B.A. (HONOURS) PSYCHOLOGY

(Three Year Full Time Programme)

COURSE CONTENTS

(Effective from the Academic Year 2011-2012 onwards)

DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF DELHI
DELHI - 110007

University of Delhi

Course: B.A. (Hons.) Psychology

Semester I	Paper 1: Foundations of Psychology
	Paper 2: statistical Methods for Psychological Research-I
	Paper 3: Concurrent – Qualifying Language
Semester II	Paper 4: Physiological Psychology
	Paper 5: Practicum-I
	Paper 6: Concurrent – Credit Language

Semester III	Paper 7: Psychological Research
	Paper 8: Practicum-II
	Paper 9 : Concurrent – Interdisciplinary
Semester IV	Paper 10: Emergence and Growth of Psychology
	Paper 11: Statistical Methods for Psychological Research-II
	Paper 12: Social Psychology
	Paper 13: Concurrent – Discipline Centered I

Semester V	Paper 14: Industrial/Organizational Psychology
	Paper 15: Abnormal Psychology-I
	Paper 16: Practicum-III
	Paper 17: Child and Adolescent Development
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	Paper 19: Counselling Psychology
	Paper 20: Project/Field Study (Report)/Human Resource Management/ Psychology of Heath and Well-Being
	Paper 21: Concurrent – Discipline Centered II

SEMESTER BASED UNDER-GRADUATE HONOURS COURSES

Distribution of Marks & Teaching Hours

The Semester-wise distribution of papers for the B.A. (Honours), B.Com. (Honours), B. Com., B.Sc. (Honours) Statistics and B.Sc. (Honours) Computer Science will be as follows:

Type of Paper	Max. Marks	Theory Exam.	I.A.	Teaching per week
Main Papers	100	75	25	5 Lectures 1 Tutorial
Concurrent Courses	100	75	25	4 Lectures 1 Tutorial
Credit Courses for B.Sc.(Hons.) Mathematics	100	75	25	4 Lectures 1 Tutorial

- Size of the Tutorial Group will be in accordance with the existing norms.
- The existing syllabi of all Concurrent/Credit Courses shall remain unchanged.
- The existing criteria for opting for the Concurrent /Credit Courses shall also remain unchanged.

B.A. (HONS.) PSYCHOLOGY

COURSE DETAILS

SEMESTER -I

Paper 1: Foundations of Psychology

UNIT 1: Perception

a) Perception: Bottom-up and top-down processing
b) Role of attention in perception
c) Principles of Perceptual Organization
d) Depth Perception
e) Perceptual Constancies
f) Illusions
g) Influence of contexts and expectations on perception

UNIT 2: Learning and Motivation

a) Nature of Learning
b) Classical and Operant Conditioning: Principles/processes, Applications
c) Cognitive influences on learning
d) Observational Learning
e) Biological constraints in learning
f) Functions of motivational concepts
g) Perspectives on Motivation
h) Types of Motivations
i) Motivational Conflicts

UNIT 3: Personality and Self

a) Nature of Personality
b) Psychodynamic theories
c) Type and trait theories
d) Humanistic theories
e) Social learning and Cognitive theories
f) Culture and Personality
g) Self and identity in Indian thought
h) Personality Assessment

UNIT 4: Intelligence

a) Intelligence in historical perspective
b) Psychometric and Cognitive process approaches to Intelligence
c) Broader conceptions of Intelligence: Multiple Intelligences, Emotional Intelligence
d) Measurement of Intelligence
e) Role of Heredity and Environment in intelligence
f) Extremes of Intelligence

Reading List:

Ciccarelli, S.K. & Meyer, G.E. (2008). *Psychology (South Asian Ed.).* New Delhi: earson Longman.

Gerrig, R.J. & Zimbardo, P.G. (2010). *Psychology and Life (19th Ed.).* Delhi: Allyn & Bacon.

Morris, C. G. (1990). *Psychology: An Introduction.* New Delhi: Prentice Hall.

Passer, M.W. & Smith, R.E. (2007). *Psychology: The Science of Mind and Behaviour (3rd Ed.)*. New Delhi: Tata McGraw-Hill

Paper 2: Statistical Methods For Psychological Research-I

UNIT 1:

1. Introduction
    a. What is Psychological Research?
    b. Relevance of Statistics in Psychological Research
    c. Descriptive and Inferential Statistics
    d. Variables and Constants
    e. Scales of Measurements

2. Frequency Distributions, Percentiles, and Percentile Ranks
    a. Organizing Qualitative Data
    b. Grouped Scores
    c. The Cumulative Frequency Distribution
    d. Percentiles and Percentile Ranks
    e. Computing Percentiles and Percentile Ranks from Grouped Data

UNIT 2:

3. Graphic Representation of Frequency Distributions
    a. Basic Procedures
    b. The Histogram
    c. The Frequency Polygon
    d. Choosing between a Histogram and a Polygon
    e. The Bar Diagram and the Pie Chart
    f. The Cumulative Percentage Curve
    g. Factors Affecting the Shape of Graphs

4. Central Tendency

    a. The Mode
    b. The Median
    c. The Mean
    d. Properties of the Mode
    e. Properties of the Mean
    f. Properties of the Median
    g. Measures of Central Tendency in Symmetrical and Asymmetrical Distributions
    h. The Effects of Score Transformations

UNIT 3:

5. Variability and Standard (z) Scores

    a. The Range and Semi-Interquartile Range
    b. Deviation Scores
    c. Deviational Measures: The Variance
    d. Deviational Measures: The Standard Deviation
    e. Calculation of the Variance and Standard Deviation: Raw-Score Method
    f. Properties of the Range and Semi-Interquartile Range
    g. Properties of the Standard Deviation
    h. How Big is a Standard Deviation?

i. Score Transformations and Measures of Variability
j. Standard Scores (z scores)
k. A Comparison of z Scores and Percentile Ranks

6. Standard Scores and the Normal Curve

a. The Nature of the Normal Curve
b. Standard Scores and the Normal Curve
c. The Standard Normal Curve: Finding areas when the score is known
d. The Standard Normal Curve: Finding scores when the area is known
e. The Normal Curve as a Model for Real Variables
f. The Normal Curve as a Model for Sampling Distributions

UNIT 4:

7. Correlation

a. Some History
b. Correlation: A Matter of Direction
c. Correlation: A Matter of Degree
d. Calculating Pearson's Correlation Coefficient from Deviation Scores
e. Calculating Pearson's Correlation Coefficient from Raw Scores
f. Spearman's Rank-Order Correlation Coefficient
g. Correlation does not prove Causation
h. The Effects of Score Transformations
i. Cautions Concerning Correlation Coefficients

8. Random Sampling and Sampling Distributions

a. Random Sampling
b. Using a Table of Random Numbers
c. The Random Sampling Distribution of the Mean: An Introduction
d. Characteristics of the Random Sampling Distribution of the Mean
e. Using the Sampling Distribution of Sample Means to Determine the Probability for Different Ranges of Values of Sample Mean
f. Random Sampling Without Replacement

Reading List:

Aron, A., Aron, E.N., & Coups, E.J. (2007).*Statistics for Psychology. (4th Ed.)* India: Pearson Education, Prentice Hall.

King, B.M. & Minium, E.W. (2007).*Statistical Reasoning in the Behavioral Sciences. (5th Ed.)* USA: John Wiley.

Paper 3

Concurrent – Qualifying Language

SEMESTER –II

Paper 4: Physiological Psychology

UNIT 1: Definition, Methods of Physiological Psychology

UNIT 2: Neuron: Structure, types, and Function, Synaptic transmission
UNIT3: Nervous System: Structure and functions of major parts of the nervous system, hemispheric specialization

UNIT 4: Endocrine system: Structure, function and Abnormalities of major glands: Thyroid, Adrenals, gonads, Pituitary, pancreas and pineal glands.

Reading List:

Carlson, N. R. (1990). *Physiology of Behaviour.* Boston: Allyn & Bacon.

Levinthal, C. F. (1983). *Introduction to Physiological Psychology*. New Delhi: PHI.

Levitt, R. A. (1981). *Physiological Psychology.* New York: Holt.

Rozenweig, M. H. (1989). *Physiological Psychology.* New York: Random.

Paper 5: Practicum – I

Psychological Testing

Total 4 tests – at least one from each of the following:
Aptitude
Intelligence
Personality

Evaluation Scheme

Viva
Record
Conduction and report writing

Paper 6

Concurrent - Credit Language

SEMESTER –III

Paper 7: Psychological Research

UNIT 1:

Part A: Beginning Psychological Research

(a) Goals of Psychological Research

(b) Formulating a problem and developing a testable hypothesis

Part B: Quantitative and Qualitative Orientations towards Research

UNIT 2: Methods of Data Collection

(a) Sampling

(b) Probability Sampling Methods

(c) Non Probability Sampling Methods

UNIT 3: Non Experimental Methods (I)

(a) Case Study

(b) Observation

(c) Survey

UNIT 4: Non Experimental Methods (II):

(a) Psychological Testing

(b) Standardization

(c) Reliability

(d) Validity

(e) Norms

Reading List:

Dyer, C. (2001) *Research in Psychology: A Practical Guide to Research Methodology and Statistics (2nd Ed.)* Oxford: Blackwell Publishers

Gregory, R.J. (2006). *Psychological Testing: History, Principles, and Applications (4th Ed.).* New Delhi: Pearson Education.

Murphy,K.R. & Davidshofer,C.O. (2004). *Psychological Testing: Principles & Applications (6th Ed.)* New Jersey: Prentice Hall.

Neuman, W.L. (2006). *Social Research Methods: Qualitative and Quantitative Approaches (6th Ed.)* Boston: Pearson Education.

Paper 8: Practicum – II

Qualitative Research Methods

Total 5 practical – at least one from each of the following:
Survey
Interview
Observation
Projective/ Semi Projective Tests

Evaluation Scheme

Viva
Record

Paper 9

Concurrent - Interdisciplinary

SEMESTER -IV

Paper 10: Emergence and Growth of Psychology

UNIT 1: Basic Issues in Psychology

Each of the issues to be dealt with from the point of view of an East-West Comparison

a) Issues of Consciousness and Mind Body Relationship
b) Issue of Determinism and Free Will
c) Issue of Empiricism and Rationality
d) Methodological Issues: Introspection to Experimentation to Clinical Approach & Phenomenology

{Note: Eastern perspective will include Yoga & Vedantic view}

UNIT 2: Positivist Thrust: Behaviourism to Cognition

- Developments in behaviourism & neo behavouristic traditions (a comparison) & the movement towards cognitive psychology.

➢ *Detailed treatment of particular thinkers within behaviourism & neo-behaviourism is not needed.*

UNIT 3: Analytical-Existential Thrust 10 Marks

a) Classical Psychoanalysis: Freud, Adler and Jung
b) Ego Psychology: Erikson

➢ *Each of these theorists in a) & b) to be covered in some detail*

c) Object Relations
d) Humanistic & Existential Consciousness: Coming back a full circle

➢ *Detailed treatment of particular thinkers in c) & d) is not needed.*

UNIT 4: Overview of Contributions to the Growth of Psychology

- Contributions of Behaviourism, Gestalt (including Lewin), Cognitive, Psychoanalytic, Humanistic, Existential thinkers & the Eastern thought to the Discipline of Psychology.

Reading List:

Leahey, T.H. (2005). *A History of Psychology: Main currents in psychological thought* (6th Ed.). Singapore: Pearson Education.

Paranjape, A.C. (1984). *Theoretical psychology: The meeting of east and west.* NY: Plenum Press.

Suggested List of Readings:

Lawson, R.B, Graham, J.E. & Baker, K.M. (2009*). History of psychology: Globalization, ideas and applications.* Delhi: Dorling Kindersley (India), Pearson Education .

Pawlik, K. & d'Ydewalle, G. (2006). *Psychological concepts: An international historical perspective.* UK: Taylor Francis.

Viney, W. & King, D.B. (2003). *A history of psychology: Ideas and context.* (3rd Ed.). Boston: Allyn & Bacon.

Wolman, B.B. (1979). *Contemporary theories and systems in psychology.* Delhi: Freeman Book Company.

Paper 11: Statistical Methods for Psychological Research-II

UNIT 1

1. Introduction to Statistical Inference: Testing Hypotheses about Single Means (z and *t*)
    a. Testing a Hypothesis about a Single Mean
    b. The Null and Alternative Hypotheses
    c. Retention and Rejection of Null Hypothesis
    d. Procedural Steps for Hypothesis Testing
    e. Hypothesis Testing about a Single Mean – Calculation
    f. The Statistical Decision
    g. Choice of H_A: One-Tailed and Two-Tailed Tests
    h. Assumptions in Testing a Hypothesis about a Single Mean
    i. Estimating the Standard Error of the Mean when σ Is Unknown
    j. The *t* Distribution
    k. Characteristics of Student's Distribution of *t*
    l. Computing *t* Using Definitional Formula Only
    m. Levels of Significance versus *p*-Values

2. Interpreting the Results of Hypothesis Testing
    a. A Statistically Significant Difference versus a Practically Important Difference
    b. Errors in Hypothesis Testing
    c. The Power of a Test

UNIT 2

3. Testing Hypotheses about the Difference between Two Independent Groups
    a. The Null and Alternative Hypotheses
    b. The Random Sampling Distribution of the Difference between Two Sample Means
    c. Properties of the Sampling Distribution of the Difference between Means
    d. Determining a Formula for *t*
    e. Testing the Hypothesis of No Difference between Two Independent Means
    f. Use of a One-Tailed Test
    g. Assumptions Associated with Inference about the Difference between Two Independent Means

4. Testing for a Difference between Two Dependent (Correlated) Groups
    a. Determining a Formula for *t*
    b. Degrees of Freedom for Tests of No Difference between Dependent Means
    c. Testing a Hypothesis about Two Dependent Means using the formula involving standard errors and correlation only
    d. Assumptions When Testing a Hypothesis about the Difference between Two Dependent Means

UNIT 3

5. Chi-Square and Inference about Frequencies
    a. The Chi-Square Test for Goodness of Fit
    b. Chi-Square as a Measure of Discrepancy between Expected and Observed Frequencies

c. The Logic of the Chi-Square Test
d. Interpretation of the Outcome of a Chi-Square Test
e. Assumptions in the Use of the Theoretical Distribution of Chi-Square
f. Chi-Square as a Test for Independence between Two Variables
g. Calculation of Chi-Square and Determination of Significance in a Contingency Table

6. Testing for Differences among Three or More Groups: One-Way Analysis of Variance
   a. The Null Hypothesis
   b. The Basis of One-Way Analysis of Variance: Variation within and between Groups
   c. Partition of the Sums of Squares
   d. Degrees of Freedom
   e. Variance Estimates and the *F* Ratio
   f. The Summary Table
   g. Raw-Score Formulas for Analysis of Variance only
   h. Comparison of *t* and *F*
   i. Assumptions Associated with ANOVA

UNIT 4

7. Some (almost) Assumption-Free Tests (Nonparametric Tests)
   a. Concept
   b. Comparison with Parametric Tests
   c. Uses and Applications

8. Introduction to SPSS
   a. What is SPSS?
   b. Uses of SPSS in Statistics and Research

Reading List:

Aron, A., Aron, E.N., & Coups, E.J. (2007). *Statistics for Psychology (*4th Ed). India: Prentice Hall .

Coakes, S. J.,Steed, L., & Ong,C. (2009). *SPSS: Analysis Without Anguish Using Version 16.0 for Windows.* Milton,QLD: Wiley Students Edition.

Field, A. (2009). *Discovering Statistics using SPSS (*3rd Ed)*.* New Delhi :Sage.

King, B.M. & Minium, E.W. (2007). *Statistical Reasoning in the Behavioral Sciences* (5th Ed).USA: John Willey.

Siegal, S. (1956). *Nonparametric Statistics.* NY: McGraw Hill.

Paper 12: Social Psychology

UNIT 1: Introduction
Definition, Nature, Origin and Development. Social Psychology in Indian context. Applications.

UNIT 2: Understanding and Evaluating the Social World
Social cognition, Perception, Attitudes and Attitudes change.

UNIT 3: Aspects of Social Interaction and Influence
Interpersonal attraction. Prosocial behavior, Aggression. Changing others behavior.

UNIT 4: Group Dynamics and Intergroup Relations
Nature of groups, Consequences of belonging-performance, decision making, cooperation and conflict. Nature of intergroup relation-prejudice, intergroup conflict, Intervention techniques.

Reading List:

Baron. R.A. , Byrne, D.& Bhardwaj. G (2010).*Social Psychology* (12th Ed).New Delhi: Pearson

Deaux.K & Wrightsman, L. (2001).*Social Psychology*. California: Cole Publishing

Misra, G. (1990) .*Applied Social Psychology*. New Delhi: Sage.

Misra, G. (2009). *Psychology in India, Volume 4: Theoretical and Methodological Developments (ICSSR survey of advances in research)*. New Delhi: Pearson.

Taylor,S.E., Peplau,L.A. & Sears,D.O. (2006). *Social Psychology* (12th Ed). New Delhi: Pearson.

Paper 13

Concurrent – Discipline Centred I

SEMESTER -V

Paper 14: Industrial /Organizational Psychology

UNIT 1: Introduction and issues in I/O Psychology
Brief history of I/O psychology; Industry and Organization; Organizational Behavior; Current status of I/O psychology; I/O psychology in the Indian context; Organizational structure; Organizational climate and culture

UNIT 2: Introduction to Work Related Attitudes & Work Motivation

(a) Job satisfaction; Job involvement; Organizational Commitment; Organizational Citizenship Behavior; Psychological Contract; Work Engagement
(b) Work Motivation: Theories and application; Indian perspective

UNIT 3: Leadership
Contemporary perspectives on leadership; Cross-cultural leadership issues; Indian perspective on leadership; Diversity issues in leadership

UNIT 4: Positive Organizational Behaviour
Optimism, Emotional Intelligence; Self-Efficacy; Work-Life balance

Reading List:

Aamodt, M. G. (2001) *Industrial Organizational Psychology*. India: Cengage Learning

Greenberg, J. & Baron, R.A. (2007). *Behaviour in Organizations* (9th Ed.). India: Dorling Kindersley.

Luthans, F. (2009). *Organizational behavior*. New Delhi: McGraw Hill.

Muchinsky, P.(2006). Psychology applied to work: An introduction to industrial and organizational psychology. NC: Hypergraphic Press.

Pareek, U.(2010). *Understanding organizational behaviour.* Oxford: Oxford University Press.

Prakash, A. (2011). Organizational behaviour in India: An indigenous perspective. In G. Misra (Ed.), *Handbook of Psychology.* New Delhi: Oxford University Press.

Singh, K. (2010). *Organizational Behaviour: Texts & Cases*. India: Dorling Kindersley.

Paper 15: Abnormal Psychology-I

UNIT1: Definition of abnormality, criteria, classification, and clinical assessment

UNIT2: Clinical States

a) Clinical Picture of GAD, OCD, and Phobias, Dynamics of anxiety disorders;
b) Clinical Picture of Conversion Disorder and its Dynamics;
c) Clinical Picture of Dissociative Identity Disorder and its Dynamics

UNIT 3: Developmental Disorders (Clinical Picture and Dynamics)
Mental Retardation, Autism, ADHD, and Learning Disabilities

UNIT4: Diathesis-Stress Model

a) The Impact of Stress on Physiological Parameters (Coronary Heart Disease and Essential Hypertension)
b) Substance-Related Disorder

Reading List:

Ahuja N. (2011). *A Short Textbook of Psychiatry* (7th Ed). New Delhi: Jaypee

Barlow D.H. and Durand V.M. (2005). *Abnormal Psychology: An Integrated Approach* (4th Ed.).Wadsworth: New York.

Carson R.C., Butcher J.N., Mineka, S., & Hooley J.M. (2007). *Abnormal Psychology* (13th Ed.).ND: Pearson Education.

Kring,A.M.,Johnson,S.L.,Davison G.C. & Neale J.M. (2010). *Abnormal Psychology* (11th Ed.).NY: John Wiley.

Paper 16: Practicum-III

- One experiment based on group data analysis
- One test based on group data analysis

Evaluation Scheme

Viva
Record
Conduction and report writing

Paper 17: Child and Adolescent Development

UNIT 1: Introduction
a) Nature of Development and related terms
b) Theories and themes of Developmental Psychology
c) Research methods and designs for studying development
d) Development in the Indian context

UNIT 2: Periods of Development
a) Prenatal development
b) Birth and Infancy
c) Early childhood
d) Middle childhood
e) Adolescence

UNIT 3: Domains of Development
a) Cognitive development: perspectives of Piaget and Vygotsky
b) Language development: issues and debates
c) Emotional development
d) Personality development
d) Moral development

UNIT 4: Contexts for development
a) Family and parenting
b) Peers
c) Media
d) Schooling
e) Socio-cultural context.

Reading List:

Berk, L. E. (2010). *Child Development* (8th Ed.). New Delhi: Prentice Hall.

Mitchell, P. and Ziegler, F. (2007). *Fundamentals of development: The Psychology of Childhood*. New York: Psychology Press.

Misra, G. (2009). *Psychology in India, Vol 1: Basic Psychological Processes and Human Development*. India: Pearson.

Papalia, D. E., Olds, S.W. & Feldman, R.D. (2006). *Human development* (9th Ed.). New Delhi: McGraw Hill.

Santrock, J. W. (2008). *Child Development* (11th Ed.). New Delhi: McGraw Hill.

Santrock, J.W. (2006). *Adolescence.* New Delhi: McGraw Hill.

Saraswathi, T.S. (2003). *Cross-cultural perspectives in Human Development: Theory, Research and Applications*. New Delhi: Sage Publications.

Srivastava, A.K. (1997). *Child Development: An Indian Perspective.* New Delhi: NCERT.

SEMESTER -VI

Paper 18: Abnormal Psychology-II

UNIT1: Schizophrenia: Clinical Picture and Dynamics

UNIT2: Mood Disorders: Clinical Picture & Dynamics

UNIT3: a) Personality Disorders (Clinical Picture and Dynamics): Antisocial and Borderline Personality Disorders

b) Sexual Disorders (Clinical Picture): Paraphilias, Gender Identity Disorder, Sexual Dysfunction

UNIT4: Intervention and Management

a) Biological
b) Psychoanalytic
c) Cognitive-Behavioural

Reading List:

Ahuja N. (2011). *A Short Textbook of Psychiatry* (7th Ed). New Delhi: Jaypee.

Barlow D.H. and Durand V.M. (2005). *Abnormal Psychology: An Integrated Approach* (4th Ed.).Wadsworth: New York.

Carson R.C., Butcher J.N., Mineka, S., & Hooley J.M. (2007). *Abnormal Psychology* (13th Ed.).ND: Pearson Education.

Kring,A.M.,Johnson,S.L.,Davison G.C. & Neale J.M. (2010). *Abnormal Psychology* (11th Ed.).NY: John Wiley.

Paper 19: Counselling Psychology

UNIT 1: Introduction

a) Definition and nature
b) Counselling as a profession-Training, activities and professional ethics
c) The effective counsellor- Personality characteristics, skills, self of counselor

UNIT 2: Counselling Process

a) Stages of counselling
b) Counselling relationship
c) Initial interview
d) Assessment for counselling

UNIT 3: Counselling Theory and Techniques

a) Individual counseling theory and techniques- Psychoanalytic, Humanistic, Behavioral, Cognitive, Brief approaches
b) Group techniques
c) Multi-cultural techniques with special reference to Indian techniques such as yoga and meditation
d) Counselling and technology

UNIT 4: Counselling Applications

a) Family and couples counselling
b) Child Counselling
c) School and Career counselling
d) Workplace Counselling
e) Crisis intervention
f) Counselling for wellness

Note: Projects and practical work related to the paper should include preparation of case study, assessment in counseling, supervised training including role-play and self-development workshops.

Reading List:

Feltham, C and Horton, I. (2000). *Handbook of Counseling and Psychotherapy*. London: Sage .

Gibson, R.L. and Mitchell, M.H. (2003). *Introduction to Counseling and Guidance* (6th Ed.). New Delhi: Pearson India.

Gladding, S.T. (2009). *Counselling: A comprehensive profession*(6th Ed.). New Delhi: Pearson India.

Misra, G. (Ed) (2010). *Psychology in India, Volume 3: Clinical and Health Psychology.* New Delhi: Pearson India.

Rao, S. (2002). *Counselling and Guidance* (2nd Ed.). New Delhi: McGraw Hill.

Paper 20: Project /Field Report/ Human Resource Management/ Psychology of Health and Well-Being

Project

- American Psychological Association (APA) – Publication Manual 2006 to be followed for project writing

- Format and Distribution of marks.
  Marks
  ☞ **Abstract** – 150 words including problem, method & results.
  ☞ **Introduction** – Theoretical consideration, review, present study, objectives and hypotheses.
  ☞ **Method** – Design, Sample, Measures, Procedure
  ☞ **Results**
  - Quantitative analysis of group data
    (Raw data should not be attached in Appendix)
  - Graphical representation of data wherever required.
  - Qualitative analysis wherever done should indicate the method of qualitative analysis.

  ☞ **Discussion**
  ☞ **References (APA Style) & Appendix**

- Project should be in Soft binding. It should be typed in 1.5 spacing on both sides of the paper. Total text should not exceed 50 pages (References & Appendices extra).

- Date of submission of projects to be announced towards the end of semester

- Project should be prepared in the form of research paper to be published in a reputed scientific journal.

- Four copies of the project along with one CD should be submitted to the College.

Evaluation Scheme

Viva
Project Report

***Viva for any paper should be conducted jointly by one internal and one external examiner.**

Field Study (Report)

Evaluation Scheme

Viva
Record

Human Resource Management

UNIT 1: Introduction to Human Resource Management (HRM)

HRM and HRD, Context and issues in HRM

UNIT 2: Human Resource Practices
Job analysis; Recruitment and selection; Training; Performance evaluation

UNIT 3: International human resource management (IHRM)
The context of Globalization, Forms of IHRM/ Types of cross-national organizations (Domestic, International, Multinational, Global, Transnational), Role of culture in IHRM, Dimensions of Cultural difference (Hofstede).

UNIT 4: International human resource management (IHRM)
Policies and practices in the multinational enterprise.Selection for international assignees, Expatriate failure, Training: Development of a global mind set, Cross-cultural training; Well-being of the global work force

Reading List:

Bhatnagar, J. & Budhwar, J.(2009). The *changing face of people management in India.* London: Routledge.

Briscoe, D. R., Schuler, R. S. & Claus, L. (2009). *International human resource management: Policies and practices for multinational enterprises(3rd Ed)*. New York: Routledge.

DeCenzo,D.A.& Robbins, S.P.(2006). *Fundamentals of human resourse management.* (8th Ed). NY: Wiley.

Harzing,A-W.K. and Pennington, A. (2011). *International human resource management.* New Delhi: Sage publications.

Khandelwal, K.A. (2009). *In search of Indianness: Cultures of Multinationals*. New Delhi: Kanishka Publishers.

Psychology of Health and Well-Being

UNIT 1:

Introduction to Health Psychology: components of health as social, emotional, cognitive and physical aspects, relationship between health and psychology, mind and body relationship, goals of health psychology

UNIT 2: Well-Being: components of well-being for e.g., life satisfaction, affect

UNIT 3: Managing stress, illness and pain: causes, consequences and interventions

UNIT 4: Health enhancing behaviors: Implications for well-being: psychological factors as resilience, hope, optimism, positive self; Physical factors as exercise, safety, nutrition etc.

Reading List:

Carr, A. (2004). *Positive Psychology: The science of happiness and human strength.*UK: Routledge.

DiMatteo, M.R. and Martin, L.R.(2002). *Health psychology.* New Delhi: Pearson.

Misra,G.(1999).*Stress and Health*. New Delhi: Concept.

Sarafino, E.P. (2002). *Health psychology: Bio psychosocial interactions*(4th Ed.).NY: Wiley.

Snyder, C.R., & Lopez,S.J.(2007).*Positive psychology :The scientific and practical explorations of human strengths.* Thousand Oaks, CA: Sage.

Taylor, S.E. (2006). *Health Psychology* (6th Ed.). New York: Tata McGraw Hill.

Paper 21

Concurrent – Discipline Centred II

A.C. :
Item No. :
Annexure No.

UNIVERSITY OF DELHI
DELHI-110007

B.A. (PROGRAMME) PSYCHOLOGY EXAMINATION

THREE-YEAR FULL-TIME PROGRAMME
(Six-Semester Course)

COURSE CONTENTS
(Effective from the Academic Year 2011-2012)

Prof. Anand Prakash
Head
Department of Psychology
University of Delhi

STRUCTURE OF B.A. (PROGRAMME) PSYCHOLOGY COURSE

The B. A. (Program) Psychology of Delhi University is a unique construction for enriching and encompassing those minds who have not been able to or intend to join the Honors Courses. The Program envisions the capturing of the academic brilliance in the minds of those pupils who look for holistic and competence enhancing spheres, which includes a multidimensional, interesting and empowering academic discourse. This Program is second to none as it facilitates the discovery of those areas for the knowledge seekers, which may not have been apparent in the routine syllabus. This Course is not only inert-disciplinary but also a course, which will open multiple avenues for academic and professional explorations.

1st Year

SEMESTER-I
Paper 001: Orientation to Psychology — 50 Marks

SEMESTER-II
Paper 002: Practicum-I (General Experiments) — 50 Marks

2nd Year

SEMESTER-III
Paper 003 : Introduction to Social Psychology — 50 Marks

SEMESTER-IV
Paper 004: Psychological Distress and Well-Being — 50 Marks

3rd Year

SEMESTER-V — 50 Marks
Paper 005: Psychological Skills

SEMESTER-VI — 50 Marks
Paper 006: Practicum II (Psychological Testing)

General Notes:

All other papers are for 50 Marks (Theory 38 Marks and Internal Assessment 12 Marks).

For all Practicals, there should be total 3 classes per week per group (group size 10-12).

The internal assessment will be as per the University norms.

Committee of Courses recommended that a Review Committee under the convenorship of the Head of the Department and Teacher-In-Charge of each of the Colleges where such program is taught be constituted and approved to look into the matters related to the courses at the end of each Academic Session.

Prof. Anand Prakash
Head
Department of Psychology
University of Delhi

COURSE DETAILS

1st Year

SEMESTER–I

Paper 001: Orientation to Psychology **50 Marks**

Unit I: ***Introduction to Psychology***
Psychology: A science and a perspective, Origin and development in the discipline, Psychology in India: main trends, Methods: Experimentation, Case study. 10 Marks

Unit II: ***Biological Foundations***
Physiological system
Neurons, Nervous system- Central Nervous System 8 Marks

Unit III: ***Cognitive Processes***
Perception- Nature of Perception, Laws of Perceptual organization Learning- Conditioning
Memory- Processes of Memory, Model-Information processing model, how to improve memory.
10 Marks

Unit IV: ***Motivation and Emotion***
Motives: Biogenic (hunger and sex) and sociogenic (achievement and affiliation).
Human Emotions: Aspects of emotion; Key emotions: Fear, Anger, Love, and Forgiveness.
10 Marks

Reading List:

Ciccarelli, S. K & Meyer, G. E. (2008). *Psychology* (South Asian Edition). New Delhi: Pearson

Feldman. S. Robert (2009). *Essentials of understanding psychology* (7th Edition). New Delhi: Tata- McGraw Hill.

Glassman, W. E. (2000). *Approaches to psychology*. (3rd Edition). London: Open University Press.

Sternberg, R. J. (2001). *Psychology: In search of the human mind*. (3rd Edition). New York: Harcourt College Publish

Prof. Anand Prakash
Head
Department of Psychology
University of Delhi
Delhi-110007

SEMISTER-II

Paper 002: Practicum-I **50 Marks**

General Experiments

Conduct and reporting of 3experiments:

1. Learning
2. Memory
3. Perception and Attention
4. Motivation and emotion

2nd Year

SEMISTER-III

Paper 003 : Introduction to Social Psychology **50 Marks**

Unit I: ***Introduction***

Scope of social Psychology. Levels of Social behavior, Main Approaches towards understanding social behavior. 8 Marks

Unit II: ***Individual level processes***

Person Perception- Attribution theories, bias and errors
Attitude- Formation, change and resistance of attitude 10 Marks

Unit III: ***Interpersonal processes***

Prosocial behavior
Aggression- Nature, causes of human aggression (social or personal), prevention and control of aggression. 10 Marks

Unit IV: ***Group dynamics***

Communication- Verbal and Non-verbal Communication
Group- Basic aspects, coordination in groups; cooperation and conflict, Decision making by groups.

10 Marks

Reading List:

Baron, R. A. & Byrne, D. (2004). *Social Psychology* (10th Edition). Delhi: Pearson Education.

Feldman, R. S. (1998). *Social Psychology* (2nd Edition). New Jersey: Prentice Hall.

Myers, D. G. (2006). *Social Psychology* (8th Edition). New Delhi: Tata McGraw Hill.

Prof. Prakash
Head
Department of Psychology
University of Delhi
Delhi-110007

SEMESTER-IV

Paper 004: Psychological Distress and Well-Being **50 Marks**

Unit I: Basic Concepts
Psychological Distress, Abnormality and Psychological Wellbeing. 10 Marks

Unit II: Theoretical Perspectives
Biological, familial, cultural, behavioural, cognitive and psychodynamic. 10 Marks

Unit III : Clinical States
Anxiety Disorder- Obsessive-Compulsive disorder(OCD), Mood Disorders-Unipolar, Bipolar, and Schizoprenia: Disorganized, Paranoid and Catatonic. 10 Marks

Unit IV: Dealing with Psychological Distress
Coping strategy- Interventions for personal growth and well-being 8 Marks

Reading List:

Carr, A. (2004). *Positive Psychology: The Science of Happiness and Human Strength*. New York: Brunner-Routledge.

Carson, R.C. & Butcher, J. N. (2000). *Abnormal Psychology in Modern Life*. Boston: Allyn Bacon.

Frude, N. (1998). *Understanding Abnormal Psychology*. Oxford: Blackwell Publishers.

3rd Year

SEMESTER-V

Paper 005: Psychological Skills **50 Marks**

Unit I: Introduction
Scales of Measurement, Graphical Representation of Data. 8 Marks

Unit II: Making sense of data
Measures of Central Tendency: Mean, Median, Mode (properties and computation). Standard Deviation: properties and computation. Correlation: Karl Pearson Method, properties of Normal Probability Curve (NPC). 15 Marks

Unit III: Assessing psychological dispositions
Introduction to psychological testing, characteristics of test, Reliability, Validity, Norms 8 Marks

Unit IV: Learning from others
Interview and observation 7 Marks

Prof. Anand Prakash
Head
Department of Psychology
University of Delhi
Delhi-110007

Reading List:

Anastasi, A. & Urbina, S. (2002). *Psychological Testing.* Delhi: Pearson Education.

Garrett, H. E & Woodworth, R. S. (1987). *Statistics in Psychology and Education.* Mumbai: Vakils, Feffer & Simons Pvt. Ltd.

Gregory, R. J. (2008). *Psychological Testing: History, Principles, and Applications.* Delhi: Pearson Education.

Minimum, E. W., King, B. M. & Bear, G. (1993). *Statistical Reasoning in Psychology and Education* (3rd Edition). New York: John Wiley.

SEMESTER-VI

Paper 006: Practicum II **50 Marks**

Administering and reporting three psychological tests.

1. Personality
2. Intelligence
3. Aptitude
4. Adjustment/ interest

Prof. Anand Prakash
Head
Department of Psychology
University of Delhi
Delhi-110007

B.Sc. (H) Mathematics

SEMESTER SCHEME (2011- ONWARDS)

(ACADEMIC RESOLUTION 3(17) DATED 25.04.2011)

DEPARTMENT OF MATHEMATICS
UNIVERSITY OF DELHI
DELHI-110007

Following will be the contents of proposed syllabus of B.Sc. (Hons.) Mathematics in the session 2011-12 and onwards.

There are 19 papers of Mathematics (Algebra 5, Analysis 5, Calculus 2, Differential Equations & Mathematical Modeling 3, Numerical Methods & Programming 1, Probability and Statistics 1, Linear Prog. & Theory of Games 1, Optional Paper 1).

The Mathematics Honors degree will consist of 2600 Marks. Each theory paper will be of 100 marks. All the theory and practical papers will have examination of 3 hours duration. Paper containing practical components will be of 150 marks. The practical paper is common for all the papers in a particular semester. There will be an external examiner in all the practical exams. There will be 5 lectures and one tutorial for all the papers. Two classes are allotted for the practical per student per week. A practical group will consists of at most 20 students. Use of Scientific Calculator is allowed.

Every college is advised to offer at least two optional courses in Mathematics out of four courses (Discrete Mathematics, Mathematical Finance, Mechanics and Number Theory) in Semester VI.

The semester-wise distribution of the papers is as follows:

SEMESTER I	Calculus I	Analysis I	Algebra I	Credit course I
SEMESTER II	Diff. Eqn. I	Analysis II	Prob. and Stats.	Credit course II
SEMESTER III	Calculus II	Num. Methods	Algebra II	Qualifying paper
SEMESTER IV	Diff. Eqn. II	Analysis III	Algebra III	Credit course III.1
SEMESTER V	Diff. Eqn. III	Analysis IV	Algebra IV	Linear Prog. & Theory of Games
SEMESTER VI	Analysis V	Algebra V	Optional	Credit course III.2

Along with the above mentioned papers, a student will have to opt for four credit courses from disciplines other than Mathematics and a qualifying paper. A student will have to choose one course each from Credit Course I in semester I , Credit Course II in semester II and Qualifying Course in Semester III .A student will have to opt for two courses from Credit Course III as Credit III.1 and Credit Course III.2 in semester IV and Semester VI respectively. In those subjects where more than one course is offered, the student shall opt for one of the course. But if a student opts for Physics-II he/ she may opt for Physics(Lab). The marks of Credit Course I, II, III.1 and III.2 shall count in the final result of the student.

Credit Course I

(i) Ethics in Public Domain
(ii) Environmental Issues in India
(iii) Reading Gandhi
(iv) The Individual and Society
(v) Hindi Language, Literature and Culture
(vi) Gender and Society
(vii) Financial Management
(viii) Chemistry
(ix) Physics-I

Note: (a) Courses (i)-(vi) are the interdisciplinary courses of the BA (Hons)

Programme.

(b) Course (vii) is the elective course EL 210 (vi) of B.Sc Programme.

(c) Course (viii) is the Paper V being taught in First year Physics (Hons).

(d) Course (ix) is the Paper V being taught in First year Chemistry (Hons).

Credit Course II

(i) English
(ii) Hindi
(iii) Sanskrit
(iv) Chemistry
(v) Physics-I
(vi) Chemistry (Lab)
(vii) Physics (Lab)

Note: (a) Courses (i)-(iii) are the language credit courses of the BA (Hons)

Programme.

(b) Course (iv) is the Paper V being taught in First year Physics (Hons). For students of Maths (Hons), only six out of the twelve experiments will have to be done. These experiments may be selected at the college level.

(c) Course (v) is the Paper V being taught in First year Chemistry (Hons).

(d) Course (vi) is the Paper VIII being taught in First year Physics (Hons).

(e) Course (vii) is the Lab II being conducted in First year Chemistry (Hons).

Qualifying Course

(i) English (Higher)
(ii) English (Lower)
(iii) Hindi (Higher)
(iv) Hindi (Lower)
(v) Sanskrit
(vi) Chemistry (Lab)
(vii) Physics (Lab)

Note: (a) Courses (i)-(v) are the language qualifying courses of the BA (Hons)

Programme.

(b) Course (vi) is the Paper VIII being taught in First year Physics (Hons).

(c) Course (vii) is the Lab II being conducted in First year Chemistry (Hons).

MARKS:

* Each of the Credit I, Credit II and Qualifying courses are of 100 marks:

Semester examination 75 marks, internal assessment 25 marks.

* The pass mark for the credit courses is 40 percent.

* The pass mark for the qualifying courses is 36 percent. A student has to pass in the

qualifying course to be eligible for an Honors degree. However, the marks in this course will not be counted in the final division awarded.

* Internal assessments will be held for the credit courses but not for the qualifying course.

NUMBER OF LECTURES:

* Four hours per week or four classes for Credit Course I , Credit Course II and Qualifying Course (i)-(v). For each of the credit courses, one tutorial will be held for students. Six hours for (vi) and (vii).

RULES:

* Every student must opt for at least one language. It can either be a credit course or a qualifying course. If they are opting for a language in both the credit as well as the qualifying course then these cannot be the same languages.
* A student offering Chemistry/ Physics-I as Credit Course I will not be allowed to offer the same as Credit Course II.
* A student offering Chemistry/ Physics-I as Credit Course I can opt for Chemistry (Lab)/ Physics (Lab) as Credit Course II but then they cannot opt for these courses as qualifying courses.
* A student will be allowed to take Chemistry (Lab)/ Physics (Lab) as a qualifying course if they have opted for Chemistry/Physics-I respectively as a credit course.

Credit Course III

(i) Psychology for Living
(ii) Hindi Literature
(iii) Modern Indian Literature, Poems and Short Stories; Novel or Play
OR

Cultural Diversity, Linguistic Plurality and Literary Traditions in India.

(iv) Formal Logic/ Symbolic Logic
OR

Readings in Western Philosophy

OR

Theory of Consciousness

(v) Citizenship in Globalizing World
(vi) Culture in India: a Historical Perspective
OR

Delhi: Ancient, Medieval and Modern

OR

Religion and Religiosity in India

OR

Inequality or Difference in India

(vii) Sociology of Contemporary India
(viii) Principles of Geography
OR

Geography of India

(ix) Principles of Economics
(x) Financial Accounting
(xi) Green Chemistry
(xii) Biotechnology
(xiii) Physics- II
(xiv) Biophysics
(xv) Physics (Lab)

Note: (a) Courses (i)-(ix) are the discipline centred courses of the BA (Hons)

Programme.

(b) Course (x-xii) are the elective courses EL 210 (v), EL 310 (i) and EL 310 (iii) of B.Sc Programme.

(c) Course (xiii) is the Paper XI being taught in Second year Chemistry (Hons).

(d) Course (xiv) is the Paper XXII (Option 2) being taught in Third year Physics (Hons).

(e) Course (xv) is Lab V being conducted in Second year Chemistry (Hons)

MARKS:

* Each course carries 100 marks: examination 75 marks, internal assessments 25 marks.

* The pass mark is 40 percent.

NUMBER OF LECTURES:

* Four hours per week or Four classes for courses (i-xiv). For each of these courses, one tutorial will be held for students.

* Six hours or Six classes for course (xv).

SEMESTER I

I.1 Calculus I

Total marks: 150
Theory: 75
Practical: 50
Internal Assessment: 25
5 Lectures, 2 Practicals, 1 Tutorial (per week per student)

Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hopital's rule, applications in business, economics and life sciences.

References:

[1]: Chapter 4 (Sections 4.3-4.5 (page 124-157), 4.7).

[2]: Chapter 7 (Section 7.8), Chapter 11 (Section 11.1).

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\, dx$, $\int \cos^n x\, dx$, $\int \tan^n x\, dx$, $\int \sec^n x\, dx$, $\int (\log x)^n\, dx$, $\int \sin^n x \cos^m x\, dx$, volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

References:

[1]: Chapter 9 (Sections 9.4 (Pages 471-475 (excluding lines in R^3))).

[2]: Chapter 8 (Sections 8.2-8.3 (pages 532-538 (excluding integrating products of tangents and secants))), Chapter 6 (Section 6.2-6.5 (excluding arc length by numerical methods))

Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics.

Reference:

[2]: Chapter 11 (Sections 11.4-11.6 (up to page 775 excluding sketching conics in polar coordinates)).

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modeling ballistics and planetary motion, Kepler's second law.

Reference:

[1] Chapter 9 (Section 9.3 (pages 468-469)), Chapter 10

***Practical / Lab work to be performed on a computer*:**

Modeling of the following problems using *Matlab / Mathematica / Maple* etc.

(i) Plotting of graphs of function e^{ax+b}, $\log(ax+b)$, $1/(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $|ax+b|$ and be able to find the effect of a and b on the graph.

(ii) Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

(iii) Any one of the following

(a) Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid)

(b) Obtaining surface of revolution of curves

(c) Tracing of conics in Cartesian coordinates/ polar coordinates

(d) Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic paraboloid, hyperbolic paraboloid using Cartesian co-ordinates.

(iv) Any one of the following

(a) To find numbers between two real numbers.

(b) Plotting subsets of R to study boundedness /unboundedness and bounds (if they exist).

(c) Plotting of sets on R to discuss the idea of cluster points, lim sup, lim inf.

(v) Any one of the following

(a) Plotting of recursive sequences.

(b) Study the convergence of sequences through plotting.

(c) Verify Bolzano Weirstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.

(d) Studying the convergence / divergence of infinite series by plotting their sequences of partial sum.

(vi) Any one of the following

(a) Cauchy's root test by plotting n^{th} roots

(b) Ratio test by plotting the ratio of n^{th} and $n+1^{th}$ term.

(vii) Matrix operation (addition, multiplication, inverse, transpose)

REFERENCES:

1. **M. J. Strauss, G. L. Bradley** and **K. J. Smith**, *Calculus* (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. **H. Anton, I. Bivens** and **S. Davis**, *Calculus* (7th Edition), John Wiley and Sons (Asia) Pte. Ltd., Singapore, 2002.

I.2 Analysis I

Total marks: 100

Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

The algebraic and order properties of R, suprema and infima, the completeness property of R, the Archimedean property, density of rational numbers in R, characterization of intervals, neighborhoods, open sets, closed sets, limit points of a set, isolated points, closure, complements, idea of uncountability of R.

References:

[1]: Chapter 2 (Sections 2.1-2.4, 2.5 (up to 2.5.1)), Chapter 11 (Section 11.1 (up to 11.1.6 and 11.1.8)).

[2]: Chapter 1 (Sections 1-5).

Sequences, bounded sequence, limit of a sequence, convergent sequences, limit theorems, monotone sequences, monotone convergence theorem, subsequences, convergence and divergence criteria, existence of monotonic subsequences (idea only), Bolzano-Weierstrass theorem for sequences and sets, definition of Cauchy sequence, Cauchy's convergence criterion, limit superior and limit inferior of a sequence.

References:

[1]: Chapter 3 (Sections 3.1-3.5, up to 3.5.6).

[2]: Chapter 2 (Sections 7-12)

Definition of infinite series, sequence of partial sums, convergence of infinite series, Cauchy criterion, absolute and conditional convergence, convergence via boundedness of sequence of partial sums, tests of convergence: comparison test, limit comparison test, ratio test, Cauchy's nth root test (proof based on limit superior), integral test (without proof), alternating series, Leibniz test.

Reference:

[2]: Chapter 2 (Sections 14-15)

REFERENCES:

1. **R. G. Bartle** and **D. R. Sherbert**, *Introduction to Real Analysis* (3rd Edition), John Wiley and Sons (Asia) Pte. Ltd., Singapore, 2002.
2. **K. A. Ross**, *Elementary Analysis*: *The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

I.3 Algebra I

Total Marks: 100

Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Polar representation of complex numbers, the nth root of unity, some simple geometric notions and properties, conditions in collinearity, orthogonality and concyclicity, similar triangles, equilateral triangles, some analytic geometry in the complex plane, the circle, statement of the fundamental theorem of algebra and its consequences, Descartes' rule of signs, bound on the real zeros, interpreting the coefficients of a polynomial.

References:

[1]: Chapter 2, Chapter 3.

[2]: Chapter 4 (Sections 4.4, 4.6 (4.6.1-4.6.8)), Chapter 5 (Sections 5.2.7, 5.2.12), Chapter 6 (Section 6.1)

Sets, binary relations, equivalence relations, congruence relation between integers, finite product of sets, functions, composition of functions, bijective functions, invertible functions, introduction of finite and infinite sets through correspondence, binary operations, principle of mathematical induction, well-ordering property of positive integers, division algorithm, statement of fundamental theorem of arithmetic.

References:

[3]: Chapter 0.

[4]: Chapter 2 (Sections 2.1-2.4), Chapter 3, Chapter 4 (Section 4.4 up to Def. 4.4.6).

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax = b$, solution sets of linear systems, applications of linear systems, linear independence, introduction to linear transformations, the matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices, partitioned matrices, subspaces of R^n, bases and dimension of subspaces of R^n.

Reference:

[5]: Chapter 1 (Sections 1.1-1.9) and Chapter 2 (Sections 2.1-2.4, 2.8-2.9).

REFERENCES:

1. **Titu Andreescu** and **Dorin Andrica**, *Complex Numbers from A to .... Z*, Birkhauser, 2006.
2. **E.J. Barbeau**, *Polynomials*, Springer Verlag, 2003.
3. **Joseph A. Gallian**, *Contemporary Abstract Algebra* (4th Edition), Narosa Publishing House, New Delhi, 1999.
4. **Edgar G. Goodaire** and **Michael M. Parmenter**, *Discrete Mathematics with Graph Theory* (2nd Edition), Pearson Education (Singapore) Pvt. Ltd., Indian Reprint, 2003.

5. David C. Lay, *Linear Algebra and its Applications* (3rd Edition), Pearson Education Asia, Indian Reprint, 2007.

I.4 Credit course I

SEMESTER II

II.1 Differential Equations and Mathematical Modeling I

Total marks: 150
Theory: 75
Practical: 50
Internal Assessment: 25
5 Lectures, 2 Practicals, 1 Tutorial (per week per student)

Differential equations and mathematical models, order and degree of a differential equation, exact differential equations and integrating factors of first order differential equations, reducible second order differential equations, application of first order differential equations to acceleration-velocity model, growth and decay model.

References:

[2]: Chapter 1 (Sections 1.1, 1.4, 1.6), Chapter 2 (Section 2.3)

[3]: Chapter 2.

Introduction to compartmental models, lake pollution model (with case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills, case study of alcohol in the bloodstream), exponential growth of population, limited growth of population, limited growth with harvesting.

Reference:

[1]: Chapter 2 (Sections 2.1, 2.5-2.8), Chapter 3 (Sections 3.1-3.3)

General solution of homogeneous equation of second order, principle of superposition for a homogeneous equation, Wronskian, its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters, applications of second order differential equations to mechanical vibrations.

Reference:

[2]: Chapter 3 (Sections 3.1-3.5).

Equilibrium points, interpretation of the phase plane, predator-prey model and its analysis, competing species and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

Reference:

[1]: Chapter 5 (Sections 5.1, 5.3-5.4, 5.6-5.7), Chapter 6.

***Practical / Lab work to be performed on a computer*:**
Modeling of the following problems using *Matlab / Mathematica / Maple* etc.

(i) Plotting second and third order solution families

(ii) Acceleration-velocity model

(iii) Growth and decay model (both exponential and logistic)

(iv) Any two of the following

(a) Lake pollution model (with constant/ seasonal flow and pollution concentration)

(b) Case of a single cold pill and a course of cold pills

(c) Case study of alcohol in the bloodstream (initial input/ continuous input on empty stomach and with substantial meal)

(d) Limited growth of population (with and without harvesting

(v) Any two of the following

(a) Predator prey model (basic Lotka volterra model, with density dependence, effect of DDT, two prey one predator)

(b) Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers, disease with re-infection, density dependent contact rate)

(c) Battle model (basic battle model, jungle warfare, with desertion, long range weapons)

(vi) Taylor and Maclaurin series of sin x, cos x, log $(1+x)$, e^x, $(1+x)^n$, maxima and minima, inverse of graphs.

REFERENCES:

1. **Belinda Barnes** and **Glenn R. Fulford**, *Mathematical Modeling with Case Studies, A Differential Equation Approach Using Maple*, Taylor and Francis, London and New York, 2002.
2. **C. H. Edwards** and **D. E. Penny**, *Differential Equations and Boundary Value Problems: Computing and Modeling*, Pearson Education, India, 2005.
3. **S. L. Ross**, *Differential Equations*, John Wiley and Sons, India, 2004.

II.2 Analysis II

Total marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Limits of functions, sequential criterion for limits, divergence criteria, review of limit theorems and one-sided limits, continuous functions, sequential criterion for continuity, discontinuity criterion, Dirichlet's nowhere continuous function (illustrations), combinations of continuous functions and compositions of continuous functions, continuous functions on intervals, boundedness theorem, the maximum-minimum theorem, location of roots theorem, Bolzano's intermediate value theorem, intermediate value property, preservation of interval property.

References:

[1]: Chapter 4 (Sections 4.1-4.3), Chapter 5 (Sections 5.1-5.3).

[2]: Chapter 3 (Sections 17, 18 and 20).

Uniform continuity, uniform continuity theorem, differentiation, derivative, combinations of differentiable functions, Caratheodory theorem, chain rule, derivative of inverse functions, interior extremum theorem, intermediate value property for derivatives (Darboux's theorem), review of Rolle's theorem, mean value theorem, Cauchy's mean value theorem.

References:

[1]: Chapter 5 (Section 5.4 up to 5.4.3), Chapter 6 (Sections 6.1-6.2, 6.3.2).

[2]: Chapter 3 (Section 19), Chapter 5 (Sections 28, 29)

Taylor's theorem with Lagrange and Cauchy form of remainders, binomial series theorem, Taylor series, Maclaurin series, expansions of exponential, logarithmic and trigonometric functions, convex functions, applications of mean value theorems and Taylor's theorem to monotone functions. Power series, radius of convergence, interval of convergence

References:

[1]: Chapter 6 (Sections 6.4 (up to 6.4.6)), Chapter 9 (Section 9.4 (page 271)).

[2]: Chapter 5 (Sections 31).

REFERENCES:

1. **R. G. Bartle** and **D. R. Sherbert**, *Introduction to Real Analysis* (3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. **K. A. Ross**, *Elementary Analysis: The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

II.3 Probability and Statistics

Total marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

References:
[1]: Chapter 1 (Sections 1.1, 1.3, 1.5-1.9).
[2]: Chapter 5 (Sections 5.1-5.5, 5.7), Chapter 6 (Sections 6.2-6.3, 6.5-6.6).

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

References:
[1]: Chapter 2 (Sections 2.1, 2.3-2.5).
[2]: Chapter 4 (Exercise 4.47), Chapter 6 (Section 6.7), Chapter 14 (Sections 14.1, 14.2).

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

References:
[2]: Chapter 4 (Section 4.4).
[3]: Chapter 2 (Section 2.7), Chapter 4 (Sections 4.1-4.3).

REFERENCES:

1. **Robert V. Hogg, Joseph W. McKean** and **Allen T. Craig**, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. **Irwin Miller** and **Marylees Miller**, *John E. Freund's Mathematical Statistics with Applications* (7th Edition), Pearson Education, Asia, 2006.
3. **Sheldon Ross**, *Introduction to Probability Models* (9th Edition), Academic Press, Indian Reprint, 2007.

SUGGESTED READING:

1. **Alexander M**. **Mood**, **Franklin** A. **Graybill** and **Duane C. Boes**, *Introduction to the Theory of Statistics*, (3_{rd} Edition), Tata McGraw- Hill, Reprint 2007

II.4 Credit course II

SEMESTER III

III.1 Calculus II

Total marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Functions of several variables, level curves and surfaces, graphs of functions of two variables, limits and continuity of functions of two and three real variables, partial differentiation (two variables), partial derivative as a slope, partial derivative as a rate, higher order partial derivatives (notion only), equality of mixed partials, tangent planes, approximations and differentiability, sufficient condition for differentiability (statement only), chain rule for one and two independent parameters, illustration of chain rule for a function of three variables with three independent parameters, directional derivatives and the gradient, extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Lagrange multipliers with two parameters.

Reference:
[1]: Chapter 11.

Double integration over rectangular region, double integration over nonrectangular region, double integrals in polar co-ordinates, triple integrals, cylindrical and spherical co-ordinates, change of variables.

Reference:
[1]: Chapter 12.

Divergence and curl, line integrals, The Fundamental Theorem and path independence, Green's Theorem, surface integrals, Stoke's Theorem, The Divergence Theorem.

Reference:
[1]: Chapter 13.

REFERENCE:

1. **M. J. Strauss**, **G. L. Bradley** and **K. J. Smith**, *Calculus* (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.

SUGGESTED READING:

1**. Jerrold E. Marsden, Anthony J. Tromba** and **Alan Weinstein,** *Basic Multivariable Calculus*, Springer-Verlag, 2005.

III.2 Numerical Methods and Programming

Total marks: 150
Theory: 75
Practical: 50
Internal Assessment: 25
5 Lectures, 2 Practicals, 1 Tutorial (per week per student)

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.

Reference:

[1]: Chapter 1 (Sections 1.1-1.2), Chapter 2 (Sections 2.1-2.5), Chapter 3 (Section 3.5, 3.8).

Lagrange and Newton interpolation: linear and higher order, finite difference operators.

References:

[1]: Chapter 5 (Sections 5.1, 5.3)

[2]: Chapter 4 (Section 4.3).

Numerical differentiation: forward difference, backward difference and central difference. Integration: trapezoidal rule, Simpson's rule, Euler's method.

Reference:

[1]: Chapter 6 (Sections 6.2, 6.4), Chapter 7 (Section 7.2)

Note: Emphasis is to be laid on the algorithms of the above numerical methods.

***Practical / Lab work to be performed on a computer*:**

Use of computer aided software (CAS), for example *Matlab / Mathematica / Maple* / *Maxima* etc., for developing the following Numerical programs:

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.

(ii) To find the absolute value of an integer.

(iii) Enter 100 integers into an array and sort them in an ascending order.

(iv) Any two of the following

(a) Bisection Method

(b) Newton Raphson Method

(c) Secant Method

(d) Regulai Falsi Method

(v) LU decomposition Method

(vi) Gauss-Jacobi Method

(vii) SOR Method or Gauss-Siedel Method

(viii) Lagrange Interpolation or Newton Interpolation

(ix) Simpson's rule.

Note: For any of the CAS *Matlab / Mathematica / Maple* / *Maxima* etc., Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

REFERENCES:

1. **B. Bradie**, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. M**. K. Jain, S. R. K. Iyengar** and **R. K. Jain**, *Numerical Methods for Scientific and Engineering Computation*, New age International Publisher, India, 5th edition, 2007.

SUGGESTED READING:

1. **C. F. Gerald** and **P. O. Wheatley**, *App;ied Numerical Analysis*, Pearson Education, India,7th edition, 2008

III.3 Algebra II

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Symmetry of a square, dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups, subgroups and examples of subgroups, centralizer, normalizer, center of a group, cyclic groups, generators of cyclic groups, classification of subgroups of cyclic groups.

Reference:

[1]: Chapters 1, Chapter 2, Chapter 3 (including Exercise 20 on page 66 and Exercise 2 on page 86), Chapter 4, Chapter 5 (upto Example 3).

Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, a Check-Digit Scheme based on the dihedral group D_5, product (HK) of two subgroups, definition and properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, an application of cosets to permutation groups, the rotation group of a cube and a soccer ball, definition and examples of the external direct product of a finite number of groups, normal subgroups, factor groups, applications of factor groups to the alternating group A_4, commutator subgroup.

Reference:

[1]: Chapter 5, Chapter 7 (including Exercises 3, 6 and 7 on page 168), Chapter 8 (upto Example 2), Chapter 9 (upto Example 13 and including Exercise 52 on page 188).

Definition and examples of homomorphism, properties of homomorphism, definition and examples of isomorphism, Cayley's theorem, properties of isomorphism, Isomorphism theorems I, II and III, definition and examples of automorphisms, inner automorphisms, automorphisms and inner automorphisms group, automorphism group of finite and infinite cyclic groups, applications of factor groups to automorphisms groups, Cauchy's theorem for finite abelian groups.

Reference:

[1]: Chapter 6, Chapter 9 (Theorems 9.3-9.5), Chapter 10

REFERENCES:

1. **Joseph A. Gallian**, *Contemporary Abstract Algebra* (4th Ed.), Narosa Publishing House, 1999.

SUGGESTED READING:

1. **David S. Dummit** and **Richard M. Foote**, *Abstract Algebra* (2nd Edition), John Wiley and Sons (Asia) Pvt. Ltd, Singapore, 2003.

III.4 Qualifying paper

SEMESTER IV

IV.1 Differential Equations and Mathematical Modeling II

Total marks: 150
Theory: 75
Practical: 50
Internal Assessment: 25
5 Lectures, 2 Practicals, 1 Tutorial (per week per student)

Introduction, classification, construction and geometrical interpretation of first order partial differential equations (PDE), method of characteristic and general solution of first order PDE, canonical form of first order PDE, method of separation of variables for first order PDE.

Reference:
[1]: Chapter 2.

Mathematical modeling of vibrating string, vibrating membrane, conduction of heat in solids, gravitational potential, conservation laws and Burger's equations, classification of second order PDE, reduction to canonical forms, equations with constant coefficients, general solution.

Reference:
[1]: Chapter 3 (Sections 3.1-3.3, 3.5-3.7), Chapter 4.

Cauchy problem for second order PDE, homogeneous wave equation, initial boundary value problems, non-homogeneous boundary conditions, finite strings with fixed ends, non-homogeneous wave equation, Riemann problem, Goursat problem, spherical and cylindrical wave equation.

Reference:
[1]: Chapter 5.

Method of separation of variables for second order PDE, vibrating string problem, existence and uniqueness of solution of vibrating string problem, heat conduction problem, existence and uniqueness of solution of heat conduction problem, Laplace and beam equation, non-homogeneous problem.

Reference:
[1]: Chapter 7.

***Practical / Lab work to be performed on a computer*:**
Modeling of the following problems using *Matlab / Mathematica / Maple* etc.

(i) Solution of Cauchy problem for first order PDE.

(ii) Finding the characteristics for the first order PDE.

(iii) Plot the integral surfaces of a given first order PDE with initial data.

(iv) Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for any two of the following associated conditions

(a) $u(x,0) = \varphi(x), \quad u_t(x,0) = \psi(x), \ x \in R \ \ t > 0$
(b) $u(x,0) = \varphi(x), \quad u_t(x,0) = \psi(x), \ u(0,t) = 0, \ x \in (0,\infty), \ t > 0$
(c) $u(x,0) = \varphi(x), \quad u_t(x,0) = \psi(x), \ u_x(0,t) = 0, \ x \in (0,\infty), \ t > 0$
(d) $u(x,0) = \varphi(x), \quad u_t(x,0) = \psi(x), \ u(0,t) = 0, \ u(l,t) = 0, \ 0 < x < l, \ t > 0$

(v) Solution of the heat equation $\frac{\partial u}{\partial t} - \kappa \frac{\partial^2 u}{\partial x^2} = 0$ for any two of the following associated conditions

(a) $u(x,0) = \varphi(x), \quad u(0,t) = a, \ u(l,t) = b \ , 0 < x < l, \ t > 0$
(b) $u(x,0) = \varphi(x), \quad x \in R, \ \ 0 < t < T$
(c) $u(x,0) = \varphi(x), \quad u(0,t) = a, \ x \in (0,\infty), \ t \geq 0$

REFERENCE:

1. **Tyn Myint-U** and **Lokenath Debnath,** *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.

SUGGESTED READING:

1. **Ioannis P Stavroulakis** and **Stepan A Tersian**, *Partial Differential Equations: An Introduction with Mathematica and MAPLE*, World Scientific, Second Edition, 2004.

IV.2 Analysis III

Total marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Riemann integral, basic inequality of Riemann integral, Riemann condition of integrability, Riemann sum, algebraic and order properties of the Riemann integral, Riemann integrability for continuous functions, monotonic functions and functions with finite number of discontinuities(without proof), the fundamental theorem of calculus(second fundamental theorem without proof), consequences of the fundamental theorem of calculus: integration by parts and change of variables, mean value theorem of calculus(statement only). improper integrals, convergence of improper integrals, tests of convergence for improper integrals, Abel's and Dirichlet's tests for improper integrals, Beta and Gamma functions and their relations.

References:
[3]: Chapter 6 (Articles 32-34, 36).
[2]: Chapter 9 (Sections 9.4-9.6)

Pointwise and uniform convergence of sequence of functions, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration, Cauchy criterion for uniform convergence, series of functions and convergence, Weierstrass M-test, Weierstrass approximation theorem (statement only).Differentiation and integration of Power series, Abel's theorem (without proof),exponential and logarithmic functions

References:
[1]: Chapter 8 (Sections 8.1, 8.2.3, 8.2.4), Chapter 9 (Sections 9.4.1-9.4.6).
[3]: Chapter 4 (Sections 24-27), Chapter 6 (Section 37)

REFERENCES:

1. **R. G. Bartle** and **D. R. Sherbert**, *Introduction to Real Analysis* (3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. **Sudhir R. Ghorpade** and **Balmohan V. Limaye**, *A Course in Calculus and Real Analysis*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2006.
3. **K. A. Ross**, *Elementary Analysis: The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

IV.3 Algebra III

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lecture, 1 Tutorial (per week per student)

Definition and examples of rings, properties of rings, subrings, integral domains, definition and examples of fields, characteristic of a ring, ideals, ideal generated by subsets in a commutative ring with unity, factor rings, operations on ideals, prime ideals and maximal ideals, definition and examples of ring homomorphisms, properties of ring homomorphisms, isomorphisms, isomorphism theorems I, II and III, field of quotients.

Reference:
[2]: Chapter 12, Chapter 13, Chapter 14, Chapter 15.

Definition of polynomial rings over commutative rings, the division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in $Z[x]$, an application of unique factorization to weird dice, divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

Reference:
[2]: Chapter 16, Chapter 17, Chapter 18.

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combinations and systems of linear equations, linear span, linear independence, basis and dimension, dimensions of subspaces, linear transformations, null space, range, rank and nullity of linear transformations, matrix of a linear transformation, algebra of linear transformations, isomorphism, Isomorphism theorems, invertibility and isomorphisms, change of basis.

Reference:
[1]: Chapter 1 (Sections 1.2-1.6), Chapter 2 (Sections 2.1-2.5).

REFERENCES:

1. **Stephen H. Friedberg**, **Arnold J. Insel** and **Lawrence E. Spence**, *Linear Algebra* (4^{th} Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
2. **Joseph A. Gallian**, *Contemporary Abstract Algebra* (4^{th} Edition), Narosa Publishing House, New Delhi, 1999.

IV.4 Credit course III.1

SEMESTER V

V.1 Differential Equations and Mathematical Modeling III

Total marks: 150
Theory: 75
Practical: 50
Internal Assessment: 25
5 Lectures, 2 Practicals, 1 Tutorial (per week per student)

Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order.

Reference:
[2]: Chapter 7 (Sections 7.1-7.3), Chapter 8 (Sections 8.2-8.3).

Monte Carlo Simulation Modeling**:** simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers**:** middle square method, linear congruence, Queuing Models**:** harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis

Reference:
[3]: Chapter 5 (Sections 5.1-5.2, 5.5), Chapter 7.

Graphs, diagraphs, networks and subgraphs, vertex degree, paths and cycles, regular and bipartite graphs, four cube problem, social networks, exploring and traveling, Eulerian and Hamiltonian graphs, applications to dominoes, diagram tracing puzzles, Knight's tour problem, gray codes.

Reference:
[1]: Chapter 1 (Section 1.1), Chapter 2, Chapter 3.

Note: Chapter 1 (Section 1.1), Chapter 2 (Sections 2.1-2.4), Chapter 3 (Sections 3.1-3.3) are to be reviewed only. This is in order to understand the models on Graph Theory.

***Practical / Lab work to be performed on a computer*:**
Modeling of the following problems using *Matlab / Mathematica / Maple* etc.

(i) Plotting of Legendre polynomial for $n = 1$ to 5 in the interval [0,1]. Verifying graphically that all the roots of $P_n(x)$ lie in the interval [0,1].

(ii) Automatic computation of coefficients in the series solution near ordinary points

(iii) Plotting of the Bessel's function of first kind of order 0 to 3.

(iv) Automating the Frobenius Series Method

(v) Random number generation and then use it for one of the following

(a) Simulate area under a curve

(b) Simulate volume under a surface

(vi) Programming of either one of the queuing model

(a) Single server queue (e.g. Harbor system)

(b) Multiple server queue (e.g. Rush hour)

(vii) Programming of the Simplex method for 2/3 variables

REFERENCES:

1. **Joan M. Aldous** and **Robin J. Wilson**, *Graphs and Applications*: *An Introductory Approach*, Springer, Indian reprint, 2007.
2. **Tyn Myint-U** and **Lokenath Debnath**, *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.
3. **Frank R. Giordano**, **Maurice D. Weir** and **William P. Fox**, *A First Course in Mathematical Modeling*, Thomson Learning, London and New York, 2003.

V.2 Analysis IV

Total marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Definition and examples of metric spaces, isometries, diameter, isolated points, accumulation and boundary points, closure and interior, open and closed sets, Cantor's intersection theorem, open and closed balls, convergence, Cauchy sequence and boundedness.

References:

[1]: Chapter 1 (Sections 1.1 (up to example 1.1.17), 1.3-1.4, 1.6-1.7), Chapter 2 (Sections 2.1-2.3, 2.5-2.6), Chapter 3 (Sections 3.1, 3.6-3.7), Chapter 4 (Sections 4.1-4.4, 4.7), Chapter 5 (Sections 5.1-5.3), Chapter 6 (Sections 6.1-6.2, 6.4-6.8), Chapter 7 (Sections 7.1, 7.4, 7.6-7.8).

Continuity and uniform continuity, completeness, contraction mapping theorem, Baire's category theorem.

Reference:

[1]: Chapter 8 (Sections 8.1-8.3, 8.5, 8.9-8.10), Chapter 9 (Sections 9.1 (up to Subsection 9.1.3), 9.2 (Theorem 9.2.1 with 1st two criteria), 9.4, 9.9), Chapter 10 (Sections 10.2 (only Cauchy criterion), 10.3, 10.8, 10.10).

Connectedness, connected subsets, connected components, pathwise connectedness.

Reference:

[1]: Chapter 11 (Sections 11.1 – 11. 8)

Compactness, compact subsets, compactness of products.

Reference:

[1]: Chapter 12 (Sections 12.1 – 12. 5).

REFERENCES:

1. **Mícheál Ó Searcóid**, *Metric Spaces*, Springer Undergraduate Mathematics Series, Springer-Verlag, London Limited, London, 2007.
2. **G. F. Simmons**, *Introduction to Topology and Modern Analysis*, Mcgraw-Hill Editions, 2004.

V.3 Algebra IV

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Dual spaces, dual basis, double dual, transpose and its matrix in the dual basis, annhilators, eigenvalues and eigenvectors, characteristic polynomial, diagonalizability, invariant subspaces and the Cayley-Hamilton theorem, the minimal polynomial for a linear transformation.

Reference:

[1]: Chapter 2 (Section 2.6), Chapter 5 (Sections 5.1-5.2, 5.4, 7.3).

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, adjoints of linear operators, least square approximations, minimal solutions to system of linear equations.

Reference:

[1]: Chapter 6 (Sections 6.1-6.3).

Extension fields, fundamental theorem of field theory, splitting fields, zeros of an irreducible polynomial, perfect fields, characterization of extensions, algebraic extensions, finite extensions, properties of algebraic extensions, classification of finite fields, structure of finite fields, subfields of finite fields, constructible numbers, straight edge and compass construction.

Reference:

[2]: Chapter 20, Chapter 21, Chapter 22, Chapter 23.

REFERENCES:

1. **Stephen H. Friedberg**, **Arnold J. Insel** and **Lawrence E. Spence**, *Linear Algebra* (4^{th} Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
2. **Joseph A. Gallian**, *Contemporary Abstract Algebra* (4^{th} Edition), Narosa Publishing House, New Delhi, 1999.

V.4 Linear Programming and Theory of Games

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Reference:
[1]: Chapter 3 (Sections 3.2-3.3, 3.5-3.8), Chapter 4 (Sections 4.1-4.4).

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

Reference:
[1]: Chapter 6 (Sections 6.1- 6.3).

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Reference:
[3]: Chapter 5 (Sections 5.1, 5.3-5.4).

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

Reference:
[2]: Chapter 14.

REFERENCES:

1. **Mokhtar S. Bazaraa**, **John J. Jarvis** and **Hanif D. Sherali**, *Linear Programming and Network Flows* (2nd edition), John Wiley and Sons, India, 2004.
2. **F. S. Hillier** and **G. J. Lieberman**, *Introduction to Operations Research* (9th Edition), Tata McGraw Hill, Singapore, 2009.
3. **Hamdy A. Taha**, *Operations Research, An Introduction* (8th edition), Prentice-Hall India, 2006.

SUGGESTED READING:

1. **G. Hadley**, *Linear Programming*, Narosa Publishing House, New Delhi, 2002.

SEMESTER VI

VI.1 Analysis V

Total marks: 150
Theory: 75
Internal Assessment: 25
Practical: 50
5 Lectures, Practical 2,1 Tutorial (per week per student)

Review of complex plane, sequences and series, connected sets and polygonally connected sets in the complex plane, stereographic projection, analytic polynomials, power series, analytic functions, Cauchy-Riemann equations, functions e^z , sin z and cos z.

Reference:
[1]: Chapter 1, Chapter 2, Chapter 3.

Line integrals and their properties, closed curve theorem for entire functions, Cauchy integral formula and Taylor expansions for entire functions, Liouville's theorem and the fundamental theorem of algebra.

Reference:
[1]: Chapter 4, Chapter 5.

Power series representation for functions analytic in a disc, analyticity in an arbitrary open set, uniqueness theorem, definitions and examples of conformal mappings, bilinear transformations.

Reference:
[1]: Chapter 6 (Sections 6.1-6.2, 6.3 (up to theorem 6.9), Chapter 9 (Sections 9.2, 9.7-9.8, 9.9 (statement only), 9.10, 9.11 (with examples), 9.13), Chapter 13 (Sections 13.1, 13.2 (up to Theorem 13.11 including examples)).

Fourier series, Piecewise continuous functions, Fourier cosine and sine series, property of Fourier coeffcients, Fourier theorem, discussion of the theorem and its corollary.

Reference: [2].

***Practical / Lab work to be performed on a computer*:**
Modeling of the following problems using *Matlab / Mathematica / Maple* etc.

(i) Declaring a complex number e.g. $z_1 = 3 + 4i$, $z_2 = 4 – 7i$. Discussing their algebra $z_1 + z_2$, $z_1 – z_2$, $z_1 * z_2$, and z_1 / z_2 and then plotting them.

(ii) Finding conjugate, modulus and phase angle of an array of complex numbers. e.g., Z = [2+ 3i 4–2i 6+11i 2–5i]

(iii) Compute the integral over a straight line path between the two specified end points e.g., $\int_C f(z)\,dz$, where C is the straight line path from $a + ib$ to $c + id$.

(iv) Perform contour integration e.g. $\int_C f(z)\,dz$ where C is the Contour given by $g(x, y) = 0$.

(v) Plotting of the complex functions like $f(z) = z, f(z) = z^3, f(z) = (z^4 - 1)^{1/4}$, etc.

(vi) Finding the residues of the complex function.

(vii) Taylor series expansion of a given function $f(z)$ around a given point z, given the number of terms in the Taylor series expansion. Hence comparing the function and its Taylor series expansion by plotting the magnitude of each. For example

(i) $f(z) = \exp(z)$ around $z = 0$, $n = 40$.

(ii) $f(z) = \exp(z^2)$ around $z = 0$, $n = 160$, etc.

(viii) To perform Laurentz series expansion of a given function $f(z)$ around a given point z, e.g., $f(z) = (\sin z - 1)/z^4$ around $z = 0$, $f(z) = \cot(z)/z^4$ around $z = 0$., etc.

(ix) Computing the Fourier series, Fourier sine series and Fourier cosine series of a function and plotting their graphs.

REFERENCES:

1. **Joseph Bak** and **Donald J. Newman**, *Complex analysis* (2nd Edition), Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.
2. **John P. D'Angelo,** An Introduction to Complex Analysis and Geometry, American Mathematical Society, 2010
3. *Fourier Series*, Lecture notes published by the Institute of Life Long Learning, University of Delhi, Delhi, 2011.

VI.2 Algebra V

Total Marks : 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Properties of external direct products, the group of units modulo n as an external direct product, applications of external direct products to data security, public key cryptography, definition and examples of internal direct products, fundamental theorem of finite abelian groups, definition and examples of group actions, stabilizers and kernels of group actions, permutation representation associated with a given group action.

References:
[1]: Chapter 1 (Section 1.7), Chapter 2 (Section 2.2), Chapter 4 (Section 4.1).
[3]: Chapter 8, Chapter 9 (Section on internal direct products), Chapter 11.

Applications of group actions: Cauchy's theorem, Index theorem, Cayley's theorem, conjugacy relation, class equation and consequences, conjugacy in S_n, p-groups, Sylow's theorems and consequences. Definition and examples of simple groups, non-simplicity tests, composition series, Jordan-Holder theorem, solvable groups.

References:
[1]: Chapter 3 (Section 3.4, Exercise 9), Chapter 4 (Sections 4.2-4.3, 4.5-4.6).
[3]: Chapter 25.

Normal operators and self-adjoint operators, unitary and orthogonal operators, matrices of orthogonal and unitary operators, rigid motions, orthogonal operators on R^2, conic sections.

Reference:
[2]: Chapter 6 (Sections 6.4-6.5).

Primary decomposition theorem, theorem on decomposition into sum of diagonalizable and nilpotent operator, cyclic subspaces and annihilators, cyclic decomposition theorem, rational form, invariant factors, Jordan form.

Reference:
[4]: Chapter 6 (Section 6.8), Chapter 7 (Sections 7.1-7.3).

REFERENCES:

1. **David S. Dummit** and **Richard M. Foote**, *Abstract Algebra* (2nd Edition), John Wiley and Sons (Asia) Pte. Ltd, Singapore, 2003.
2. **Stephen H. Friedberg**, **Arnold J. Insel** and **Lawrence E. Spence**, *Linear Algebra* (4th Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
3. **Joseph A. Gallian**, *Contemporary Abstract Algebra* (4th Edition), Narosa Publishing House, New Delhi, 1999.
4. **Kenneth Hoffman** and **Ray Kunze**, *Linear Algebra* (2nd edition), Pearson Education Inc., India, 2005.

OPTIONAL PAPERS VI.3

Optional Paper 1: Discrete Mathematics

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.

References:

[1]: Chapter 1 (till the end of 1.18), Chapter 2 (Sections 2.1-2.13), Chapter 5 (Sections 5.1-5.11).

[3]: Chapter 1 (Section 1).

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

References:

[1]: Chapter 6.

[3]: Chapter 1 (Sections 3-4, 6), Chapter 2 (Sections 7-8).

Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

Reference:

[2]: Chapter 9, Chapter 10.

REFERENCES:

1. **B A. Davey** and **H. A. Priestley**, *Introduction to Lattices and Order,* Cambridge University Press, Cambridge, 1990.
2. **Edgar G. Goodaire** and **Michael M. Parmenter**, *Discrete Mathematics with Graph Theory* (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.
3. **Rudolf Lidl** and **Günter Pilz**, *Applied Abstract Algebra* (2nd Edition), Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

Optional Paper 2 : Mathematical Finance

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields, Macaulay and modified duration, term structure of interest rates: spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, putable and callable bonds.

References:

[1]: Chapter 1, Chapter 2, Chapter 3, Chapter 4.

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints), Two fund theorem, risk free assets, One fund theorem, capital market line, Sharpe index. Capital Asset Pricing Model (CAPM), betas of stocks and portfolios, security market line, use of CAPM in investment analysis and as a pricing formula, Jensen's index.

References:

[1]: Chapter 6, Chapter 7, Chapter 8 (Sections 8.5--8.8).

[3]: Chapter 1 (for a quick review/description of expectation etc.)

Forwards and futures, marking to market, value of a forward/futures contract, replicating portfolios, futures on assets with known income or dividend yield, currency futures, hedging (short, long, cross, rolling), optimal hedge ratio, hedging with stock index futures, interest rate futures, swaps. Lognormal distribution, Lognormal model / Geometric Brownian Motion for stock prices, Binomial Tree model for stock prices, parameter estimation, comparison of the models. Options, Types of options: put / call, European / American, pay off of an option, factors affecting option prices, put call parity.

References:

[1]: Chapter 10 (except 10.11, 10.12), Chapter 11 (except 11.2 and 11.8)

[2]: Chapter 3, Chapter 5, Chapter 6, Chapter 7 (except 7.10 and 7.11), Chapter 8. Chapter 9

[3]: Chapter 3

REFERENCES:

1. **David G. Luenberger**, *Investment Science*, Oxford University Press, Delhi, 1998.
2. **John C. Hull**, *Options, Futures and Other Derivatives* (6th Edition), Prentice-Hall India, Indian reprint, 2006.
3. **Sheldon Ross**, *An Elementary Introduction to Mathematical Finance* (2nd Edition), Cambridge University Press, USA, 2003.

Optional Paper 3 : Mechanics

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Reference:
[1]: Chapter 3, Chapter 4, Chapter 5.

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Reference:
[1]: Chapter 6 (Sections 6.1-6.7), Chapter 7

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles, translation and rotation of rigid bodies, Chasles' theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Reference:
[1]: Chapter 11, Chapter 12 (Sections 12.5-12.6), Chapter 13.

REFERENCES:

1. I.**H. Shames** and **G. Krishna Mohan Rao**, *Engineering Mechanics: Statics and Dynamics* (4^{th} Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
2. **R.C. Hibbeler** and **Ashok Gupta**, *Engineering Mechanics: Statics and Dynamics* (11^{th} Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

Optional Paper 4 : Number Theory

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese remainder theorem, Fermat's little theorem, Wilson's theorem.

References:

[1]: Chapter 2 (Section 2.5), Chapters 3 (Section 3.3), Chapter 4 (Sections 4.2 and 4.4), Chapter 5 (Section 5.2 excluding pseudoprimes, Section 5.3).

[2]: Chapter 3 (Section 3.2).

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Möbius inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.

References:

[1]: Chapter 6 (Sections 6.1-6.3), Chapter 7.

[2]: Chapter 5 (Section 5.2 (Definition 5.5-Theorem 5.40), Section 5.3 (Theorem 5.15-Theorem 5.17, Theorem 5.19)).

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last Theorem.

Reference:

[1]: Chapters 8 (Sections 8.1-8.3), Chapter 9, Chapter 10 (Section 10.1), Chapter 12.

REFERENCES:

1. **David M. Burton**, *Elementary Number Theory* (6th Edition), Tata McGraw-Hill Edition, Indian reprint, 2007.
2. **Neville Robinns,** *Beginning Number Theory* (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.

VI.4 Credit course III.2