G Simmons: McGraw Hill and Modem Analysis Book company Chapters 2,9, and 10(1963).
2. Elements of Functional Analysis : L. A. Luestemik and LJ Sobolev:

CALCULAS OF VARIATIONS AND INTEGRAL EQUATIONS **Paper Code:**

03PMAT102 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

Unit I

Existence and Uniquencess of solution dy/dx = f(x,y). Green's function. Sturm- Liouville Boundary value problem. Cauchy problem and characteristics.

Unit II

Classification of Second order P .D.E. Separation of variables for heat equation. Wave equation and Laplace Equation.

Unitm

Linear functional, Minimal functional theorem, General variation of a function Euler-Lagrange's equation, Variational Methods for Boundary value problems in ordinary and partial differential equations.

Unit IV

Linear Integral equation of the first and second kind of Fredholm and Volterra types, Solution by successive substitutions and successive approximations, Solution equation with separable kernels.

UnitV

The Fredholm alternative Hilbert Schimdt theory for symmetric kernels.

References:

1. Integral Equations,: Lovitte W.V Dover Publications.
2. Linear Integral Equations,: Kanwal R.P Academic PressNew York.

OPTIONAL PAPERS (ANY THREE OF THF, FOLLOWING)

NUMERICAL ANALYSIS

Paper Code: 03PMAT103 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

Unit I

Iterative Methods: Simple iteration theory of iteration, Accleration of convergence. Methods for multiple and complex roots. Newton-Raphson Method for simultaneous equations .Convergence of iteration process in the case of several unknown. Solution of Polynomial Equations: Polynominal Evaluation, Real and complex roots. Synthetic division. The Birge -Vieta. Bairstow and Graffe's root squareing methods.

Unit II

System of simultaneous equation (linear): Direct methods-Methods of determination. Gauss - elimination, Gauss-Jordan , Cholesky, Partition Methods of Sucecessive , Appproximate- Conjugate Gradient, Gauss and Jacohi iteration, Gauss seidel iteration and relaxation methods.

Unitm

Eigen value Problems: Basic properties of Eigen values and Eigen Vector , Power method, Method for finding all Eigen pairs of a Matrix. Complex

Unit IV

Eigen values. Curve fitting and Function Approximation : Least square error criterion Linear regression, Polynominal fitting and other curve fitting . approximation of functions by Taylor series and Chebyshev Polynominals.

UnitV

Numerical solution of Ordinary Differential Equations: Taylor Series method. Euler,s and modified Euler's methods. Runge-kutta method upto fourth order. Multistep method (Predictor - corrector strategies). Stability Analysis -Single and multistep methods. Difference methods for BVPs ordinary Differential Equations Boundary value problems (BVP's) Shooting methods. Finite difference method.

References:

1. Numerical Analysis : Jain, Iyenger and Jain
2. Numerical Method : S.S. Sastry
3. Numerical Solution of Differential equations : Jain M.K.

OPERATIONS RESEARCH

Paper Code: 03PMAT104 Maximum Marks: 100

External Marks: 70 Internal Marks: 30

UNIT-1

Linear Programming-Simplex Method. Theory of the Simplex Method. Duality and Sensitivity Analysis.

UNIT- II

Other Algorithms for Linear Programming Dual simplex method, Parametric Linear Programming, Upper Bound Technique, Interior Point Algorithm, Linear Goal Programming. Transportation and Assignment Problems.

UNIT III

Network Analysis - Shortest Path Problem, Minimum Spanning Tree Problem, Maximum Flow Problem, Minimum cost folu problem, Network simplex method, Project planning and control with PERT-CPM.

UNIT IV

Game theory - Two person, Zero-sum games, Games with mixed strategies, Graphical Solution, Solution by Linear Programming. Integer Programming - Branch and Bound Technique.

UNITV

Dynamic programming, Principle of optimality due to Bellman, Solution of an LPP by dynamic programming.Nonlinear Programming - One and Multi variable unconstrained optimization. Kuhn-Tucker conditions for constrained optimization, Quadraticprogramming. Separable programming, Convex programming, Non-convex programming.

References:

1. F.S. Hiller and G.J. Lieberman, Introduction to Operation Research (Sixthedition), McGraw Hill International edition, Industrial engineering Series, 1995.
2. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
3. G. Hadley, Nonlinear and Dynamic Programming, Addison-Wesley, ReadingMass.
4. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi.

RELATIVITY AND COSMOLOGY

Paper Code: 03PMAT105 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

Unit I

Bianchi identities and Einstein tensor, conformal curvature tensor, Algebraic clsssification of conformal curvature tensor, condition for flat spacetime, Lorentz transformation. Mass-Energy formula. Minkowski's n dimensional continuum, space-like and time-like intervals.

Unit II

Principal of equivalence and Principle of general co-variance, Newtonain approximation of relativistic equations of motion . Einsten's field equations and its Newtonian approximation. Schwarzschild exterior solution and its isotropic form.

Unitm

Planetary orbits and analogues of Kepler's Laws in general relativity. Advance of perihelion of Mercury. Bending of light rays in a gravitational field. Gravitational red shift of spectral lines , Energy- Momentum tensor of perfect fluid.

Unit IV

Conservation of electric charge. Transformation formula for electric charge and electric current densities, Maxwell's equations in vacuo. Propagation of electric and magnetic intensities. Transformation of electricand magnetic intensities, Lorentz invariance of Maxwell's equations in tensor form. Energy-momentum tensor of electromagnetic field. Electromagnetism in general relativity. Reissner -Nordstrom solution.

UnitV

Static cosmological models. Einstein universe. De-sitter universe. Properties of these universe.Comparison with actual universe.

References:

1. Weatherbwom C.E : An introduction of riemannian Geometry and tensor calculus: Cambridge Univ. Press

2. Eddington A.S.: The mathematical Theory of Relativity :Cambridge Univ, Press

3. Narlikar J.V : General Relativity and cosmology: The MacMillan &Co. Ind.Ltd.

4. Alder R.Bazim M.: Introduction to general relativity: McGraw hilllnc. Schiffer M.

GRAPH THEORY

Paper Code: 03PMAT106 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices - Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices.

UNIT-n

Connectivity - Blocks - Euler tours - Hamilton Cycles.

UNIT-IH

Matchings - Matchings and Coverings in Bipartite Graphs - Edge Chromatic Number - Vizing's Theorem.

UNIT-IV

Independent sets - Ramsey's Theorem - Chromatic Number - Brooks' Theorem - Chromatic Polynomials.

UNIT-V

Plane and planar Graphs - Dual graphs - Euler's Formula - The Five-Colour Theorem and the Four-Colour Conjecture.

Reference Books

1. J.Clark and D.A.Holton, *A First look at Graph Theory*, Allied Publishers, New Delhi, 1995.
2. R. Gould. *Graph Theory*, Benjamin/Cummings, Menlo Park, 1989.
3. A.Gibbons, *Algorithmic Graph Theory*, Cambridge University Press, Cambridge, 1989.
4. R.J.Wilson and J.J.Watkins, *Graphs: An Introductory Approach*, John Wiley and Sons, New York, 1989.
5. R.J. Wilson, *Introduction to Graph Theory*, Pearson Education, 4th Edition, 2004, Indian Print.
6. S.A.Choudum, *A First Course in Graph Theory*, MacMillan India Ltd

MATHEMATICAL STATISTICS

Paper Code: 03PMAT107 **Maximum Marks: 100**

External Marks:70 **Internal Marks: 30**

Unit I

Sample spaces, Combination of events. Statistical independence, Conditional probability,Bays theorem, Repeated trials. Random Variable,Distribution function.

Unit II

Probability, Probability function, Density function , Mathematical expectation, Generating function (mfg and pgf) continuous probability distribution, characteristic function , Fourier's Inversion, Cheby-Shev, Normal, Hypergeometric , Rectangular ,Negative, Binominal ,Beta ,Gama and Cauchy's distribution.

Unit II

Association of attributes. Index number, Introduction, Price-relatives, Quantity relatives, Value relatives ,Link and Chain relatives ,Aggregate methods, Fisher,s Ideal Index.

Unit in

Elementary sampling theory, Distribution of means of sampling from Binomial,Cauchy, Rectangular and normal distribution Distribution of second order moments in sampling from normal population. Exact distribution of 2 X,t,z and F Statistics in samples from a normal population, Their simple properties and applications.

Unit IV

Test of significance of difference between two means and two standard deviations for large samples with modification for small samples and taken from normal population. Analysis of variance, simple cases(one criteria and two criteria of classification)

UnitV

Elementary statistical Theory of estimation. Fisher's criteria for the best estimator. Consistent, Efficient and sufficient estimator. Method of Maximum likelihood estimators and other methods of estimation. Method of least square.

References :

1. Mathematical Theory of Statistics : Kapur and Saxena
2. A first course in Mathematical Statistics : Wealtherbum
3. The Advanced Theory of Statistics : M.G. Kendall
4. Introduction of Mathematical Probability: Uspensky

M.SC. (MATHEMATICS!

FOURTH SEMESTER

ORDINARY DIFFERENTIAL EQUATIONS

Paper Code: 04PMAT101 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Second order homogeneous equations-Initial value problems-Linear dependence and independence - Wronskian and a formula for Wronskian -Non-homogeneous equation of order two.

UNIT-n

Homogeneous and non-homogeneous equation of order n - Initial value problems- Annihilator method to solve non-homogeneous equation - Algebra of constant coefficient operators.

UNIT-in

Initial value problems - Existence and uniqueness theorems - Solutions to solve a nonhomogeneous equation - Wronskian and linear dependence - reduction of the order of a homogeneous equation - homogeneous equation with analytic coefficients -The Legendre equation.

LNIT-IV

Euler equation - Second order equations with regular singular points -Exceptional cases - Bessel Function.

UNIT-V

Equation with variable separated - Exact equation - method of successive approximations - the Lipschitz condition - convergence of the successive approximations and the existence theorem.

Reference Books

1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967.
2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudary and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.

DISCRETE MATHEMATICS

Paper Code: 04PMAT102 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Properties and examples of Lattices - Distributive lattices - Boolean algebras - Boolean polynomials - Minimal Forms of Boolean Polynomials.

UNIT - II

Switching Circuits - Applications of Switching Circuits

UNIT - m

Finite fields

UNIT-IV

Irreducible Polynomials over Finite fields - Factorization of Polynomials over Finite fields.

UNIT-V

Introduction to Coding - Linear Codes.

Reference Books

1. A.Gill, Applied Algebra for Computer Science, Prentice Hall Inc., New Jersey.
2. J.L.Gersting, Mathematical Structures for Computer Science(3rd Edn.), Computer Science Press, New York.
3. S.Wiitala, Discrete Mathematics- A Unified Approach, McGraw Hill Book Co

MATHEMATICAL PROGRAMMING

Paper Code: 04PMAT103 **Maximum** Marks: 100

External Marks: 70 Internal Marks: 30

UNIT-I

INTEGER LINEAR PROGRAMMING : Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory's All Integer Cutting Plane Method - Gomory's mixed Integer Cutting Plane method - Branch and Bound Method.

UNIT-n

CLASSICAL OPTIMIZATION METHODS : Unconstrained Optimization - Constrained Multivariable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints.
NON-LINEAR PROGRAMMING METHODS: Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe's modified Simplex Methods.

UNIT-in

Canonical and Standard form of LP - Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions - Degeneracy and its resolution

LNIT-IV

REVISED SIMPLEX METHOD : Standard forms for Revised simplex Method - Computational procedure for Standard form I - comparison of simplex method and Revised simplex Method. BOUNDED VARIABLES LP PROBLEM: The simplex algorithm.

UNIT-V

PARAMETRIC LINEAR PROGRAMMING : Variation in the coefficients cj , Variations in the Right hand side, bi. GOAL PROGRAMMING : Difference between LP and GP approach - Concept of Goal Programming - Goal Programming Model formulation - Graphical Solution Method of Goal Programming - Modified Simplex method of Goal Programming.

Reference Books

1. Hamdy A. Taha, *Operations Research*, (seventh edition) Prentice - Hall of India Private Limited, New Delhi, 1997.
2. F.S. Hillier & J.Lieberman *Introduction to Operation Research* (7th Edition) Tata- McGraw Hill ompany, New Delhi, 2001.
3. Beightler. C, D.Phillips, B. Wilde *foundations of Optimization* (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979

Fluid Dynamics

Paper Code: 04PMAT104 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

Kinematics of Fluids in motion. Real fluids and Ideal fluids - Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid - Conditions at a rigid boundary.

UNIT-n

Pressure at a point in a fluid at rest. - Pressure at a point in a moving fluid - Conditions at a boundary of two inviscid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.

UNIT-in

Some three dimensional flows. Introduction- Sources, sinks and doublets - Images in a rigid infinite plane - Axis symmetric flows - stokes stream function

UNIT-IV

Meaning of two dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional, irrotational incompressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompson circle Theorem. *Chapter 5. Sections 5.1 to 5.8*

UNITV

Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principal stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain - The coefficient of viscosity and Laminar flow - The Navier - Stokes equations of motion of a Viscous fluid.

Reference Books

1. R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985.
2. E.Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005.
3. B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005
4. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002.
5. T.Petrila, Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics, Springer, berlin, 2004.

FUZZY MATHEMATCS

Paper Code: 04PMAT105 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

The Mechanical system - Generalised coordinates - Constraints - Virtual work - Energy and Momentum

UNIT-n

Derivation of Lagrange's equations- Examples - Integrals of motion.

UNIT-in

Hamilton's Principle - Hamilton's Equation - Other variational principle.

LNIT-IV

Hamilton Principle function - Hamilton-Jacobi Equation - Separability

UNIT-V

Differential forms and generating functions - Special Transformations - Lagrange and Poisson brackets.

Reference Books

1. H. Goldstein, *Classical Mechanics*, (2nd Edition) Narosa Publishing House, New Delhi.
2. N.C.Rane and P.S.C.Joag, *Classical Mechanics*, Tata McGraw Hill, 1991.

MECHANICS

Paper Code: 04PMAT106 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT-I

The Mechanical system - Generalised coordinates - Constraints - Virtual work - Energy and Momentum

UNIT-n

Derivation of Lagrange's equations- Examples - Integrals of motion.

UNIT-in

Hamilton's Principle - Hamilton's Equation - Other variational principle.

LNIT-IV

Hamilton Principle function - Hamilton-Jacobi Equation - Separability

UNIT-V

Differential forms and generating functions - Special Transformations - Lagrange and Poisson brackets.

Reference Books

1. H. Goldstein, *Classical Mechanics,* (2nd Edition) Narosa Publishing House, New Delhi.

2. N.C.Rane and P.S.C.Joag, *Classical Mechanics,* Tata McGraw Hill, 1991.

PARTIAL DIFFERENTIAL EQUATIONS

Paper Code: 04PMAT107 **Maximum Marks: 100**

External Marks: 70 **Internal Marks: 30**

UNIT -I

Formation and solution of PDE- Integral surfaces - Cauchy Problem order equation - Orthogonal surfaces - First order non-linear - Characteristics - Compatible system - Charpits method.

UNIT-II

Intrduction-Classification of Second order PDE-Canonical forms-Adjoint operators-Riemans method.
Introduction - Classification of Second Order PDE - Canonical forms - Adjoint Operators _ Riemann's method.

UNIT-III

Derivation of Laplace and Poisson equation - BVP - Separation of Variables - Dirichlet's Problem and Newmann Problem for a rectangle - Solution of Laplace equation in Cylindrical and spherical coordinates - Examples.

UNIT -IV

Formation and solution of Diffusion equation - Dirac-Delta function - Separation of variables method - Solution of Diffusion Equation in Cylindrical and spherical coordinates - Examples.

UNIT-V

Formation and solution of one-dimensional wave equation - canocical reduction - IVP- d'Alembert's solution - IVP and BVP for two-dimensional wave equation - Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems - Uniqueness of the solution for the wave equation - Duhamel's Principle - Examples.

Reference Books

1. R.C.McOwen, *Partial Differential Equations*, 2ndEdn. Pearson Eduction, New Delhi, 2005.
2. I.N.Sneddon, *Elements of Partial Differential Equations*, McGraw Hill, New Delhi, 1983.
3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, New York, 1968.
4. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd., New Delhi, 2001.

M.Sc Physics Semester Syllabus

First Semester:-

SLN	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	OlPPhylOl	Classical Mechanics	CCC	3	0	3	0	30	70	100
2	01PPhyl02	Classical Electrodynamics	CCC	3	0	3	0	30	70	100
3	01PPhyl03	Quantum Mechanics	CCC	3	0	3	0	30	70	100
4	01PPhyl04	Mathematical methods in Physics	CCC	3	0	3	0	30	70	100
5	01PPhy201	Electronics lab	CCC	0	6	0	6	50	50	100

Second Semester:-

s. N	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	02PPhyl01	Classical Electrodynamics n	CCC	3	0	3	0	30	70	100
2	02PPhyl02	Atomic & Molecular Physics	CCC	3	0	3	0	30	70	100
3	02PPhyl03	Electronics	CCC	3	0	3	0	30	70	100
4	02PPhyl04	Numerical Method & Computer Prog.	CCC	3	0	3	0	30	70	100
5	02PPhy201	Computational Physics Lab I	CCC	0	6	0	6	50	50	100

Third Semester:-

s. N	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	03PPhyl01	Nuclear Physics	CCC	3	0	3	0	30	70	100
2	03PPhyl02	Statistical & Solid State Physics	CCC	3	0	3	0	30	70	100
3	03PPhyl03	Advanced Quantum Mechanics	CCC	3	0	3	0	30	70	100
4	03PPhyl04	Solid State Electronics	ECC	3	0	3	0	30	70	100
5	03PPhy201	Computational Physics Lab n	CCC	0	6	0	6	50	50	100

Anyone out of the following special papers can be Elective I:

(A) Microwave Electronics
(B) Solid State electronics
(C) Plasma physics -I
(D) Energy Studies-I

Fourth Semester:-

s. N	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	04PPhyl01	Nuclear Physics II	CCC	3	0	3	0	30	70	100
2	04PPhyl02	Solid State Physics	CCC	3	0	3	0	30	70	100
3	04PPhyl03	Advanced Quantum Mechanics	CCC	3	0	3	0	30	70	100
4	04PPhyl04	Solid State Electronics n	CCC	3	0	3	0	30	70	100
5	04PPhy201	Advanced Physics Lab	CCC	0	6	0	6	50	50	100

Elective paper-Anyone out of the following special papers

(A) Microwave Electronics (Only for students who opted Paper(A) in third semester)

(B) Solid State electronics (Only for students who opted Paper (B) in third semester)

(C) Plasma physics-II (Only for students who opted Paper (C) in third semester)

COURSE DETAIL - FIRST SEMESTER

OlPPhylOl Classical Mechanics 3hrs duration 70 marks

UNIT-I

Constraints, holonomic and non-holonomic constraints, D'Alembert's Principle andLagrange's Equation, velocity dependent potentials, simple applications of Lagrangian formulation. Hamilton Principle, Calculus of Variations, Derivation of Lagrange's equation from Hamilton's principle. Extension of Hamilton's Principle for non-conservative and non-holonomic systems, Method of Lagrange's multipliers, Conservation theorems and Symmetry Properties, Noether's theorem. Conservation of energy, linear momentum and angular momentum as a consequence of homogeneity of time and space and isotropy of space.

UNIT-n

Generalized momentum, Legendre transformation and the Hamilton's Equations of Motion, simple applications of Hamiltonian formulation, cyclic coordinates, Routh's procedure, Hamiltonian Formulation of Relativistic Mechanics, Derivation of Hamilton's canonical Equation from Hamilton's variational principle. The principle of least action.

UNIT-in

Canonical transformation, integral invariant of Poincare: Lagrange's and Poisson brackets as canonical invariants, equation of motion in Poisson bracket formulation. Infinitesimal contact transformation and generators of symmetry, Liouvilee's theorem, Hamilton-Jacobi equation and its application.

Action angle variable adiabatic invariance of action variable: The Kepler problem in action angle variables, theory of small oscillation in Lagrangian formulation, normal coordinates and its applications.

UNIT-IV

Fourier Transforms: Development of the Fourier integral from the Fourier Series, Fourier and inverse Fourier transform: Simple Applications: Finite wave train, Wave train with Gaussian amplitude, Fourier transform of derivatives, solution of wave equation as an application. Convolution theorem, Application of Fourier transform to diffraction theory: diffraction pattern of one and two slits

UNIT-V

Curvilinear coordinates: Orthogonal coordinate systems, Gradient, Curl, Divergence and Laplacian in orthogonal coordinate systems, Spherical, Polar and Cylindrical coordinates, Poisson's and Laplace Equations, Solution of Laplace differential equations, two dimensional steady flow of heat (Cartesian coordinates), Solution of two dimensional Laplace's equation in the cylindrical coordinates, Green' stheorem.

Books Suggested

1. H. Goldstein, C. Poole and J. Safko : Classical Mechanics, Addison-Wesley, 3

Reference Books:

2. Herbert Goldstein -Classical Mechanics, Narosa Publishing House

01PPhyl02 Classical Electrodynamics (I) **3 hrs duration** **70 marks**

UNIT-I

Electrostatics: Electric field, Gauss Law, Differential form of Gaussian law. Another equation of electrostatics and the scalar potential, surface distribution of charges and dipoles and discontinuities in the electric field and potential, Poisson and Laplace equations, Green's Theorem, Uniqueness of the solution with the Dirichlet or Neumann boundary Conditions, Formal Solutions of electro static Boundary value problem with Green's function, Electrostatic potential energy and energy density, capacitance.Boundary Value

UNIT-II

Problems in Electrostatics: Methods of Images, Point charge in the presence of a grounded conducting sphere, point charge in the presence of a charged insulated conducting sphere, point charge near a conducting sphere at a fixed potential, conducting sphere in a uniform electric field by method of images, Green's function for the sphere, General solution for the potential, conducting sphere with hemispheres at different potentials.

UNIT-III

Multipoles, electrostatics of Macroscopic Media Dielectric: Multipole expansion, multipole expansion of the energy of a charge distribution in an external field, Elementary treatment of electrostatics with permeable media. Boundary value problems with dielectrics. Molar polarizability and electric susceptibility. Models for molecular polarizability, electrostatic energy in dielectric media.

UNIT-IV

Magnetostatics: Introduction and definition, Biot and Savart Law, the differential equations of magnetostatics and Ampere's law, Vector potential and magnetic induction for a current loop, Magnetic fields of a localized current distribution,

Magnetic moment, Force and torque on and energy of a localized current distribution in an external magnetic induction, Macroscopic equations, Boundary conditions on B and H. Methods of solving Boundary value Problems in magnetostatics, Uniformly magnetized sphere, magnetized sphere in an external fields,permanent magnets, magnetic shielding, spherical shell of permeable material in an uniform field.

UNIT-V

Time varying fields, Maxwell's equations conservation laws:Energy in a magnetic field, vector and scalar potentials, Gauge transformations, Lorentz gauge, Coulomb gauge, Green function for the wave equation, Derivation of the equations of Macroscopic Electromagnetism, Poynting's Theorem and conservation of energy and momentum for a system of charged particles and EM fields. Conservation laws for macroscopic media. Electromagnetic field tensor.

Reference Books:

1. J.D. Jackson: Classical Electrodynamics
2. Panofsky & Phillip: Classical electrodynamics and magnetism
3. Griffith: Introduction to Electrodynamics
4. Landau & Lifshitz: Classical Theory of Electrodynamics
5. Landau & Lifshitz: Electrodynamics of continuous media

01PPhyl03 :Quantum Mechanics **3 hrs duration** **70 marks**

UNIT-I

(a) Origins of Quantum Physics : inadequacy of classical mechanics ,Particles versus Waves , Complementarity ,Principle of Linear Superposition , Indeterministic Nature of the Microphysical World

(b) Mathematical Tools of Quantum Mechanics :The Hilbert Space and Wave Functions, Dimension and Basis of a Vector Space , Dirac Notation .Operators .Hermitian Adjoint .Projection Operators , Commutator Algebra, Uncertainty Relation between Two Operators .Functions of Operators .Inverse and Unitary Operators .Eigenvalues and Eigenvectors of an Operator .Infinitesimal and Finite Unitary Transformations .Representation in Discrete Bases .Matrix Representation of Kets, Bras, and Operators .Change of Bases and Unitary Transformations .Matrix Representation of the Eigenvalue Problem .Representation in Continuous Bases .Position Representation, Momentum Representation, Connecting the Position and Momentum Representations, Parity Operator .Matrix and Wave Mechanics

UNIT-n

Postulates of Quantum Mechanics: The State of a System, Probability Density .The Superposition Principle .Observables and Operators .Measurement in Quantum Mechanics , .Expectation Values .Complete Sets of Commuting Operators, Measurement and the Uncertainty Relations , Time Evolution Operator, Stationary States: Time-Independent Potentials .Time Evolution of Expectation Values.

UNIT-in

Angular Momentum: Orbital Angular Momentum .General Formalism of Angular Momentum .Matrix Representation of Angular Momentum .Geometrical Representation of Angular Momentum .Spin Angular Momentum .Experimental Evidence of the Spin .General Theory of Spin, Spin l/2and the Pauli Matrices , Eigen functions of Orbital Angular Momentum Addition of Angular Momenta: Addition of Two Angular Momenta-General
Formalism,Calculation of the Clebsch-Gordan Coefficients

LNIT-IV

Three-Dimensional Problems: 3D Problems in Cartesian Coordinates .The Harmonic Oscillator, 3D Problems in Spherical Coordinates .Central Potential: General Treatment .The Spherical Square Well Potential, The Isotropic Harmonic Oscillator

UNIT-V

Identical Particles: Many-Particle Systems .Interchange Symmetry .Systems of Distinguishable Non interacting Particles .Systems of Identical Particles .Exchange Degeneracy .Symmetrization Postulate .Constructing Symmetric and Anti-symmetric Functions .Systems of Identical Noninteracting Particles .The Pauli Exclusion Principle

Reference Books:

Nouredine Zettili--------Quantum Mechanics: Concepts and Applications

01PPhyl04 :Mathematical Methods in Physics **3 hrs duration** **70 marks**

UNIT-I

Orthogonal curvilinear coordinates, scale factors, expressions for gradiant, divergence and curl and their applications to cartesian, cylinderical and spherical polar coordinate system.

UNIT-n

Coordinate transformation, transformation of covariant, contravariant and mixed tensors. Addition, multiplication and contraction of tensors, quotient Law, pseudo tensors. Metric tensors and its use in transformation of Tensors.

UNIT-in

Vector spaces and Matrices:Linear independence, Bases;Dimensionality, Inner product, Linear transformation, Matrices,Inverse orthogonal and unitary matrices;Independent elements of a matrix; eigen values and eigen matrix; Diagnolization: complete orthonormal sets of functions.

LNIT-IV

Differential equations and special functions: Second order linear differential equation with variable coefficients, solution by series expansion, Legendre, Bessel, Hermite and Lagaurre equations, physical application, generating function,reccurance relations.

UNIT-V

Integral transforms:Laplace transform, First and second shifting theorems, inverse L T by partial fractions; LT derivative and integral of a function; Fourier series: FS of arbitary period; half wave expansion;Partial sums;Fourier integral and transforms, FT of a delta function

Reference books:

1. Mathematical Methods for Physicists: George Arfken (Academic Press)
2. Applied Mathematics for Engineers and Physicists: L. A. Pipe (McGraw Hill)
3. Mathematical Methods - Potter and Goldberg (Prentice Hall of India)
4. Elements of Group Theory for Physicists: A.W. Joshi (Wiley Eastern Ltd.)
5. Mathematical Physics by Satya Prakash
6. Mathemetical Physics by B.S. Rajput

01PPhy201 ELECTRONICS LABORATORY

7 hrs duration 100 marks

1. Design of a Regulated Power supply.
2. Design of a Common Emitter Transistor Amplifier.
3. Experiment of Bias Stability.
4. A Stable, Monostable and Bistable Multivibrators.
5. Characteristics and applications of Silicon Controlled Rectifier.
6. Experiment on FET and MOSFET characterization and application as an amplifier.
7. Experiment on Uni-junction Transistor and its application.
8. Digital I: Basic Logic Gates, TTL, NAND and NOR.
9. Digital n : Combinational logic.
10. Flip-Flops.
11. Operational Amplifier(741)
12. Differential Amplifier.
13. Programming Exercises in FORTAN/C(Based on theory syllabus paper-VIII)
14. Simple Programming Exercises based on assembly language for microprocessor 8085

Second Semester

02PPhyl01 Classical Electrodynamics -II **3 hrs duration** **70 marks**

UNIT-I

Plane Electromagnetic Waves and Wave Equation : Plane wave in a nonconducting medium. Frequency dispersion characteristics of dielectrics, conductors and plasma, waves in a conducting or dissipative medium, superposition of waves in one dimension, group velocity, casualty connection between D and E. Kramers-Kroning relation.

UNIT-n

Magnetohydrodynamics and Plasma Physics : Introduction and definitions, MHD equations, Magnetic diffusion, viscosity and pressure, Pinch effect, instabilities in pinched plasma column, Magnetohydrodynamics waves, Plasma oscillations, short wave length limit of plasma oscillations and Debye shielding distance.

UNIT-in

Covariant Form of Electrodynamic Equations : Mathematical properties of the space-time special relativity, Invariance of electric charge covariance of electrodynamics. Transformation of electromagnetic field. Radiation by moving charges : Lienard-Wiechert Potential for a point charge, Total power radiated by an accelerated charge : Larmour's formula and its relativistic generalization

Angular distribution of radiation emitted by an accelerated charge, Radiation emitted by a charge in arbitrary extremely relativistic motion. Distribution in frequency and angle of energy radiated by accelerated charges, Thomson scattering and radiation, Scattering by quasifree charges, coherent and incoherent scattering, Cerenkov radiation.

Radiation damping, self fields of a particle, scattering and absorption of radiation by a bound system; Introductory considerations, Radiative reaction force from conservation of energy, Abraham Lorentz evaluation of the self force, difficulties with Abraham Lorentz model, Integro- differential equation of motion including radiation damping, Line Breadth and level shift of an oscillator, Scattering and absorption of radiation by an oscillator, Energy transfer to a harmonically bound charge.

Reference Books:

1. Classical Electrodynamics : Jackson
2. Classical Electricity and Magnetism: Panofsky and Philips.
3. Introduction to Electrodynamics : Griffiths.
4. Classical Theory of Field: Landan and Lifshitz.
5. Electrodynamics of Continuous Media : Landau and Lifshitz.

02PPhyl02 Atomic And Molecular Physics 3 hrs duration 70 marks

UNIT-I

Gross structure of energy spectrum of hydrogen atom. Non degenerate first order perturbation method, relativistic correction to energy levels of an atom, atom in a weak uniform external electric field - first and second order Stark effect.

UNIT-n

• alculation of the polarizability of the ground state of hydrogen atom and of an isotropic harmonic oscillator; degenerate stationary state perturbation theory, linear Stark effect for hydrogen atom levels, inclusion of spin orbit interaction and weak magnetic field, Zeeman effect, effect of strong magnetic field. Magnetic dipole interaction, hyperfine structure and Lamb shift (only qualitative description).

UNIT-in

Indistinguishability and exchange symmetry, many particle wave functions and Pauli's exclusion principle, spectroscopic terms for atoms.The helium atom, Variational method and its use in calculation of ground state energy. Hydrogen molecule, Heitler London method for hydrogen molecule. WKB method for one dimensional problem, application to bound states (Bohr Sommerfeld quantization) and the barrier penetration.

Spectroscopy (qualitative):General features of the spectra of one and two electron system - singlet, doublet and triplet characters of emission spectra, general features of alkali spectra. Rotation and vibration band spectrum of a molecule, P,Q and R branches. Raman spectra for rotational and vibrational transitions, comparison with infrared spectra - application to learning about molecular symmetry. General features of electronic spectra, Frank and Condon's principle.

Laser cooling and trapping of atoms: The scattering force, slowing an atomic beam, chirp cooling, optical molasses technique, Doppler cooling limit, magneto optical trap. Introduction to the dipole force, theory of the dipole force, optical lattice. Sisyphus cooling technique - description and its limit. Atomic fountain. Magnetic trap (only qualitative description) for confining low temperature atoms produced by Laser cooling, Bose-Einstein condensation in trapped atomic vapours, the scattering length, Bose-Einstein condensate, coherence of a Bose- Einstein Condensate, The Atom Laser.

Reference Books:

1. G. Banewell - Atomic and Molecular spectroscopy
2. Christopher J. Foot - Atomic Physics, Oxford Master series, 2005
3. G.K. Woodgate, Elementray Atomic Structure, Second Edition Clarendon Press, Oxford.
4. T.A. Littlefield - Atomic and Molecular Physics.
5. Eistaberg and Rasmic- Quantum Physics of Atoms. Molecules Solids and Nuclear Particles.
6. Ashok Das and A.C. Melfessions. Quantum Mechanics; A Modem Approach (Gordon and Breach Science Publishers).
7. White - Atomic Spectra.
8. Herzberg- Molecular spectra.

02PPhyl02 Electronics 3 hrs duration 70 marks

UNIT-I

Operational Amplifiers: Differential amplifier - circuit configurations - dual input balanced output differential amplifier- DC analysis, inverting and non-inverting inputs, CMRR-constant current bias level translator. Block diagram of typical OP-Amp analysis. Open loop configuration, inverting and non-inverting amplifiers, Op-Amp with negative feedback, voltage series feedback, effect of feed back on closed loop gain, input resistance, bandwidth and output offset voltage, voltage follower. Practical Op-Amp, input offset voltage-input bias current-input offset current, total output offset voltage, CMRR frequency response. DC and AC amplifier, integrator and differentiator.

UNIT-n

Oscillators and wave shapping Circuits: Oscillator Principle, Frequency stability response, the phase shift oscillator, Wein bridge oscillator, LC tunable oscillators, Multivibrators- Monostable, astable and bistable, Comparators, Square wave and triangle wave generation, clamping and clipping circuits.

UNIT-in

Digital Electronics: Combinational logic: Standard representations for logic functions, Karnaugh Map Representation of logical functions, Simplification of logical functions using K- Map, Minimization of Logical functions specified in Minterms / Maxterms or truth table, Don't care conditions, Adder (half and full), Subtractor (half and full), comparator.

.....—their uses, Demultiplexer / Decoders and their uses. BCD arithmatics, Parity generators / Checkers, Code Converters, Priority Encoders, Decoder / Drivers for display devices, Seven Segment display device. ROM, Programmable Logic Array. Basic concepts about fabrication and characteristics of integrated circuits.

Sequential Logic: Flip-Flops: one - bit memory, RS, JK, JK master slave, T and D type flip flops, shift resisters - synchronous and asynchronous counters, cascade counters, Binary counter, Decade counter. A/D and D/A conversion- Basic principles, circuitry and simple applications. Voltage regulators - fixed regulators, adjustable voltage regulators, switching regulators. Basic idea of IC 555 and its applications as multivibrator and sqaure wave generator. Opto-electronic Devices: Photo diode, Phototransistor, Light emitting Diode and their applications

Reference Books:

1. "Electronic Devices and Circuit Theory" by Robert Boylested and Louis Nashdsky, PHI, New Delhi -110001,1991.
2. "OP-AMP and Linear Integrated Circuits" by Ramakanth, A. Gayakwad, PHI, Second Edition 1991.
3. "Digital Principle and Applications" by A.P. Malvino and Donald P. Leach, Tata McGraw Hill Company, New Delhi, 1993.

02PPhyl04 Numerical methods and Computer Programming

3 hrs duration **100 marks**

UNIT-I

Errors in Numerical Analysis: Source of Errors, Round off error, Computer Arithmetic, Error Analysis, Condition and stability, Approximation, Functional and Error analysis, the method of Undetermined Coefficients, use of interpolation formula, Iterated interpolation, Inverse interpolation, Hermite interpolation and Spline interpolation, Solution of Linear equations : Direct and Iterative methods, Calculation of eigen values and eigen vectors for symmetric matrices.

UNIT-n

Solution of Nonlinear equation : Bisection method, Newton's method, modified Newton's method, method of Iteration, Newton's method and method of iteration for a system of causation Newtons' method for the case of complex roots. Integration of a function. Trapezoiddal and Simpson's rules. Gaussian quadrature formula, Singular integrals, Double integration.

UNIT-in

Integration of Ordinary differential equation: Predictor-corrector methods, Runga-Kutta method. Simultaneous and Higher order equations. Numerical Integration And Differentiation of Data, Least-Squares Approximations, Fast Fourier Transform.

Programming in C: Character set, variables and constants, keywords, Instructions, assignment statements, arithmetic expression, comment statements, simple input and output, Boolean expressions, Relational operators, logical operators, control structures, decision control structure, loop control structure, case control structure, functions, subroutines.

Arrays and strings, structures, array of structures, Unions of structures, operations on bits, usage of enumerated data types. Bit-fields, Pointers to Function, Function returning Pointers.

Reference Books:

1. A Ralston and P. Rabinowitz: A First Course in Numerical Analysis, McGraw Hill (1985).
3. S.S. Sastry: Introductory Methods of Numerical Analysis, Prentice-Hall of India (1979).
4. Robert W. Sebesta: Concepts of Programming Language, Addison Wesley, Pearson Education Asia, 1999.
5. Deitel and Deitel: How to Program C, Addison Wesley, Pearson Education Asia, 1999.
6. Bryon Gottfried, Programming with C, McGraw Hill International.

02PPhy201 COMPUTATIONAL LABORATORY
7 hrs duration 100 marks

1. To use a Michelson Interferometer to determine:
(I) the wave length of sodium yellow light
(II) the difference between the wave lengths of the two sodium D-lines.
(III) the thickness of a mica sheet.
2. To test the validity of the Hartmann's prism dispersion formula using the visible region of mercury spectrum.
3. To find the refractive index of air hy means of a Fabry-Perot Etalon, the thickness between the plants being given.
4. Determination of wave length of Neon light taking Hg source as a standard source applying Hartmann formula.
5. Determine Stetan's constant.
6. X-ray diffraction by Telexometer.
7. Determination of Ionization potential of Lithium.
8. Determination of e/m of electron by Normal Zeeman Effect.
9. Determination of dissociation energy of Iodine (I) molecules by photography, the absorptions band of I in the visible region.
10. Using He-Ne laser light.
(I) Measure of wavelength with the help of ruler.
(II) Measure the thickness of the wire.
11. Testing goodness of fit of Poisson distribution to cosmic ray busts by Chi-square test.
12. To study Faraday effect using He-Ne laser

Third Semester

03PPhyl01 Nuclear Physics-I 3 Hrs Duration 70 Marks

UNIT-1

Two Nucleon system and nuclear forces: General nature of the force between nucleons , saturation of nuclear forces, charge independence and spin independence , General forms of two nucleons interaction, Central, noncentral and velocity dependent potential, Analysis of ground state (3S1) of deuteron using a square well potential, range-depth relationship, Discussion of the ground state of deuteron under noncentral force , D-state admixture.

UNIT-2

Nucleon-Nucleon Scattering and Potentials: partial wave analysis of the neutron proton scattering at low energy assuming central potential with square well shape, concept of the scattering length, coherent scattering of neutrons by protons in (ortho and para) hydrogen molecule : the effective range theory (in neutron-proton scattering) and the shape independence of nuclear potential.

UNIT-3

A qualitative discussion of proton-proton scattering at low energy ; General features of two- body scattering at high energy, effect of exchange forces. Interaction of radiation and charged particle with matter (Not derivation); Laws of absorption and attenuation coefficient photoelectric effect, Compton , scattering ,pair production.

UNIT-4

Klein-Nishina cross section for polarized and unpolarized radiation angular distribution of scattered photon and electrons ,Energy loss of charged particles due to ionization, Bremstrahlung ; energy target and projectile dependence of all three processes, Range-energy curves; Straggling.

UNIT-5

Experimental Techniques; Gas filled counters; Scintillation counter; Cerenkov counters; solid state detectors ; Surface barrier detectors, Multiwire proportion chambers ; Nuclear emulsion, techniques of measurement and analysis of tracks; Proton synchrotron; Linear accelerators.

Books Suggested

1. B. K. Agarwal & M. Eisner, Statistical Mechanics, Wiley Eastern Limited (1988).
2. B. Laud, Fundamentals of Statistical Mechanics, New Age International Publishers (1998).
3. R. P. Feynman, Statistical Mechanics, A set of lectures, W.A. Benjamin, Inc (1972).

03PPhyl02 Statistical & solid State Physics
3 hrs duration 70 marks

UNIT-1

Basic Principles , Canonical and Grand canonical ensembles; Concept of statistical distribution , phase space, density of states , systems and ensemble , entropy in statistical mechanics Connection between thermodynamic and statistical quantities micro canonical ensemble , equation of state, specific hear and entropy of a perfect gas , using micro canonical ensemble.

UNIT-2

Canonical ensemble, thermodynamic ftmctions for the canonical ensemble, calculation of means values, energy fluctuation in a gas, grand canonical ensemble, thermodynamic functions for the grand canonical ensemble, density fluctuations.

UNIT-3

Partition functions and Statistics; Partition functions and properties, partition functions and properties , partition function for an ideal gas and calculation of thermodynamic quantities, Gibbs Paradox , validity of classical approximation, determination of translational, rotational and vibration contributions to the partial function of an ideal Diatomic gas. Specific heat of a diatomic gas , ortho and para hydrogen.

UNIT-4

Identical particles and symmetry requirement, difficulties with Maxwell- Boltzmann statistics, quantum distribution functions, Bose Einstein and Fermi- Dirac statistics and Planck's formula, Bose Einstein condensation, liquid He4 as a Boson system, quantization of harmonic oscillator and creation and annihilation of phonon operators , quantization of fermions operators.

UNIT-5

Theory of Metals: Fermi-Dirac distribution function, density of states, temperature dependence of Fermi energy, specific heat, use of Fermi-Dirac statistics in the calculation of thermal conductivity and electrical conductivity, Drude theory of light absorption in metals.

Band Theory: Block Theorem, Kronig Penney model, effective mass of electrons, Wigner-Seitz approximation, NFE model, tight binding model and calculation of density for a band in simple cubic lattice, pseudo potential method.

Books Suggested

4. B. K. Agarwal & M. Eisner, Statistical Mechanics, Wiley Eastern Limited (1988).
5. B. Laud, Fundamentals of Statistical Mechanics, New Age International Publishers (1998).
6. R. P. Feynman, Statistical Mechanics, A set of lectures, W.A. Benjamin, Inc (1972).

03PPhyl03 Advanced Quantum Mechanics -I

3 hrs duration 70 marks

UNIT-1

Approximation Methods for stationary states: Time-Independent Perturbation theory, Non - degenerate Perturbation Theory, degenerate Perturbation Theory, The Variational Method , The Wentzel-Kramers-Brillouin Method.

UNIT-2

General Formalism, Bound states for Potential Wells with No rigid Walls , Bound states for Potential Wells with One rigid Walls , Bound state for Potential wells with Two rigid Walls, Tunneling through a potential barrier.

UNIT-3

Time dependent Perturbation Theory: The Schrodinger Heisenberg and Interaction Picture, Time-dependent Perturbation theory, Transition probability for a constant and Harmonic Perturbation, Adiabatic and sudden Approximations.

UNIT-4

Interaction of atoms with Radiation, Classical Treatment of the Incident Radiation , Quantization of the Electromagnetic Field, Transition Rates for Absorption and Emission of Radiation , Transition Rates within the Dipole Approximation, The Electric Dipole Selection Rules, Spontaneous Emission.

UNIT-5

Scattering Theory, Scattering and cross section, Connecting the Angles and Cross section in the lab and CM frames , Scattering Amplitude of Spinless Particles, Scattering Amplitude and differential Cross section, The Bom Approximation, Partial Wave Analysis, Partial wave Analysis for Elastic and Inelastic scattering , Scattering of Identical Particles.

Books Suggested

1. Ashok Das and A.C. Milissiones, Quantum mechanics - A Modem Approach, Garden and Breach Science Publishers.
2. Eugen Merzbacher, Quantum Mechanics, Second Edition, John Wiley and Sons, (1970).
3. Bjorken and Drell, Relativistic Quantum Mechanics, McGraw

03PPhyl04 **Solid State Electronics**

3 hrs duration **70 marks**

UNIT-1

Semiconductor Materials and carrier transport in semiconductors: Energy bands Intrinsic carrier concentration .Donars and acceptors .Direct and Indirect band semiconductors . Elemental and compound semiconductors,Doping calculation of Fermi level and conductivity of semiconductors.

UNIT-2

Carrier Drift .Carrier Diffusion .Continuity equation .Ambipolar transport carrier injection .Generation Recombination processes-Direct .Indirect .band semiconductors , band to band trap assisted and auger recombination .low and high injection , Quasi Fermi levels .minority carrier life time .Drift and diffusion of minority carrier .(Haynes Shockley Experiment)

UNIT-3

Semiconductor surface : Surface charge barrier .surface recombination . Amorphous semiconductors .mobility edge band tails and dangling band states.

UNIT-4

Junction Devices : Basic fabrication steps .Diffusion of impurities .thermal diffusion .Constant total doping diffusion ,ion implantation. Need for junction.

UNIT-5

Energy band diagram for homo and hetero junctions , current flow mechanism in p-n junction .effect of indirect and surface recombination currents on the forward biased diffusion current .diode ideality factor ..breakdown mechanism, p-n junction diode rectifiers (high frequency limit) ,ac response .diffusion capacitance , switching properties .P-I-N diode.

Books suggested

1. George Kennedy, Electronic Communication Systems, Tata McGraw Hill
2. S. P. Sharma, Basic Radio and Television, TMH
3. H. Taub and D. L. Schilling, Principle of Communication Systems, TMH
4. H. A. Atwater, Introduction to Microwave Theory, McGraw-Hill.
5. S. Y. Liao, Microwave Devices and Circuits, PHI
6. M. L. Sisodia and G. S. Raghvanshi, Basic Microwave Techniques and Laboratory Manual, Wiley
7. J. Gower, Optical Communication Systems, PHI
8. B. P. Lathi, Modem Digital and Analog Communication Systems, Oxford University Press

03PPhv 201 **COMPUTATIONAL LAB II**
100 Marks **7 Hrs Duration**

1 Determine fine structure constant using sodium doublet.

2 Verify Cauchy's relation & determination of constants.

3 To determine e/m for an electron by Zeeman effect.

4 Determine the dissociation energy of Iodine molecule.

5 Determine of energy of a given ray from Re-De source.

6 Find out the percentage resolution of given scintillation spectrometer using Csm

7 Find out the energy of a given 9mm x-ray source with the help of a scintillation spectrometer.

8 Plot the gaussian distribution curve for a radioactive source.

9 To study the frequency and phase characteristics of band pass filter.

10 Study the wave from characteristics of transistorised astahle symmetircal mult.vibrator using CRO&determine its frequency by various C&R.

11 Artificial transmission line.

12 Determine the dielectric constant of turpentine oil with the help of leacher wire system.

13 To determine velocity of waves in water using ultrasonic interferometer.

14 To determine the magnetic susceptibility of two given samples by Gouys method.

15 Determination of Lande's 'g' factor for IRRH crystal using electron spin resonance spectrometer.

Semester IV

04PPhyl01 **Nuclear Physics II**
3 hrs duration **70 marks**

UNIT-1

Nuclear shell model: Single Particle and collective motions in nuclei. Empirical evidences of Magic numbers, Assumptions and justification of shell model. Average shell potential , spin orbit coupling; single particle wave function and level sequence; magic numbers, shell model predictions for ground state parity.

UNIT-2

Angular momentum, magnetic dipole and electric quadrupole moments and their comparison with experimental data; configuration mixing; Nuclear isomerism. Collective nuclear deformation-rotational and vibrational modes. Generalized nuclear deformation and Nielsson model.

UNIT-3

Nuclear gamma and Beta decay: Electric and magnetic multipole moments and gamma decay probabilities in nuclear system(No Derivations) reduced transition probability, selection rules, interval conversion and zero-zero transition. General characteristics of weak interaction; nuclear beta decay and lapton capture.

UNIT-4

Electron energy spectrum and Fermi Kurie plot ; Fermi Theory of Beta decay (parity conserved selection rules Fermi and Gamow- Teller) for allowed transition ; ft-values ; forbidden transition ; experimental verification of Parity Violation; The V-A interaction and experimental verification.

UNIT-5

Nuclear reactions; Theories of Nuclear reaction; Partial wave analysis of reaction cross section; compound nucleus formation and break up; Resonance sectoring and reaction-Breit-Wigner dispersion formula for S-waves(l=0), Continuum cross section; statistical theory of nuclear reaction; The optical model Stripping and Pick-up-reaction.

Books Suggested

1. R. D Evans, The Atomic Nucleus, McGraw Hill Book Company Inc., New York.
2. W. E. Burcham and M. Jobes, Nuclear and particle physics, Addison Wesley
3. S. N. Ghoshal, Nuclear Physics, S. Chand & Co. Ltd., New Delhi
4. R. R. Roy and B. P. Nigam, Nuclear Physics, New Age Int.(P) Ltd., Publishers
5. J. Singh, Fundamentals of Nuclear Physics, Pragati Prakashan
6. B. K. Agarwal, Nuclear Physics Lokbharti Publication Allahabad
7. R. M. Singru, Introductory Experimental Nuclear Physics
8. B. L. Cohen, Concept of Nuclear Phsyics, Tata McGraw Hills
9. Jagdish Varma, R.C.Bhandari and D. R. S. Somayajulu, Fundamentals of Nuclear Physics, CBS
10. Publishers & Distributors Pvt. Ltd.

04PPhyl02 Solid State Physics

3 hrs duration 70 marks

UNIT-1

Lattice dynamic and optical properties of solids; Interatomic force and Lattice dynamics and simple metals, ionic and covalent crystals. Optical phonons and Dielectric constant. Inelastic neutron scattering.

UNIT-2

Mossbauer effect. Debye-Waller Factor. Anharmonicity thermal expression and thermal conductivity interaction of electron and phonons with photons. Direct and indirect transition absorption in insulators, Polarons, 1- phonon absorption, optical properties of metals, skin effect and anomalous skin effect.

UNIT-3

Semiconductors; Law of mass action,calculation of impurity conductivity, Ellipsoidal energy surface in Si and Ge , Hall effect recombination mechanism optical transitiction and Schockely-Read theory, Excition , Photo conductivity,Photo-luminuscence. Points line, Planar and Bulk defects, Color centers, f centre and aggregate centers in alkali halides.

UNIT-4

Magnetism: Larmor diamagnetism. Paramagnetism, Curie Langevin and quantum theories.

Susceptibility of rate earth and transition metals. Ferromagnetism; Do-main theory, Weiss molecular field and exchange, spin waves; dispersion relatior and its experimental determination by inelastic neutrons scattering , heat capacity Nuclear Magnetic resonance; conditions of resonance, Bloch equation . NMR experiment and characteristic of an absorption line.

UNIT-5

Superconductivity (a) Experimental Results: Meissner effect, heat capacity, microwave and infrared properties, isotope effect, flux quantization , ultrasonic attenuation, density of states nuclear spin relaxation, Giaver and AC and DC Josephson tunneling, (b) Cooper pairs and derivation of BCS Hamiltonian, results of BCS Theory(NO derivation)

Books Suggested

1. C. Kittle, Introduction to Solid State Physics, Seventh Edition, John Wiley & Sons, Inc., Singapore,
2. New York.

A. J. Dekker, Solid State Physics, Macmillan India Ltd, Delhi.

3. M. A. Omar, Elementry Solid State Physics, Pearson.
4. J. P. Mckely, Solid State Physics and Semiconductor Physics, A Harper International Edition, New

04PPhyl03 **ADVANCE QUANTUM MECHANICS (II)**

70 Marks **3Hrs duration**

UNIT-1

Relativistic Formulation and Dirac equation; Attempt for Relativistic Formulation of quantum theory, The Klein- Gordon equation, Probability density and probability current density, solution free particle K.G. equation in momentum representation,interpretation of negative probability density and negative energy solutions.

UNIT-2

Dirac equation for a free particle, properties of Dirac matrices and algebra of gamma matrices, non-relativistic correspondence of the Pauli equation (inclusive of electromagnetic interaction). Solution of the free particles Dirac equation, orthogonality and completeness relations for Dirac spinors, interpretation of negative energy solution and the hole theory.

UNIT-3

Symmetries of Dirac Equation ; Lorentz covariance of Dirac equation, proof of covariance and derivation of Lorentz boost and rotation matrices or Dirac spinors, Projection operators involving four momentum and spin, Parity(P), charge conjugation© , time reversal(T) and CPT operators for Dirac spinors.

UNIT-4

Bilinear covariant and their transformations, behavior under Lorentz transformation, P.C.T and CPT. Expectation values of coordinate and velocity involving only positive energy solutions and the associated problems, inclusion of negative energy solution, Zitterbewegung, Klein paradox.

UNIT-5

The Quantum Theory of Radiation; Classical radiation field, transversality condition, Fourier decomposition and radiation oscillators , quantization of radiation oscillator , creation, annihilation and number operators, photon states, photons a quantum mechanical excitations of the radial field, Fluctuations and the uncertainty relation, validity of the classical description, matrix element for emission and absorption, spontaneous emission in the dipole approximation.

Books Suggested

1. Elliot, The Physics and chemistry of solids, John Wiley & sons, New York.
2. Thomas, Transmission Electron Microscopy,
3. Tolansky, Multiple Beam Interferometery.
4. Heavens, Thin Films.
5. Chopra, Physics of Thin Films.

04PPhyl04 **Solid State Electronics**
70 Marks **3Hrs Duration**

UNIT-1

Metal- semiconductor (Schottky) junction; Energy band diagram, current flow mechanism in forward and reverse bias, thermionic and diffusion currents, effect of interfaces states. Application of Schottky diodes, ii) Metal-Oxide semiconductor (MOS) diodes.

UNIT-2

Energy band diagram, depletion and inversion layer. High and low capacitance voltage(C-V) characteristics. Smearing of C-V curve, flat band shift. Application of MOS diode.

UNIT-3

Bipolar transistor and Thyristors: General characteristic of BJT, factors controlling current gain frequency performance, switching of bipolar transistor .Basic concepts of PNPN Structure, thyristors turn on turn off and power consideration, triacs.

UNIT-4

Microwave devices:

Tunnel diode, high field effect in two valley semiconductors transfer electron devices(Gunn diode), Avalanche transit time devices(Read, Impatt diodes) JFETS,MESFETS and MOSFETS.

UNIT-5

JFET Modeling including saturation velocity effects , GaAs MESFET, MOSFET, surface space. Charge region under non equilibrium condition, channel conductance, basic characteristic current, voltage and device parameters.

Books Suggested

A. P. Malvino, Digital Computer Electronics, Tata McGraw Hill.

A. P. Malvino and D. Leach, Digital Principle and applications, Tata McGraw Hill.

1. Morris-Mano, Computer System Architecture, PHI.
2. R. S. Gaonkar, Microprocessor Architecture, Programming and Applications. Wiley Eastern Ltd.
3. M. Rafflquzzaman, Microprocessor: Theory and Application, Prentice Hall Of India.
4. Ghosh and Sridhar, Introduction to Microprocessor for Engineers and Scientists, Prentice Hall Of India.
5. D. V. Hall, Microprocessor and Interfacing, Tata McGraw Hill.

04PPhy 201 Advanced Physics Lab

100 Marks 7 Hrs Duration

1 To determine e/m of an electron by magnetron valve method.

2 To determine e/k using transistor characteristics .

3 To study dark and illumination characteristic of p-n-junction solar cell and to detertmine

(i) its internal series resistance

(II) Diode ideality factor

4 To study the characteristics of following semiconductor devices

(i) VDR

(ii) photo transistor

(iii) LDR

(iv) LED

5 To study the characteristics of MOSTET and MOSFET amplifier.

6 To study dark and illumination characteristics of p-n-junction solar cell and to determine its (i) Maximum power available (ii) Fill factor

7 To study capacitance variation of p-n-junction with bias voltage in reverse bias and determination of built in potential and other related parameters.

8 To study temperature characteristics of a thermistor and determination of activation energy.

9 Studies on life-time measurements in p-n-junction by various methods.(VOC decay method/reverse recovery method)

10 Resistivity measurements by vander-paw method and magneto resistance.

M.Sc Chemistry Semester Syllabus

First Semester:-

S.N	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	OIPChelOl	Inorganic Chemistry	CCC	3	0	3	0	30	70	100
2	01PChel02	Reaction Mechanism-I	CCC	3	0	3	0	30	70	100
3	01PChel03	Physical Chemistry-1	CCC	3	0	3	0	30	70	100
4	01PChel04	Computer and Diffraction Methods	CCC	3	0	3	0	30	70	100
5	01PChe201	Practical's	CCC	0	6	0	6	50	50	100

Second Semester:'

s. N	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	02PChel01	Coordination Chemistry	CCC	3	0	3	0	30	70	100
2	02PChel02	Reaction Mechanism- II And Stereochemistry	CCC	3	0	3	0	30	70	100
3	02PChel03	Physical Chemistry - II	CCC	3	0	3	0	30	70	100
4	02PChel04	Group Theory And Spectroscopy	CCC	3	0	3	0	30	70	100
5	02PChe201	Practical's	CCC	0	6	0	6	50	50	100

Third Semester:-

s. N	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	03PChel01	Spectroscopy	CCC	3	0	3	0	30	70	100
2	03PChel02	Photochemistry and Solid State Chemistry	CCC	3	0	3	0	30	70	100
3	03PChel03	Environmental Chemistry	CCC	3	0	3	0	30	70	100
4	03PChel04	Chemistry Of Life	ECC	3	0	3	0	30	70	100
5	03PChe201	Practical's	CCC	0	**6**	0	**6**	50	50	100

Fourth Semester:'

s. N	Sub. Code	Subject	Course Category	Con. Hrs.per week		EoSE Duration (in Hrs)		Marks Distribution		
				T	P	T	P	IA	EoSE	Tot
1	04PChel01	Contemporary Inorganic Chemistry	CCC	3	0	3	0	30	70	100
2	04PChel02	Organic Synthesis-1	CCC	3	0	3	0	30	70	100
3	04PChel03	Chemical Dynamics	CCC	3	0	3	0	30	70	100
4	04PChel04	Heterocyclic Chemistry	CCC	3	0	3	0	30	70	100
5	04PChe201	Practical's (For Group -A, B, C)	CCC	0	**6**	0	**6**	50	50	100

M.Sc Chemistry First Semester

OIPChelOl **Inorganic Chemistry**

70 Marks **3Hrs Duration**

Unit I

(a) Stereochemistry and Bonding in Main Group Compounds VSEPR, Irregular Geometry of molecules.d7r-pjr bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

(b) Metal Clusters Higher boranes, carboranes, metalloboranes and metallocarboranes.

Unit II

Fundamentals of Transition Metal Complexes

Energy profile of reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories.

Unit II

kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanismdirect and indirect evidences in favor of conjugate mechanism.

Unit IV

Reaction Mechanismof Transition Metal Complexes

Anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction.

UnitV

Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer- sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

Books Suggested

1. Advanced Inorganic Chemistry, F. A.Cotton and Wilkinson. John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Eamshow, Pergamon.
4. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
5. Reaction mechanism, Basalo Pearson, Academic Press.

M.Sc Chemistry First Semester

01PChel02 **Reaction Mechanism-I**

70 Marks **3Hrs Duration**

Unit I

(a) Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes,tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of Jt-molecular orbitals,annnulenes, anti aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent - addition compounds, Crown ether complexes and cryptands, inclusion compounds.

Unit II

(b) Reaction Mechanism: Structure and Reactivity Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams. Generation, structure, stability and reactivity of carbocations, carbanions free radicals, carbenes and nitrenes.

Effect of structure on reactivity-resonance and field effects, steric effect,the Hammett&Taft equation- linear free energy relationship., substituent and reaction constants.

Unitm

(a) Aliphatic Nucleophilic substitution

The SN2 SN1, mixed SN1 and SN2 and SET mechanism

(b) Aromatic Nucleophilic Substitution The ArSNl, ArSN2, benzyne and SRN1 mechanism. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangements.

Unit IV

(a) Aliphatic Electrophilic Substitution. Bimolecular mechanism-SE2 and SEi. The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

(b) Aromatic Electrophilic Substitution The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring system, quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vismeir reaction, Gattermann-koch reaction.

Unit-V

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvent on reactivity. Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement, Hunsdiecker Reaction

Books Suggested

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold Cornell University Press.
5. Organic Chemistry, T.R. Morrison and R.N. Boyd, Prentice-Hall
6. Modem Organic Reactions, H.O. Housee, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
8. Pericyclic Reactions S.M. Mukheiji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukheiji and S.P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International. 11. Stereochemistry of Organic Compounds, P.S. New Age International.
12. Quantum Chemistry hy Zimmerman Academic Press.

M.Sc Chemistry First Semester

01PChel03 Physical Chemistry-1

70 Marks 3Hrs Duration

Unit I

(a) Quantum Chemistry Schrodinger equation to some model systems viz., harmonic oscillator, the rigid rotor, the hydrogen atom. Applications of variation method and perturbation theory to the Helium atom.

(b) Molecular Orbital Theory Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc.

Unit II

Thermodynamics Concept of fiigacity and determination of fiigacity. Non-ideal systems, Excess functions for non-ideal solutions, Activity, Activity coefficient.

Unitm

Debye Huckel theory for activity coefficient for electrolytic solution; determination of activity and activity coefficient; ionic strength. Application of phase rule to three component system - acetic acid + chloroform + water.

Unit IV

Chemical Dynamics Collision theory of reaction rates, steric factor, activated complex theory, ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, methods of determining mechanism, isotope effects.

UnitV

Dynamic chain (hydrogen-bromine reactions, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine reaction), acid base catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, flash photolysis, dynamics of unimolecular reactions (Lindemann Theory,Hinshelwood Modifications).

Books Suggested :

1. Physical Chemistry, P.W. Atkins, ELBS
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valance, R McWeeny, ELBS
5. Chemical Kinetics, KJ.Laidler, MacGraw-Hill
6. Kinetics and Mechanism of Chemical transformations, I. Rajaram and J. Kuriacose,McMillan.
7. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.

M.Sc Chemistry First Semester

01PChel04 **Computer and Diffraction Methods**

70 Marks **3Hrs Duration**

Unit I

(a) Introduction to Computers and Computing Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/O devices. Secondary Storage. Computer language. Operating systems with DOS as an example. Introduction to UNIX and WINDOWS. Data Processing, principles of programming. Algorithms and flow-charts.

Unit II

(a) Computer Programming in C Overview of C, Constants., Variable and Data Types, Operators and Expression, Managing Input and output Operators, Decision Making and Branching, IF statement, IF....ELSE statement, GO TO statement, Decision Making and Looping, WHILE statement, DO statement and FOR Statement, Jumps in loop.

Unit-Ill

(a) Programming in Chemistry Development of small computer codes involving simple formulae in chemistry, such as Vander waals equation, titration, kinetics, radioactive decay. Evaluation of lattice energy and ionic radii from experimental data.

Unit-IV

(a) Electron Diffraction Scattering intensity Vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, Low energy electron diffraction and structure of surfaces.

(b) Neutron diffraction Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

Unit-V

X-ray Diffraction Debye-Scherrer method of X-ray structural analysis of crystal, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structural factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules. Ramchandran diagram.

Books Suggested

1. Modem Spectroscopy, J.M. John Wiley.
2. Applied Electron Spectroscopy for chemical Analysis Ed. H. Windawi and F.L. No, Wiley Interscience.
3. NMR, NQR, EPR and Mossbaur Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry R.S. Drago, Saunders College.
5. Chemical Application of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, R. Chang, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill
8. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
9. Introduction of Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance., A Carrington and A.D. Carrington and A.D. Maclachalan, Harper & Raw.
11. Programming inAnsiC-E. Balagursamy

M.Sc Chemistry First Semester

OIPChe 201 **Practical's**

100 Marks **7 Hrs Duration**

A. Inorganic Preparations (Any five of the following preparations)

(1) Tris(thiourea)copper (II)sulphate.

(2) Cis -Potassium Diaquatrioxalatochromate(III).

(3) Sodium Diamminetetrathiocynatoclrromate(III).

(4) Tris(acetylacetonato)manganese(II).

(5) Potassium Trioxalatoferrate(in).

(6) Purssian Blue.

(7) Hexamminecobalt(III) Hexanitro-N-cobaltate(III).

(8) Vanadyl acetylacetonate

(9) Dichloridobis(pyridine)cobalt(II).

(10) Hexamminenickle(II) chloride.

(1 l)Bis(dimethylglyoximato)nickel (II).

(12)Tetramminecopper(II) sulphate.

B. Organic (a)Qualitative Analysis Separation, purification and identification of compounds of binary mixture (two solids). **(b)Quantitative Analysis (any three)**

(i) Estimation of amines/phenols using bromide solution/or acetylation method.

(11) Determination of Iodine value of an oil sample.

(iii) Determination of Acid Value of an oil sample.

(iv) Determination of Saponification value of an oil sample.

C. Physical Chemistry (Students are required to perform at least five experiments from the following experiments.) 1.Determination of the effect of (a) change of temperature (b) change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions. 2.Determination of strength of acid in gm/1 conductmetrically using following combinations(i)SA-WB(ii)WA-SB(iii)WA-WB(iv)SA-SB {S-Strong, W-Weak, A-Acid, B-Base } 3.Determination of the velocity constant, order of the reaction and energy of activation of saponification of ethyl acetate by sodium hydroxide conductometrically.

^Determination of solubility and solubility product of sparingly soluble salts (e.g. PbS04, BaS04) conductomerically. 5.Determination of the strength of strong and weak acids in a given mixture conductometrically. 6.To study the effect of solvent on the conductance of AgN03/acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixture (DMSO, DMF, dioxane, acetone, water) and to test the validity of Debye-Huckel-Onsager theory. 7.Determination of the dissociation constant of acetic acid in DMSO,DMF acetone and dioxane by titrating it with KOH. 8.Determination of the dissociation constant of monobasic/dibasic acid.

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, GH. Jeffery and J. Mendham, E1BS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D.Past, C.Johnson and M. Miller, Prentice Hall.
4. Macroscale and Miicroscale Organic Experiments, K.L. Williamson, D.C. Health.
5. Systematic Qualitative Organic Analysis, H. Mideleton, Adward Arnold.
6. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
9. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.
10. Experiments in Physical Chemistry, R.C. Das and B. Behera. Tata McGraw Hill.

M.Sc Chemistry Second Semester

02PChel01 **Coordination Chemistry**

70 Marks **3Hrs Duration**

Until

(a) Metal-Ligand Equilibria in Solution Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

Unit II

(a) Metal Ligand Bonding Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, a-bonding and molecular orbital theory.

Unit III

Electronic Spectra and Magnetic Properties of Transition Metal Complexes Spectroscopic ground state, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (dl-d9States).

Unit IV

Calculations of Dq,B and p parameters, charge transfer spectra, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

UntiV

Metal n-Complexes. Metal carbonyls, structure and bonding. Vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

Books Suggested

1. Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson. John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Eamshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetochemistry, R.L. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.

M.Sc Chemistry Second Semester

02PChel02 **Reaction Mechanism- II And Stereochemistry**

70 Marks **3Hrs Duration**

Unit I

(a)Addition to Carbon-Hetero Multiple Bonds Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reaction involving enolates-Aldol, Knoevenagel. Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.Hydrolysis of esters and amides, ammonolysis of esters.

Unit II

(a)Addition to Carbon-Carbon Multiple Bonds Mechanism and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemo- selectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

Unitm

(a)StereochemistryElements of symmetry, Chirality, molecules with more than one chiral center, threo and erythroisomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms,groups and faces,stereospecific and stereroselective synthesis .

Unit IV

Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus, **(b)** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.

UnitV

Pericyclic Reactions Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene,l,3,5-hexatriene and allyl system. Classification of pericyclic reaction. Woodward- Hoffinann correlation diagrams. FMO and PMO approach Electrocyclic reactions- conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions-antarafacial and suprafacial additions, 4n, 4n+systems, 2+2 addition of ketenes, 1,3 dipolar cycloaddition and cheleotropic reactions. Sigmatropic rearrangements-suprafacial and antarafacial shifts of P sigmatropic shifts involving carbon moieties, 3,3-and 5,5-sigmatropic rear-rangements. Claisen, Cope and aza- Cope rearrangements, Ene reaction.

Books Suggested:

I. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley. 2. Advance Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.

3. A guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman

4. Structure and Mechanism in Organic Chemistry, C.K. Ingold Cornell University Press.

5. Organic Chemistry, T.R. Morrison and R.N. Boyd, Prentice-Hall

6. Modem Organic Reactions, H.O. Housee, Benjamin.

7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Profesional.

8. Pericyclic Reactions S.M. Mukheiji, Macmillan, India.

9. Reaction Mechanism in Organic Chemistry, S.M. Mukheiji and S.P. Singh, Macmillan.

10. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

II. Sterochemistry of Organic Compounds, P.S. New Age International.

12. Quantum Chemistry by Zimmerman Academic Press.

M.Sc Chemistry Second Semester

02PChel03 **Physical Chemistry - II**

70 Marks **3Hrs Duration**

Unit I

Electrochemistry Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Bjerrum model. Thermodynamics of electrified interface equations, methods of determination. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Overpotentials, exchange current density, derivation of Butler-Volmer equation, Tafel Plot. Polarography theory, Ilkovic equation; half wave potential and its significance. Corrosion - Types, mechanism and inhibition.

Unit II

Surface Chemistry

(a) Adsorption Pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation without derivation), mechanism of surface catalytic reactions.

Unitm

(a) Micelles Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, solubilization, micro emulsion, reverse micelles.

(b) Macromolecules Electrically conducting, fire or heat resistant, liquid crystal polymers

UNIT IV

Statistical Thermodynamics Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulate of ensemble and averaging. Canonical, grand canonical and micro canonical ensembles.

UNITV

Partition functions-translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions.Chemical equilibria and equilibrium constant in terms of partition functions, Fermi- Dirac statistics. Bose-Einstein statistics-distribution law and application to helium in brief.

Books Suggested:

1. Physical Chemistry, P.W. Atkins, ELBS
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valance, R McWeeny, ELBS
5. Chemical Kinetics, KJ.Laidler, MacGraw-Hill
6. Kinetics and Mechanism of Chemical transformations, J. Rajaraman and J. Kuriacoose, McMillan.
7. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.
8. Modem Electrochemistry Vol.I and Vol.n J.O.M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Easterm.
10. Phase Rule hy Bowden.
11. Phase Rule by Y.K. Gupta.

M.Sc Chemistry Second Semester

02PChel04 **Group Theory and Spectroscopy**

70 Marks **3Hrs Duration**

Unit I

(a) Symmetry and Group Theory in Chemistry Symmetry elements and symmetry operation, definitions of group, sub-group, relation between orders of a finite group and its subgroup Conjugacy relation and classes. Point symmetry group.

Unit II

(a) Raman Spectroscopy Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle.Resonance Raman spectroscopy, coherent anti Stokes Raman spectroscopy (CARS).

Unitm

(a) **Molecular spectroscopy** Energy levels, molecular orbitals, vibrational transitions, vibration progression and geometry of the excited states, Franck-Condon Principle, electronic spectra of polyatomic molecules, Emission spectra, radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

Unit IV

(b) **Photoelectron Spectroscopy** Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules. ESCA. Chemical information from ESCA. Auger electron spectroscopy-basic idea. Photoacoustic Spectroscopy:, Basic principle of photoacoustic spectroscopy (PAS), PAS-gases and condensed systems, chemical and surface applications.

UnitV

Electron SpinResonance Spectroscopy Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the "g" value Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one impaired electron) including biological systems and to inorganic free radicals such as PH4 F2 and [BH3]. **Books Suggested**

1. Modem Spectroscopy, J.M. John Wiley.
2. Applied Electron Spectroscopy for chemical Analysis Ed. H. Windawi and F.L. No, Wiley Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry R.S. Drago, Saunders College.
5. Chemical Application of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, R. Chang, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill
8. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
9. Introduction of Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.

M.Sc Chemistry Second Semester

02PChe201 **Practical's**

100 Marks **7 Hrs Duration**

A. Inorganic Separation and determination of two metal ions Cu-Ni, Ni-Mg, Cu-Fe,Cu-Ba etc. involving volumetric and gravimetric methods.

B. Organic (a)Organic Synthesis (any five)

(i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.

(ii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.

(iii) Aldol condensation: Dibenzal acetone from benzaldehyde.

(iv) Sandmeyer reaction: p-chlorotoluene from p-toluidine.

(v) Cannizzaro reaction: 4-chlorobenzaldehyde as substrate.

(vi) Friedel Crafts Reaction: p-Benzoylpropionic acid from succinic anhydride and benzene.

(vii) Aromatic electrophilic substitutions: Synthesis ofp-nitroaniline and p-bromoaniline

(b)Quantitative Analysis (any two)

(i) Determination of DO of a water sample.
(ii) Determination of COD of a water sample.
(iii) Determination of BOD of a water sample.

C. Physical Chemistry (Students are required to perform at least five experiments from the following experiments.)

1. Determination of congruent composition and temperature of a binary system (e.g. diphenylamine-benzophenone system).
2. To construct the phase diagram for three component system(e.g., chloroform-acetic acid- water).
3. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
4. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.
5. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodine ion is oxidized by persulphate ion).
6. Determination of strengths of halides in a mixture potentiometrically.
7. Determination of the strengths of strong and weak acids in a given mixture using a potentiometer/pH meter.
8. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
9. Acid-base titration in a non-aqueous media using a pH meter.
10. Determination of activity and activity coefficient of electrolytes.
11. Determination of partition coefficient of 12 between water and CC14.

M.Sc Chemistry Third Semester

03PChel01 Spectroscopy

70 Marks 3Hrs Duration

UNIT I

13C N MR Spectroscopy

Difficulties and solution for recording 13C-NMR spectra, recording of 13CNMR spectra scale, solvent, solvent signals and their positions, multiplicity, 13C-1H coupling constant proton coupled and decoupled 13C spectra, broad band decoupling, off resonance technique.

UNIT n

Chemical shifts in 3C spectra -chemical shift calculation for alkanes, alkenes and alkynes, chemical shift calculation in internal and terminal substituted compounds, aromatic ' compounds. Use of 13C spectra in differentiating stereoisomer, Nuclear overhauser Effect.l3C- Dept Spectra-Differentiation in primary, secondary and tertiary carbons by Dept-45, Dept

90,Dept-135 Spectra.

UNIT III

2D NMR Spectroscopy: Theory and Principles of 2D NMR Spectroscopy, interpretation of 1H- 1H COSY, 1H13C Hector, HMQC,HMBC, Inadequate Spectra.

UNIT IV

Mass Spectroscopy

Introduction, ion production-EI, Cl, F D and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable Peak, Me Lafferty rearrangement. Nitrogen rule. High resolution mass Spectrometry. Examples of mass spectral fragmentation of organic compounds With respect to their structure determination.

UNIT-V

Applications of spectroscopy

UV-Visible, IR, 1H NMR, 13C NMR, MASS-interpretation of common organic compounds. .

Books Suggested.

1. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley
2. Inorganic Electronic Spectroscopy, A. **P.** B. Lever, Elsevier
3. NMR, NQR, EPR and Mossbauer Spectroscopy m Inorganic Chemistry, RV. Parish, Ellis Horwood
4. practical NMR Spectroscopy, M.L. Martin, JJ.Delpeuch and G.J Martin, heyden.
5. Spectrometric identification of Organic Compounds, R.M. Silverstein G.C Bassler and T. C. Merrill, John Wiley.
6. Introduction to NMR Spectroscopy, R. J Abraham, J Fisher and P loftus Wiley.
7. Application of Spectroscopy of organic Compounds, J. R. Dyer, Prentice Hall.
8. Spectroscopic Methods In Organic Chemistry, D.H. Williams,I.Fleming Tata McGraw Hill.

M.Sc Chemistry Third Semester

03PChel02 **Photochemistry and Solid State Chemistry**

70 Marks **3Hrs Duration**

UNIT-I

Electronic Properties and Band Theory

Metals, Insulators and semiconductors, electronic structure of solids-band theory. Band structure of metals insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junction.

UNIT-II

Super conductors-

Definition types and BCS theory Optical properties-optical reflectance, photoconduction- photoelectric effects. Magnetic Properties-Classification of materials -magnetic domains, hysteresis.

UNIT-III

(a) Photochemical Reactions

Interaction of electromagnetic radiation with matter, type of excitations fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

(b) Determination of reaction Mechanism

Classification, rate constants, and life time of reactive energy state determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Type of photochemical reactions-photo dissociation, gas-phase photolysis.

UNIT-TV

(a) Photochemistry of Alkenes.

Intermolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4and 1, 5-dienes.

(b) Photochemistry of Carbonyl Compounds

Intermolecular reactions of the carbonyl compounds saturated, cyclic and acyclic, p,y- unsaturated and a,P-unsaturated compounds , cyclohexadienones. Intermolecular cycloaddition reactions-dimerisation and oxetane formation.

UNIT-V

(a) Photochemistry of Aromatic Compounds

Isomerisations, additions and substitutions.

(b) Miscellaneous Photochemical Reactions

Photo-Fries reactions of anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photo degradation of polymers. Photochemistry of vision.

Books Suggested:

1. Structural Methods in Inorganic Chemistry, B. A. V. Ebsworth, D. W. H Rankin and S. Cradock, E1BS.
2. Progress in Inorganic Chemistry vol., 8th ed., EA. Cotton, vol. 15,ed. S J. Lippard, Wiley.
3. Transition Metal Chemistry ed.R.L. Carlin vol. 3, Dekker.
4. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
5. Fundamentals of Photochemistry, K. K. Rohtagl-Mukhelj 1, Wiley-Eastern.
6. Essentials of Molecular Photochemistry. A. Gilbert and J. Baggott, Blackwell Scientific Publication.
7. Molecular Photochemistry, NJ. Turro, W.A. Benjamin.
8. Introductory Photochemistry, A. Cox and T.Camp. Mc-Graw Hill.
9. Photochemistry, RIP. Kundall and A Gilbert, Thomson Nelson.
10. Organic Photochemistry, J .Coxon and B. Halton, Cambridge University Press.

M.Sc Chemistry Third Semester

03PChel03 **•••••••- .....**

70 Marks **3Hrs**
Duration

UNIT-I

(a) Air

Chemical composition of atmosphere, ions and radicals and their formation, chemical and photochemical reactions in atmosphere. Greenhouse effect, acid rain, ozone hole phenomenon, temperature inversion. Source and toxic effects of Pb, Cd, Hg, As, Cr, Ni and Mn.

UNIT-n

(b) Air Pollution

Classification of air pollutants sources, effects and control of CO, S02 NO, HC as gaseous pollutants, suspended particulate matter aerosols, photochemical air pollution.

UNIT-ni

(a) Water

Water quality parameters and their analysis, treatment of drinking water and waste water.

(b) Water Pollution

Sources of water pollution-solid waste, industrial, agricultural, oil, radioactive waste, thermal pollution classification of water pollutants-basis, effects and controls. Sampling of water pollutant

UN1T-IV

(a) Soil and Soil Pollution

Chemical profile of sons definition, fertility management of sods soil sediment analysis-physical and chemical parameters.

UN1T-V

(a) Soil pollution

Sources, detrimental effects and control.

Books Suggested:

1. Environmental Chemistry, S. E. Mannahan, Lewis Publishers.
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers.
3. Environmental Chemistry, A. K. De, Wiley Eastern.
4. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis. FJ. Welcher Vol.ni Van Nostrand Reinhold Co.
6. Element Analysis of Airborne Particles, Ed. S. Landsbergeer and M. Creatchman, Gordon and Breach Science Publication.
7. Environmental Chemistry, C. Baird, W. H F reeman

M.Sc Chemistry Third Semester

03PChel04 **Chemistry Of Life**

70 Marks **3Hrs Duration**

UNIT-I

(a) Metals (Mg, Ca, Mn, F e and Co) In Biological Systems Definition and classification of metals.

(b) Na+/K + Pump Role of bulk and trace metals Ions in biological processes.

UNIT-II

(a) Bioenergetics

Standard free energy change In biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP

(b) Cell Membrane and Transport of Ions .

Ion transport through cell membrane, Irreversible thermodynamic,-treatment of membrane transport. Nerve conduction.

UNIT-III

Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity . and regulation Nomenclature and classification, extraction and purification Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use at inhibitor, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis ~Menten kinetics and Michaelis constant, Lineweaver-Burk Plots, reversible and irreversible inhibition.

UNIT-TV

Mechanism of Enzyme Action

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Example of some typical enzyme mechanisms for chymotrypsin, rib nuclease, lysozyme and carboxypeptidase A.

UNIT-V

(a) Co-Enzyme Chemistry

Co-factor as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate pyridoxal phosphate, NAD+ NADP+ FMN, FAD, lipoic acid, VitaminB12

(b) Biotechnical Application of enzymes

Use of enzymes in food and drink industry-brewing and cheese making, syrups from com starch,enzymes as targets for drug design, recombinant DNA technology.

Books Suggested

1. Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Berg, University. Science Books
2. Inorganic Biochemistry vols I and 11 GL. Eichhom, 'Elsevier.
3. Progress In Inorganic Chemistry, Vols 18 and 38 ed. 1.1. Luippard, Wiley.
4. Understanding Enzymes, Trevor Palmer, Prentice Hall.
5. Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling. Chapman and Hall.
6. Fundamental of Enzymology, N. C. Price and L. Stevens. Oxford University Press.
7. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.
8. Enzyme Structure and Mechanism, A F ersht, W.H. Freeman.
9. Biochemistry: The chemical reactions of Living Cells,D.E. Metzler, Academic Press.
10. Enzyme Mechanisms Ed. M. I. Page and A Williams, Royal Society of Chemistry.
11. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
12. Biochemistry, L. Stryer. W.H. Freeman
13. Biochemistry,. J .David Rawn. Neil Patterson.
14. Biochemistry, Voet and Voet, J ohn Wiley.
15. Outline of Biochemistry. E.E. Conn and BK. Stumpf. J ohn Wiley.
16. Macromolecules: Structure and Function, F. Wold, Prentice Hall.

M.Sc Chemistry Third Semester

03PChe201 **Practical's**

100 Marks **7Hrs Duration**

Inorganic

(a)inorganic Preparations(Any Seven)

1. Sodium amide Inorg. Syrith 1946,2, 128.
2. Synthesisand thermal analysis of Group 11 metal oxalate hydrate. J.Chem. Ed., 1988,65,1024.
3. Atomic absorption analysis of Mg and Ca.
4. Trialkoxyboranes -Preparation, IR and NMR spectra.
5. Pthl2 dichlorophenylborane-Synthesis in vacuum line.
6. Preparation of Tm (TV) iodine, Tin (IV) chloride and Tin (11) iodide. Inorg, Synth, 1953 ,4,119
7. Relative stability of Tin (IV) and Pb(IV). Preparation of ammonium hexachlorostannate (N H 4)2 SnC16Ammonium hexachloroplmnbate (NH4)2PbC16
8. HexibisM-nitrophenoxy) cyclotriphosphazene..
9. Synthesis of trichlorodiphenylantimony(V) hydrate.Inorg Synth. 1985,23,194.
10. Sodium tetrathionate N212S4 06
11. Metal complexes ofdlmethyl sulfoxide(IR): CuC12 .2DMSO. PbC12 2DMSO. RuC12 4DMSO. J. Chem Educ, 1982,59, 57.
12. Synthesis of acetylacetonate Magnetic moment, IR, NMR, Inorg. Synth, 1957,5,130;1963,1, 183..
13. Bromination of Cr(acac) J. Chem. Edu., 1986,63,90.
14. Magnetic moment of Cu(acac) H2 0.
15. Cis and Trans[Co(en)2C12]+.
16. Separation of optical Isomer of cis-[Co(en)2C12]Cl. J.Chem. Soc. 1960,4369.
17. Ion exchange separation of oxidation state of vanadium. J . Chem. Educ., 1980, 57,3 16;1975,55,55.
18. Determination of Cr(III) complexes. 01(1120)6 N03. 31-120, [Cl'(l-120)4 C12]C1. 2 0,[Cr(en)2,]C13,C,(acac)3 Inorg.Synth.,1972,13,184.
19. Preparation of N, N is(salicyldehyde) ethylenediamine, salen H2 Co(salen)J. Chem. Educ 1977, 54,443,1973, 50, 670. Determination of 0 absorption by Co(salen)Acct.Chem. Res.,1975 8.384. Reaction of Oxygen adduct with CHC13(deoxygenation).
20. Preparation of Fe(II), chloride (use it as FriedelC1311 chlorination source J. Org. Chem. 1978,43,2423; J. Chem. Edu. 1984,61 ,645: 1986,63, 361.
21. Reaction of Cr (III) with a multidentate ligand: a kinetics experiments (visible spectra Cr- EDTA complex) J.A.C.S. 1953,75, 56, 70.
22. Preparation of [Co(phenonthroline-5,6.quinone]
23. Preparation and use of Ferrocene. J.Chem. Edu, 1966,43,73; 1976,53, 730.
24. Preparation of copper glycine complex-cis and trans bis(glycinato copper (II). J. Chem. Soc dalton, 1979,1901. J.Chem. Edu. 1982,59,1052.
25. Preparation of Phosphine Ph3 P and its transition metal complexes.
26. Conversion of p-xylene to terephthalic acid catalyzed by CoBr2 (homogeneous catalysis)

B. Organic Chemistry Qualitative Analysis

Separation, purification and identification of the components of mixture of three Organic compounds (three solids or two liquids and one solid, two solids and one liquid) using TLC for checking the purity of the separated compounds, chemical analysis..

C. **Physical Physical**

Experiments Major

1. Determination 6f partial molar volume of solute and solvent m a binary mixture.
2. Determinate of the temperature dependence of the solubility of a compound in two solvents having similar intermolecular interactions (benzoic acid in water and In DMSO» water Mixture) and calculate the partial molar heat of. solution.
3. Determination of dissolved oxygen in aqueous solution of organic solvents
4. To study the effect of addition of an electrolyte on the solubility of an organic acid.
5. To determine the composition of binary mixtures containing K 27C1'20 and KMn04 using a spectrophotometer.
6. To determine the heats of neutralisation of two acids eg HC1 & CH 3 COOH and hence their relative strength..

Minor

1. Response characteristics of RC network
2. Response characteristics of LR network.
3. Verification of KirchofPs law.
4. Half wave and lull wave rectifier.
5. Clipping and Clamping circuits.

M.Sc Chemistry Fourth Semester

(MPChelOl **Contemporary Inorganic Chemistry**

70 Marks **3Hrs Duration**

Unit-I

Alkyls and Aryls of Transition Metals

Types, routes of synthesis, stability and decomposition pathways, organ copper in organic synthesis.

Unit-II

Compounds of Transition Metal-Carbon Multiple Bonds

Alkylidenes, alkylidynes, low valent carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic reactions on the legends, role in organic synthesis. Compounds with metal-metal multiple bonds.

Unit-Ill

Transition Metal n-Complexes

Transition Metal Jt-Complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and tnenyl complexes, preparations, properties, nature, of bonding and structural features, Important reactions related to nucleophilic and electrophilic attack on ligands and applications in organic synthesis

LNIT-IV

Fluxional Organometallic Compounds

Fluxionality and dynamic equilibria in Compounds such as q^2-oleiin, q 3 allyl and dienyl complexes.

UNIT-V

Homogenous Catalysis

Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (0x0 reactions), Oxopalladation reactions, activation of C-H bond

Books Suggested:

1. Principles and Application of Organotransition Metal Chemistry. J .P. Collman, L.S. Hegdus, J .R. Norton and R.G.Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals John Wiley
3. Metallo-Organic Chemistry ,A.J. Pearson, Wiley.

4 Organometallic Chemistry; R.CMehrotra and A. Singh; New Age International

M.Sc Chemistry Fourth Semester

04PChel02 **Organic Synthesis-1**
70 Marks **3Hrs Duration**

UNIT-I

Oxidation

Introduction, Different Oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H bond (activated and inactivated).Alcohols,diols, aldehydes, ketones, ketals and carboxylic acids. Amines, hydrazines and sulphides.

UNIT-n

Reduction

Introduction, Different reductive processes Hydrocarbons-alkanes, alkenes, alky Carbonyl compounds-aldehydes, ketones. Acids and their derivatives. Epoxides.

UNIT-III

General mechanistic considerations-nature of migration migratory aptitude, memory effects.
A detailed study of the following rearrangements:
Pinacol-pinacolone, Wagner-Meerwein. Demjanov, Benzil-Benzilic acid, Favorskn Amdt-Eistert synthesis, Beckmann, Hoiinann, Curtius, Schmidt, Baeyer-Vlllage, Shapiro reaction.

UNIT-IV

Organometallic Reagents

Principles, preparations, properties and applications of the following In organic synthesis with mechanistic details.

(i) Groupl and H metal organic compounds
Li, Mg,Hg, Cd, Zn Compounds.[1]

(ii) Transition Metals
Cu, Pd, Ni, Fe, Co, Rh, Cr and Ti Compoumjs.

UNIT-V

Protecting Groups.
Principle of Protection of alcohol, amine, carbonyl and carboxyl groups.

Books Suggested

1. Modem Synthetic Reactions, H.O. House, W.A. Benjamin.
2. Some Modem methods of Organic Synthesis; W. Carruthers, Cambridge Univ. Press.
3. Advanced Organic Chemlstly, Reactions Mechanisms and Structure, J.March, John Wiley.
4. Principles of Organic Synthesis, R. O'. C. Norman and J. M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B. F. A. Carey and R. J. Sundberg, Pleanum Press
6. Rodd's Chemistry of Carbon Compolmds, ed. S. Coffey, Elsevier.
7. Desigling Organic Synthesis.S.WalTen, Wiley.
8. Organic Synthesis-Concept, methods and staring Materials.
9. Fuhrhop and G.PenziDin, Veriage VCH.

M.Sc Chemistry Fourth Semester

04PChel03 **Chemical Dynamics**
70 Marks **3Hrs Duration**

UNIT-I

Inorganic Substitution Reactions

Types of substitution reaction, Langford and Gray classification of substitution mechanisms, Acid hydrolysis of aquation reaction of pentaammine cobalt(III) cpmplexes, Base hydrolysis of chloropentaamminecobalt (III) complex.

UNIT-II

Electron transfer reactions.
Inner sphere electron transfer reactions.
Henry taube's classical study of electron transfer reaction between chloropentammine cobalt (HI) and Cr (II). A general mechanism involving precursor complex. Various types of bridges, Electron transfer mechanisms : adjacent attack, remote attack, resonance mechanism and chemical mechanism. skitra-molecular electron transfer reactions.

UNIT-III

Outer sphere electron transfer reactions.
Outer sphere electron transfer mechanism Marcus cross relation and its application. Bridged outer sphere electron transfer mechanism. Kinetics of electron exchange mechanism.

UNIT-IV

Radiation Chemistry

Introduction, sources of high energy radiation, dose, primary and secondary processes, radiolysis of water, reaction of hydrogen atoms and hydroxide radicals, radiation chemical yield.

UNIT-V

Photochemistry

Unimolecular photophysical processes and their rate laws, Kinetics and mechanism of photochemical hydrogen-Bromine reaction, Kinetics of collisional quenching and Stem-Volmer equation, Semiconductor Photocatalysis-formation of hole. Excited state electron transfer reaction of [Ru(bipy)3]2+ and photocatalytic splitting of water.

Suggested books

1. Keith J. Laidler, Chemical Kinetics. Harper and Row, New York, 1987
2. Donald AMcquarrie and J ohn D. Simon, Physical Chemistry A Molecular approach, Viva Books, New Delhi, 2013 .
3. S.J .E. Huheey, E.A. Keiter, O.K. Medhi, Inorganic Chemistry, Darling Kindersley, New Delhi, 2013 S K. Upadhyay, Chemical Kinetics and Reaction Mechanism, Anamya' Delhi, 2006
4. J Rajaram and J .C. Kuriacose, Kinetics and Mechanism of Chemical transformations, Mcmillan India and National Book Trust, Delhi, 1993,
5. K.K. Rohatgi-Mukheijee, Fundamentals of Photochemistry, New Age; Delhi, 1986
6. Progress in Inorganic Chemistry, Vol. 30,1967. “
7. R. Lumly and R. W. Raymond, Electron transfer Reactions, Inter science
8. N. L. Bender, Mechanism of Homogeneous Catalysis from protein to protein Wiley. 10. A.G. Sykes, Kinetics of Inorganic reactions, Pergamon.
9. S.W. Benson, Mechanism of Inorganic Reactions, Academic Press.
10. Physical Chemistry Vol. 2 Ed. Prof. Ya Grasimov, Mir Publisher.
11. Basolo and Pearson, Inorganic Reaction Mechanism, Wiley.
12. H. Taube, Electron Transfer Reaction, Oxford Press.
13. Jingwei Luo, Allen G.Oliverb and J.Scott Mclndoe, A detailed kinetic analysis of rhodium - catalyzed alkyne hydrogenation, Dalton Trans. 2013 ,42,11312
14. V. Y. Gankin & G. S. Gurevich, Chemical Technology of oxosynthesis, “Khimiya” (Chemistry) in Leningrad
15. F.A.Cotton,GWilkinson,C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistly, 6th Edn.,John Wiley, Singapore, 1999.

M.Sc Chemistry Fourth Semester

04PChel04 **Heterocyclic Chemistry**
70 Marks **3Hrs Duration**

UNIT-I

(a) Nomenclature of Heterocycles

Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles.

(b) Aromatic Heterocycles

General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H NMR-spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations.) Heteroaromatic reactivity, and tautomerism in aromatic heterocycles.

UNIT-H

(a) Non Artromatic Heterocycles

Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction.

Stereo-electronic effects-anomeric and related effects. Attractive mteractions-hydrogen bonding and intermolecular nucleophilic-electrophilic interactions .

(b) Heterocyclic Synthesis

Principles of heterocyclic synthesis involving cyclization reaction and cycloaddition reactions.,

UNIT-IH

(a) Small Ring Heterocycles

Three-membered and four-membered heteiocycles-synthesis and reactions of azmdmes oxiranes, azetidines, oxetanes.

(b) Heterocyclic Systems containing P

Heterocyclic ring containing phosphorus: Introduction, nomenclature, synthesis and characteristics of 5-and 6-membered ring systems-phosphorinanes, phosphorines, phospholanes and phospholes.

UNIT-IV

(a) Six-Membered Heterocycles with one Heteroatom

Synthesis and reactions of quinolizinium and benzopyrylium salts, cdumarins and chromones.

(b) Benzo Fused Five-mem bered Hetrocycles

Synthesis and reactions including medicinal applications of benzhpyrroles, benzofurans and benzothiophenes. Meso-Ionic heterocycles.

UNIT-V

(a) Seven and Large-membered Heterocycles

Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, diazocines, dioxocines.

(b) Six-Membered Heterocycles with Two or More Heteroatoms

Synthesis and reactions of tetrazines and thiazines.

Books Suggested:

1. Heterocyclic Chemistry Vol. 1-3, RR. Gupta, M.Kumar and V. Gupta, Springer Verlag.
2. The Chemistry of Heterocycles T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic Chemistry, J. A. Joule, K. Mills and GE Smith, Chapman and Hall.
4. Heterocyclic Chemistly, T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic Chemistry, GK Newkome and WW. Paudler, Wiley-Inter Science.
6. An introduction to the Heterocyclic Compounds, R.M. Acheson, J ohn Wiley
7. Comprehensive Heterocyclic Chemistry, A.R. Karitzky and CW. Reeds,eds. Pergamon Press.
8. Organic Chemistry, Vol.2, IL; Finar, ELBS.

M.Sc Chemistry Fourth Semester

04PChe201
100 Marks

Practical's (For Group -A, B, C)
7 Hrs Duration

A. Inorganic

(a) Spectrophotometric Determinatidn (Any Three)

1. Manganese/Chromium/Vanadium in steel sample.
2. Nickel/molybdenum/tungsten/vanadium/uranium by extractive spectrophotometric method.
3. Fluoride/nltrite/phosphate.
4. Iron-phenanthroline complex; Job's method of continuous variations.
5. Zirconium-Alizarin Red-S Complex; Mole-ratio method.
6. Copper-ethylene diamine complex: Slope-ratio method.

(b) Flame Photometric Determinations (Any Three).

1. Sodium and potassium when present together.
2. Lithium/Calcium/barium/strontium,
3. Cadmium and magnesium in tap water.
4. Sulphate.
5. Phosphate

(c) Silver.

Chromatographic Separations (Any Three)

1. Cadmium and Zinc
2. Zinc and Magnesium
3. Thin-layer Chromatography-[1 2 3 4 5 6 7 8] separation of nickel manganese, cobalt and zinc. Determination of Rf values
4. Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.
5. Separation and identification of Pb and Cd by Paper Chromatography and determ mation of Rf value.

B. Organic

(a) Organic synthesis

Multi-step Synthesis of Organic Compounds (any four) The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques.

1. Photochemical reaction.
   Benzophenone —> benzpinacol -> benzpinacolone
2. Beckmann rearrangement: benzanilide from benzene
   Benzene -> Benzphenone --> Benzophenone oxime ~> benzanilide
3. Benzoin ~> benzil --> benzilic acid
4. Preparation of Quinolme from aniline preparation of 2phenylindole from phenylhydrazine.
5. Reduction of ethyl acetoacetate using Baker' 5 yeast to yield enantiomeric excess of S(+) ethyl-3 -hydroxybutanoate and determine its optical purity.
6. Biosynthesis of ethanol from sucrose.
7. Synthesis using microwave-Alkylation of diethylmalonate with benzyl chloride.
8. Synthesis using phase transfer catalyst.

Extraction of organic compound from natural source—.

1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
3. Isolation of lactose from milk (Purity of sugar should be checked by TLC and PC and Revalue reported).
4. Isolation of nicotine dipicrate from tobacco.
5. Isolation of cinchonine from cinchona bark.
6. Isolation of piperine from black pepper.
7. Isolation of lycopene from tomatoes .
8. Isolation of B-carotene from carrots.
9. Isolation of oleic acid {i'om olive oil (involving the preparation of complex with urea and separation of linoleic acid..
10. Isolation of eugenol from cloves.
11. Isolation of (+) limonine from citrus rinds.

(b) Spectroscopy

Identification of organic compounds by the analysis of their spectral data (U V, IR, PMR).

Spectrometric (UV/VIS) estimations (Any Three):

1. Aminoacids 2. Proteins
3. Carbohydrates . 4. Cholesterol
5. Ascorbic acid.' 6. Aspirin
7. Caffei

ne **C**

Physical

(a) Major.

1. Determination of pKa of indicator (e.g.methyl red).
2. Determination of stoichiometry and stability constant of inorganic(e.g.ferricsalicyclic acid) organic (e.g. amine and iodine) complexes.
3. Characterisation of complexes by electronic and IR spectral data.
4. Estimation of Pb2+ and Cd2+ /Zn2+ and Ni+2by polarography.
5. To obtain solubility curve for a ternary system of liquids, water-acetic acid, acid chloroform system.
6. To estimate oxalic acid by carrying out suitable conductometric titration in the following solutions.

(i) A solution of pure Oxalic acid.
(ii) A solution of Oxalic acid and HC1.
(iii) A solution of oxalic acid and CH3COOH

(b) Minor

1. Capacitor as charge storage device,
2. To study the behaviour of parallel charged capacitor in series charged Capacitor placed in parallel,
3. The use of LCR bridge
4. Response characteristics of LCR network.
5. Measurement emf of thermocouple.
6. To plot characteristics curve, of diode.
7. Capacitor filter for full wave rectifier.

Books suggested

1. Inorganic Experiments, J . Kerek Woollins, VCH
2. Microseale Inolganic Chemistry, Z. Sqaiian, R.M. Pike and MM. Singh, Wiley.
3. Practical Inorganic Chemistry, GMarr and B. W. Rockelt', Van Nostrand.
4. The Systematic Identification of Organic Compounds,R.L. Shrine 1' and 'D. Y. Cutin.
5. Semimicro Qualitative Organic Analysis, N. D. Cheronis, J. B. Entrikin and E. M. Hodnett.
6. Experimental Organic Chemistly.M.P. Doyle and W.S.Mungall.
7. Small Scale Organic Preparations, P. J. Hill..
8. Organometallic Synthesis, J. J. Fisch and R. B. kmg,Acadenl lc
9. Experimental Physical Chemistry, D. P. Shoemaker, C W. Garland and J .W.Niber, McGraw Hill, Interscience.
10. F malay 3 Practical Physical Chemistry, revised B. P. Levitt, longman.
11. Experiments In Physical Chemisuy, J. C. Ghosh, Bharti Bhavan.