Five Year Integrate M.Sc Mathematics

Syllabus-2018 admissions onwards

Int M Sc Maths Syllabus 2018

18ENG101   **Communicative English**   **2-0-2-3**

Objectives:

To help students obtain an ability to communicate fluently in English; to enable and enhance the students skills in reading, writing, listening and speaking; to impart an aesthetic sense and enhance creativity

Course Contents:

Unit I

Kinds of sentences, usage of preposition, use of adjectives, adverbs for description, Tenses, Determiners- Agreement (Subject – Verb, Pronoun- Antecedent) collocation, Phrasal Verbs, Modifiers, Linkers/ Discourse Markers, Question Tags

Unit II

Paragraph writing – Cohesion - Development: definition, comparison, classification, contrast, cause and effect - Essay writing: Descriptive and Narrative

Unit III

Letter Writing - Personal (congratulation, invitation, felicitation, gratitude, condolence etc.) Official (Principal / Head of the department/ College authorities, Bank Manager, Editors of newspapers and magazines)

Unit IV

Reading Comprehension – Skimming and scanning- inference and deduction – Reading different kinds of material –Speaking**:** Narration of incidents / stories/ anecdotes- Current News Awareness

Unit V

Prose: John Halt's 'Three Kinds of Discipline*'* [**Detailed**]

Max Beerbohm's 'The Golden Drugget' [**Detailed**]

Poems: Ogden Nash- 'This is Going to Hurt Just a Little Bit' [**Detailed**]

Robert Kroetsch– 'I am Getting Old Now', Langston Hughes- 'I, Too' [**Detailed**]

Wole Soyinka- 'Telephone Conversation' [**Non- Detailed**]

Kamala Das- 'The Dance of the Eunuchs' [**Non-Detailed**]

Short Stories: Edgar Allan Poe's 'The Black Cat*',* Ruskin Bond's 'The Time Stops at Shamili*'* [**Non- Detailed**]

CORE READING:

1. *Ruskin Bond*, *Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989*
2. *Syamala, V. Speak English in Four Easy Steps, Improve English Foundation Trivandrum: 2006*
3. *Beerbohm, Max, The Prince of Minor Writers: The Selected Essays of Max Beerbohm (NYRB Classics), Phillip Lopate (Introduction, Editor), The New York Review of Book Publishers.*
4. *Edger Allan Poe. The Selected Works of Edger Allan Poe. A Running Press, 2014.*
5. *Online sources*

References:

6. *Ruskin Bond, Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989*
7. *Martinet, Thomson, A Practical English Grammar, IV Ed. OUP, 1986.*
8. *Murphy, Raymond, Murphy's English Grammar, CUP, 2004*
9. *Online sources*

18ENG121 **Professional Communication** **1- 0-2-2**

Objectives:

To convey and document information in a formal environment; to acquire the skill of self projection in professional circles; to inculcate critical and analytical thinking.

Unit I

Vocabulary Building: Prefixes and Suffixes; One word substitutes, Modal auxiliaries,Error Analysis: Position of Adverbs, Redundancy, misplaced modifiers, Dangling modifiers – Reported Speech

Unit II

Instruction, Suggestion & Recommendation - Sounds of English: Stress, Intonation

- Essay writing: Analytical and Argumentative

Unit III

Circulars, Memos – Business Letters - e - mails

Unit IV

Reports: Trip report, incident report, event report - Situational Dialogue - Group Discussion

Unit V

Listening and Reading Practice - Book Review

References

1. *FelixaEskey. Tech Talk, University of Michigan. 2005*
2. *Michael Swan. Practical English Usage, Oxford University Press. 2005*
3. *Anderson, Paul. Technical Communication: A Reader Centered Approach, V Edition, Hercourt, 2003.*
4. *Raymond V. Lesikar and Marie E. Flatley. Basic Business Communication, Tata Mc Graw Hill Pub. Co. New Delhi. 2005. Tenth Edition.*
5. *Thampi, G. Balamohan. Meeting the World: Writings on Contemporary Issues. Pearson, 2013.*
6. *Lynch, Tony. Study Listening. New Delhi: CUP, 2008.*
7. *Kenneth, Anderson, Tony Lynch, Joan Mac Lean. Study Speaking. New Delhi: CUP, 2008.*
8. *Marks, Jonathan. English Pronunciation in Use. New Delhi: CUP, 2007.*
9. *Syamala, V. Effective English Communication For You (Functional Grammar, Oral and Written Communication): Emerald, 2002.*

18HIN101   **HINDI I**   **1-0-2[2cr]**

Unit-1

a)Introduction to Hindi Language, -other Indian Language's, Official Language, link Language Technical terminology..

b) Hindi alphabet: ParibhashaAurBhed.

c) Shabda: ParibhashaAurBhed, RoopantharkiDrishti se

d) Sangya -ParibhashaAurBhed,SangyakeRoopanthar-ling, vachan, karak

e) Sarvanaam- ParibhashaAurBhed.

Unit-2

a) Common errors and error corrections in Parts of Speech –with emphasis on use of pronouns, Adjective and verb in different tenses –gender& number

b) Conversations, Interviews, Short speeches.

Unit -3

a) Letter writing –ParibhashaAurBhed, Avedanpatra (request letter) & Practice

b) Translation-ParibhashaAurBhed, English to Hindi

Unit- 4

Peom :

a) Maithilisharangupth: sakhivemujsekahakarjaate

b) Suryakanthtripatinirala :Priyatam

c) Mahadevivarma- adhikaar

d) Shiyaramsharangupth:ekphoolkichah

Unit- 5

Kahani

   a) Kafan - Premchand ,

   b) Rajasthan ki Ek Gaav kee theerthyatra - Beeshmasahni

   c) Raychandrabhai :By Mahathma Gandhi - Sathya ke prayog

   d) Rajani - Mannu Bhandari

18HIN111   **HINDI II**   **1-0-2[2cr]**

Unit -1

a) Visheshan- ParibhashaAurBhed.special usage of adverbs, changing voice and conjunctions in sentences.

b) kriya- ParibhashaAurBhed, rupantharkidrushti se-kaal

c) padhparichay.

 d) Vigyapan Lekhan (Advertisement writing),   Saar Lekhan (Precise writing).

Unit -2

Communicative Hindi – MoukhikAbhivyakthi –understanding proper pronunciation, Haptics …etc in Interviews ,short speeches .

Unit -3

Film review,Audio –Visual-Media in Hindi – Movies appreciation and evaluation.News reading and presentations in Radio and Tv channels in Hindi, samvaadhlekhan,

Unit -4

a) Harishankarparasaiyi- SadacharkaThavis

b) Jayashankarprasadh – Mamata
c) Mannubandari- Akeli
d) Habibtanvir- Karthus

Unit -5
Kavya Tarang
   a) Himadri thung shrung se (poet- Jayasankar prasad)
   b) Dhabba (poet- kedarnath sing) ,
   c) Proxy (poet- Venugopal),
   d) Machis(poet –Suneeta Jain) ,
   e) Vakth. (poet – Arun kamal)
   f) Fasal (poet- Sarveshwar Dayal Saxena)

18KAN101   **KANNADA I**   **1-0-2[2cr]**

- To enable the students to acquire basic skills in functional language.
- To develop independent reading skills and reading for appreciating literary works.
- To analyse language in context to gain an understanding of vocabulary, spelling,   punctuation and speech

UNIT – 1

- Railway Nildanadalli – K. S. Narasimha Swamy
- Amma, Aachara Mattu Naanu – K. S. Nisar Ahamad
- Kerege Haara – Janapada
- Simhaavalokana – H.S. Shivaprakash

UNIT – 2

- Dhanwantri Chikitse - Kuvempu
- Mouni - Sethuram
- Meenakshi Maneya Mestru - Kuvempu

UNIT – 3

- Sukha –H.G Sannaguddayya
- Mobile Thenkara Jen Nonagala Jhenkara – Nagesh Hegade
- Namma Yemmege Maatu Tiliyitu – Goruru Ramaswamy Iyangar

UNIT – 4
  Language structure

- Usage of punctuation marks
- Introduction to words (right usage)
- Reading skills
- Sentence formation (simple & complex)
- Translation- English to Kannada

References:

1. Kannada Samskruti Kosha – Dr. Chi. C Linganna
2. Kannada Sanna Kathegalu – G H Nayak
3. Lekhana Kale – N. Prahlad Rao
4. Kannada Sahithya Charithre – R. Sri Mugali

18KAN111   **KANNADA II**   **1-0-2[2cr]**

Objectives:
- To enable the students to acquire basic skills in functional language.
- To develop independent reading skills and reading for appreciating literary works.
- To develop functional and creative skills in language.
- To enable the students to plan, draft, edit & present a piece of writing.

UNIT – 1

- Bettada Melondu Maneya Maadi – Akka Mahadevi
- Thallanisadiru Kandya – Kanakadasa
- Avva – P. Lankesh
- Neevallave – K. S. Narasimha Swamy

UNIT – 2

Gunamukha – Drama by P. Lankesh

UNIT – 3

Karvalo – Novel by Poornachandra Thejaswi

UNIT – 4

Letter Writing –
Personal (congratulation, invitation, condolence etc.)
- Official (To Principal, Officials of various departments, etc.,)
- Report writing
- Essay writing
- Precise writing

Prescribed text:

1. Gunamukha by P. Lankesh (Lankesh Prakashana)
2. Karvalo by Poornachandra Thejaswi (Mehtha publishing house)

Reference
1. Saamanyanige Sahithya Charitre (chapter 1 to 10) – Bangalore University Publication
2. Hosa Kannada Saahithya Charithre – L.S Sheshagiri Rao
3. Kacheri Kaipidi – Kannada Adhyayana Samsthe (Mysuru University)
4. Kannada Sahithya Charithre – R. Sri Mugali
5. H.S.Krishna Swami Iyangar – *Adalitha Kannada – Chetana Publication, Mysuru*

18MAL101   **Malayalam I**

Unit 1

Ancient poet trio:*Adhyatmaramayanam*,*LakshmanaSwanthanam (Lines: valsasoumitre… mungikidakayal),*Ezhuthachan -Medieval period classics – *Jnanappana(Lines:201 to 298)*,Poonthanam.

Unit 2

Modern Poet trio: *EnteGurunathan,* VallatholNarayanaMenon- Critical analysis of the poem.

Unit 3

Short stories from period 1/2/3:*Poovanpazham*-VaikaomMuhammedBasheer-Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: *BharathaParyadanam-VyasanteChiri*–Ithihasa studies-KuttikrishnaMararu-Outline of literary Criticism in Malayalam Literature-Introduction to KuttikrishnaMararu& his outlook towards literature &life.

Unit 5

Error-freeMalayalam: **1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha

Malayalam – Writing-**a**. Expansion of ideas; **b**.PrecisWriting; **c**. Essay Writing; **d**.Letter writing; **e**.RadioSpeech;**f**.Script/Feature/Script

Writing;**g**.NewsEditing;**h**.Advertising;**i**.Editing;j.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

18MAL111   **Malayalam II**

Unit1

Ancient poet trio: *Kalayanasougandhikam,(Lines: kallum marangalum… namukkennarika vrikodara)*,KunjanNambiar - Critical analysis of his poetry-Ancient Drama: *Kerala Sakunthalam* (Act 1), Kalidasan (Transilated by Attor Krishna Pisharody).

Unit 2

Modern/romantic/contemporary poetry: *Chandanakkattil* –G.Sankara kurupu-Romanticism – modernism.

Unit 3

Memoirs from Modern Poets: *Theeppathi*, Balachandran Chullikkadu-literary contributions of his time.

Unit 4

Partof an autobiography/travelogue: *Kannerum Kinavum*, Chapter: Valarnnu Varunnoratmavu, V.T.Bhattathirippadu-Socio-cultural literature-historical importance.

Unit 5

Error-free Malayalam-**1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha Malayalam-Writing-**a**.Expansion of ideas;**b**.PrécisWriting;**c.** Essay Writing; **d**.Letter writing;**e**.RadioSpeech;**f**.Script/Feature/ScriptWriting;**g**.NewsEditing;**h**.Advertising;**i**.Editing; **j**.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

18SAN101   **SANKSKRIT I**   **1-0-2[2cr]**

To familiarize students with Sanskrit language and literature.

To read and understand Sanskrit verses and sentences.

Self-study of Sanskrit texts and to practice communication in Sanskrit.

To help the students imbibe values of life and Indian traditions propounded by the scriptures.

To be able to speak in Sanskrit.

Module I

Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit. (7 hours)

Module II

Verbs- Singular, Dual and plural — First person, Second person, Third person.

Tenses – Past, Present and future – Atmanepadi and parasmaipadi-karthariprayoga.

(8hrs)

Module III

Words for communication and moral stories. (4 hrs)

Module IV

Chanakya Neethi first chapter (first 15 Shlokas) (6 hrs)

Module V

Translation of simple sentences from Sanskrit to English and vice versa.(5hs)

18SAN111   SANSKRIT II   1-0-2[2cr]

Module I

Seven cases, Avyayas, sentence making with Avyayas, Saptha kakaras. **(5hrs)**

Module II

Kthavathu' Prathyayam, Upasargas, Kthvatha,Thumunnantha, Lyabantha Prathyayam. Three Lakaras – brief introduction, Lot lakara **(5hrs)**

Module III

New words and sentences for the communication, Slokas, moral stories(panchathanthra) Subhashithas, riddles (Selected from the Pravesha Book) **(5hrs)**

Module IV

Introduction to classical literature, classification of Kavyas, classification of Dramas - Important five Maha kavyas **(5hrs)**

Module V

Translation of paragraphs from Sanskrit to English and wise -verse **(5hrs)**

Module VI

Bhagavad - Geeta fourteenth chapter (all 27 Shlokas) **(5hrs)**

Essential Reading:

1, Praveshaha; Publisher : Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085
2, Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad
3, PrakriyaBhashyamwritten and published by Fr. John Kunnappally
4, Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5, Sabdamanjari, R.S. Vadyar and Sons, Kalpathi, Palakkad
6, Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7, SubhashitaRatnaBhandakara by Kashinath Sharma, published by Nirnayasagarpress

18SSK201   **LIFE SKILLS I**   **1 0 2 2**

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, self motivation and continuous knowledge upgradation.

Self Confidence: Characteristics of the person perceived, characteristics of the situation, Characteristics of the Perceiver. Attitude, Values, Motivation, Emotion Management, Steps to like yourself, Positive Mental Attitude, Assertiveness.

Presentations: Preparations, Outlining, Hints for efficient practice, Last minute tasks, means of effective presentation, language, Gestures, Posture, Facial expressions, Professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words.

Listening Skills: The importance of listening in communication and how to listen actively.

Prepositions and Articles: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving; Number System; LCM &HCF; Divisibility Test; Surds and Indices; Logarithms; Ratio, Proportions and Variations; Partnership; Time speed and distance; work time problems;

Data Interpretation: Numerical Data Tables; Line Graphs; Bar Charts and Pie charts; Caselet Forms; Mix Diagrams; Geometrical Diagrams and other forms of Data Representation.

Logical Reasoning: Family Tree; Linear Arrangements; Circular and Complex Arrangement; Conditionalities and Grouping; Sequencing and Scheduling; Selections; Networks; Codes; Cubes; Venn Diagram in Logical Reasoning.

TEXTBOOKS:
1.   A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.

2.	Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3.	Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa & Co.
4.	The Hard Truth about Soft Skills, by Amazone Publication.

REFERENCES:
1.	Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
2.	Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.
3.	Data Interpretation, R S Aggarwal, S Chand Publ.
4.	Nova GRE, KAPAL GRE, Barrons GRE books;
5.	Quantitative Aptitude, The Institute of Chartered Accountants of India.
6.	More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
7.	The BBC and British Council online resources
8.	Owl Purdue University online teaching resources
9.	wwwthe grammarbook.com online teaching resources
10.	www.englishpage.com online teaching resources and other useful websites.

18SSK211   **LIFE SKILLS II**   **1 0 2 2**

Professional Grooming and Practices: Basics of Corporate culture, Key pillars of Business Etiquette. Basics of Etiquette: Etiquette – Socially acceptable ways of behaviour, Personal hygiene, Professional attire, Cultural Adaptability. Introductions and Greetings: Rules of the handshake, Earning respect, Business manners. Telephone Etiquette: activities during the conversation, Conclude the call, To take a message. Body Language: Components, Undesirable body language, Desirable body language. Adapting to Corporate life: Dealing with people.

Group Discussions: Advantages of Group Discussions, Structured GD – Roles, Negative roles to be avoided, Personality traits to do well in a GD, Initiation techniques, How to perform in a group discussion, Summarization techniques.

Listening Comprehension advanced: Exercise on improving listening skills, Grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading Comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving – Money Related problems; Mixtures; Symbol Based problems; Clocks and Calendars; Simple, Linear, Quadratic and Polynomial Equations; Special Equations; Inequalities; Functions and Graphs; Sequence and Series; Set Theory; Permutations and Combinations; Probability; Statistics.

Data Sufficiency: Concepts and Problem Solving.

Non-Verbal Reasoning and Simple Engineering Aptitude: Mirror Image; Water Image; Paper Folding; Paper Cutting; Grouping Of Figures; Figure Formation and Analysis; Completion of Incomplete Pattern; Figure Matrix; Miscellaneous.

Special Aptitude: Cloth, Leather, 2D and 3D Objects, Coin, Match Sticks, Stubs, Chalk, Chess Board , Land and geodesic problems etc., Related Problems

TEXTBOOKS:
1.   A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
2.   Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3.   Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa & Co.
4.   The Hard Truth about Soft Skills, by Amazone Publication.

REFERENCES:
1.   Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
2.   Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.
3.   Quantitative Aptitude by Abjith Guha, Tata McGraw hill Publ..
4.   More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
5.   The BBC and British Council online resources
6.   Owl Purdue University online teaching resources
7.   www.the grammarbook.com online teaching resources
8.   www.englishpage.com online teaching resources and other useful websites.

18SSK301   **LIFE SKILLS III**   **1 0 2 2**

Team Work: Value of Team work in organisations, Definition of a Team, Why Team, Elements of leadership, Disadvantages of a team, Stages of Team formation. Group Development Activities: Orientation, Internal Problem Solving, Growth and Productivity, Evaluation and Control. Effective Team Building: Basics of Team Building, Teamwork Parameters, Roles, Empowerment, Communication, Effective Team working, Team Effectiveness Criteria, Common characteristics of Effective Teams, Factors affecting Team Effectiveness, Personal characteristics of members, Team Structure, Team Process, Team Outcomes.

Facing an Interview: Foundation in core subject, Industry Orientation/Knowledge about the company, Professional Personality, Communication Skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced Grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, Critical reasoning: A course on verbal reasoning. Listening Comprehension advanced: An exercise on improving listening skills.

Reading Comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Specific Training: Solving campus recruitment papers, National level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In Mathematics). Lateral Thinking problems. Quick checking of answers techniques; Techniques on elimination of options, Estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

TEXTBOOKS:
1.   *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2.   *Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3.   *Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4.   *The Hard Truth about Soft Skills, by Amazon Publication.*

REFERENCES:
1.   *Speed Mathematics, Secrets of Lightning Mental Calculations, by Bill Handley, Master Mind books;*
2.   *The Trachtenberg Speed System of Basic Mathematics, Rupa & Co., Publishers;*
3.   *Vedic Mathematics, by Jagadguru Swami Sri Bharati Krsna Tirthayi Maharaja, Motilal Banarsidass Publ.;*
4.   *How to Ace the Brainteaser Interview, by John Kador, Mc Graw Hill Publishers.*
5.   *Quick Arithmetics, by Ashish Agarwal, S Chand Publ.;*
6.   *Quicker Maths, by M tyra & K Kundan, BSC Publishing Co. Pvt. Ltd., Delhi;*
7.   *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
8.   *The BBC and British Council online resources*
9.   *Owl Purdue University online teaching resources*
10.   www.the grammarbook.com online teaching resources
11.   www.englishpage.com online teaching resources and other useful websites.

18COM104   INTRODUCTION TO MANAGEMENT AND FINANCE   3 0 0 3

Objective: To give the students an understanding on the concept of management and on the various aspects of financial management.

Unit I
Management, definition, nature, scope and objectives, importance of management, role of manager, levels of management, management and administration, functions of management.

Scientific Management Principles – Fayol's General Principles of Management - Management of Change, Resistance to Change

Unit II
Motivation and Leadership – Leadership Styles – Theories of Motivation – Maslow – McGregor.

Communication, meaning, definition and characteristics of communication, elements of communication, importance, process of communication, channels of communication.

Unit III
Financial Management, meaning, definition and scope, importance, Finance Function, objectives of financial management, finance manager, functions and role of a finance manager.

Unit IV

Banks and Banking, meaning and definition, types of banks, commercial banking, functions of commercial banks, central banking, Reserve Bank of India, Nationalisation of Commercial Banks, Retail Banking, Recent trends in banking – EMI – ECS – EFT – NEFT – RTGS – CTS – CORE Banking

Unit V

Introduction to various fundamental concepts and definitions of income tax, Finance Bill, Finance Act, person, assessment year, previous year, agricultural income, total income, gross total income, assessee, taxation of previous year's income in the same year, residence and tax liability, income excluded from total income, various heads of income, deductions available for individuals.

REFERENCE TEXTS:
1.   *I.M. Pandey – Essentials of Financial Management, Vikas Publishing*
2.   *Kootz and O'Donnel – Principles of Management, TMH*
3.   *Tripathy, Principles of Management, TMH*
4.   *Direct Taxes: Laws and Practice, Taxmann*
5.   *Modern Banking, Muraleedharan, PHI*

18CSA186   **PC SOFTWARE LAB.**   **0 0 2 1**

Unit 1 Word Processing Application – MS Word

1. Open a new document and set page size to A4, margins to left (2 cm), right (2cm), top (2.5m), bottom (2.5cm)
   a. Type the following text:
      Through Her extra ordinary acts of love and self sacrifice, Amma has endeared Herself to millions. Tenderly caressing everyone who comes to Her, holding them close to Her heart in a loving embrace, Amma shares Her boundless love with all. Be they young or old, sick or poor everyone who comes to Her receives the same unconditional love. Amma's compassion has given rise to a vast network of charitable and spiritual activities, which is drawing attention throughout the world. At the root of these services lies Amma's teaching that the divine exists in everything in every person, plant and animal. Perceiving this unity is the essence of spirituality and the means by which to end all suffering. It is through this simple, yet powerful message that Amma is transforming our world, one embrace at a time.
   b. Make the document error free using Spelling and Grammar
   c. Replace the word 'compassion' using Thesaurus utility.
   d. Practice Cut, Copy and Paste.
   e. Apply Page Borders, Paragraph Borders and shade the paragraphs.
   f . Give appropriate heading in the Header and Page number, date in the Footer.
   g. Apply paragraph settings to the document.
   h. Format the text and apply bullets and numbering using menu.
   i. Insert a picture in the document (use OLE feature)
   j. Change one paragraph of the document into newspaper layout.
   k. Practice tab settings.

2. Insert a table containing 6 rows and 7 columns: Headings – Student No, name, Mark1, Mark2, Mark3, Total, and Average.
   a. Enter the details of 5 students.
   b. Calculate Total & Average using 'Formula' option.
   c. Sort the details of students in the order of Average..

3. Generate 10 copies of interview letters to candidates from different states informing the place and time of interview. (Mail Merge)

Unit 2 Spread Sheet Application – MS Excel

1. Open a new work book and enter the details:
   Employee No Name Basic Pay DA HRA PF Net Pay
   E001 Anu 6000
   E002 Anju 8000
   E003 Pavan 4500
   E004 Jyothy 7600
   E005 Manu 6500
   Calculate DA as 7.5% of Basic Pay, HRA as 5% of Basic Pay PF as 6% of Basic Pay And Net Pay = Basic Pay + DA + HRA - PF .

2. Create a series using AutoFill handle.
3. Save the workbook & give suitable title in the Header and date in the Footer, Preview the file.
4. Create a name for a range of cells in the work sheet.
5. Practice Rows, columns, Cells and work sheet format options.
6. Clear the formats of 5 the row.
7. Delete the last sheet of the workbook
8. Make a copy of the first sheet and rename it.
9. Practice paste special options.

Unit 3 Spread Sheet Application – MS Excel

1. Find the Sum of Net Pay using function.
2. Write a function to find the count of employees in G20 cell.
3. Insert comments in different cells and practice hyperlinks.
4. Create your own style for worksheets.
5. Create a database having the headings Roll No, Name, Mark1, Mark2, Mark3 and Total. Before entering data give validation rules:
   a. For roll no – Enter numbers between 1 and 50
   b. For name – Enter names that have text length between 3 and 15.
   c. For marks – Enter marks between 0 and 99
6. Insert records and Sort the records.
7. Create a chart for the above details.
8. Create a pie chart for the student with highest mark.
9. Practice Auto Filter and advanced Filter.

Unit 4 Presentations using PowerPoint – 2000

1. Open a new Presentation and insert a new slide.
2. Apply appropriate slide transition to it.
3. Insert a number 4 more slides and set up the show for all.

4. Text and Word art into slides and apply custom animations.
5. Format the text and word art in the slides and apply design templates to slides.
6. Hyper link the slides (use text for link).
7. Use action buttons for hyperlink.
8. Create a PowerPoint presentation that contains News Headlines for a TV channel.
9. Create a presentation with minimum 5 slides regarding the programmes on Annual Day celebrations.
10. Create a presentation with minimum 5 slides regarding various products offered by a particular company.

Unit 5

Simple business case studies using the software tools.

TEXTBOOK:
Alexis Leon & Mathews Leon: Fundamentals of Information Technology, Vikas Publishing
REFERENCE BOOKS:
1. Microsoft Office 2000 Complete, BPB publications
2. Dennis P.Curtin, Kim Foley, Kunal Sen, Cathleen Morin : Information Technology The Breaking
Wave, TATA McGraw-Hill Edition

18COM116   **BASICS OF ACCOUNTING**   **3 0 0 3**
Objective: To provide a basic knowledge on the important terms and basic concepts of financial
accounting.

Unit 1
Business – Scope – Business Transactions – Book Keeping – meaning, objectives and functions – Accounting – meaning, functions and importance, distinction between book keeping and accounting – objectives of accounting – users of accounting – branches of accounting – advantages and limitations of accounting – accounting terminologies – Accounting Concepts and Conventions – Accounting Standards in India.

Unit 2
Accounting Systems – Double Entry System and Single Entry System – Account – types of accounts – Rules for Debit and Credit – Accounting Equation – Journal – Journal entries – journalizing – compound entries – Banking transactions.

Unit 3
Sub-Divisions of Journal or Subsidiary Books: Advantages of Subsidiary Books and limitations of journal – Purchase Day Book – Purchase Returns Book – Sales Book – Sales Returns Book – Cash Book – Petty Cash Book – Imprest System
[Overview Only]

Unit 4
Ledger: Meaning and importance – preparation of ledger accounts or posting – balancing an account – account balance – Trial Balance – objectives and functions of trial balance.

Unit 5

Preparation of Final Accounts – simple adjustments like outstanding expenses, prepaid expenses, bad debts, accrued income, unearned income. Depreciation: Meaning and definition – causes of depreciation – need for depreciation – Fixed Instalment Method and Diminishing Balance Method.

TEXTBOOKS:
1. Goyal and Ruchi Goyal – Financial Accounting, Prentice Hall India
2. Jain and Narang – Advanced Accounts Volume 1, Kalyani Publishers

REFERENCE BOOKS:
1. T S Grewal and S C Gupta – Introduction to Accountancy, S. Chand
2. S N Maheshwari and S K Maheshwari – Financial Accounting, Vikas Publishing
3. Mukharjee and Hanif – Financial Accounting, Tata McGraw Hill

18COM181 **ACCOUNTING LAB.** **0 0 2 1**

Objective: To give an understanding on the application of Tally Software.

Unit 1
Getting started with Tally – Company information – Features and configuration.

Unit 2
Tally accounting - Chart of accounts – Ledgers and Groups.

Unit 3
Vouchers – Financial and Trading vouchers - advanced voucher entry.

Unit 4
Display and reporting – reporting and printing.

Unit 5
Budgeting – Interest Calculations – Banking.

REFERENCE TEXTS:
1. Tally complete reference material
2. Tally for everyone – Roopa, Add to Cart Publishing
3. Nadhani – Tally ERP 9 Training Guide – BPB Publication

18PHY101   **PHYSICS**   **3 0 0 3**

UNIT 1
Units and measurements, Vectors: fundamentals, Motion in One Dimension: Displacement, Velocity, and Speed, instantaneous, velocity and speeds ,acceleration, motion diagrams, constant acceleration, varying acceleration, freely falling body, kinematic equations.

Motion in 2D and 3D: The displacement, Velocity and acceleration vectors,Relative velocity and Relative acceleration Two dimensional motion with constant acceleration, Projectile motion ,horizontal range and maximum height.

UNIT 2
Newton's laws of motion, inertia, torque, Newton's law of universal gravitation applications & Free body diagrams, work and Kinetic energy, potential energy and conservation of energy momentum & collisions.

Circular motion,uniform circular motion, Non-uniform Circular motion tangential and radial acceleration Rotational of rigid body inertia, torque, Angular momentum.

UNIT 3
Kinematics of moving fluids, equation of continuity, Euler's equation, Bernoulli's theorem, viscous fluids, surface tension and surface energy, capillarity.

UNIT 4
Zeroth law of thermodynamics: Concept of temperature & its measurement, Triple point of water, Thermometers: constant volume, Constant pressure, Platinum resistance thermometry, Thermal expansion,

First law of thermodynamics: Internal energy and work, Heat and Enthalpy, Heat Capacity and its measurement, Heat transfer mechanisms - Conduction, Convection, Radiation, kinetic Theory of gases, Avogadro number, Work done by an ideal gas, Molecular Speed distribution, Molar specific heat, Adiabatic, Isothermal, Constant volume Constant Pressure process for an ideal gas.

UNIT 5
Second law of thermodynamics: Kelvin Planck statements, Entropy and its variation external and internal combustion engines - Carnot engine: Steam engine, Stirling engine, Clausius statement of second law, Refrigerator, Equivalence of Kelvin-Planck and Clausius statement. Reversibility and irreversibility, Conditions for irreversibility. Irreversibility of second law of thermodynamics

TEXTBOOK:
*David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics 9th Edition,John Wiley (2012){**Chapters 1-14, 18-20**}*

REFERENCE BOOKS:
1.   Kittel et al, Mechanics, Berkeley Physics Course Vol. 1, 2nd edition, Tata McGraw Hill 2011.

2.   *Raymond. A. Serway and Jerry. S. Faughn, College Physics 7th Ed., Thomson Brooks/Cole, USA, 2009.*
3.   *Francis. W. Sears, Mark. W. Zemanski and Hugh. D. Young, University Physics, Narosa Publishing House, 2011.*
4.   *Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynman Lectures on Physics Vol. 1, Narosa, 2003*

18PHY181   Physics Lab - Mechanics and Properties of Matter   0 0 2 1

1. Young's modulus – Uniform bending
2. Torsional Pendulum
3. Compound Pendulum
4. Coefficient of viscosity- Poiseuille's method
5. Surface tension of liquid by capillary raise method
6. Thermal conductivity of bad conductor - Lee's disc
7. Kundt's tube
8. Specific heat capacity of a liquid by method of cooling.

Text Book: Laboratory manual supplied by the Department

18CHY113   CHEMISTRY   3 0 0 3

Unit 1 Chemical Bonding
Review of orbital concept and electronic configuration, electrovalency and ionic bond formation, ionic compounds and their properties, lattice energy, solvation enthalpy and solubility of ionic compounds, covalent bond, covalency, orbital theory of covalency - sigma and pi bonds - formation of covalent compounds and their properties Hybridization and geometry of covalent molecules - VSEPR theory - polar and non-polar covalent bonds, polarization of covalent bond - polarizing power, polarisability of ions and Fajan's rule, dipole moment, percentage ionic character from dipole moment, dipole moment and structure of molecules - co-ordinate covalent compounds and their characteristics, molecular orbital theory for H_2, N_2, O_2 and CO, metallic bond - free electron, valence bond and band theories, weak chemical bonds – inter and intra molecular hydrogen bond - van der Waals forces.

Unit 2 Thermodynamic Parameters
Stoichiometry - mole concept, significance of balanced chemical equation - simple calculations - Conditions for occurrence of chemical reactions - enthapy, entropy and free changes – spontaneity – Thermochemistry - heats of reactions - (formation, combustion, neutralization) - specific heats - variation of enthalpy change with temperature - Kirchhoff' relation (integrated form) - bond enthalpy and bond order - Problems based on the above.

Unit 3 Kinetics
Review of molecularity and order of a reaction, rate law expression and rate constant - first, second, third and zero order reactions, pseudo-first order reactions (pseudo-unimolecular reactions) - complex reactions - equilibrium and steady state approximations - mechanism of

these reactions - effect of temperature on reaction rates - Arrhenius equation and its significance, Michaelis Menden kinetics - enzyme catalysis.

Unit 4 Electrochemistry
Electrolytes - strong and weak, dilution law, Debye-Huckel theory, faraday's laws, origin of potential, single electrode potential, electrochemical series, electrochemical cells, Nernst equation and its application, reference electrodes - SHE, Ag/AgCl, Calomel.

Unit 5 Photochemistry
Photochemistry, laws of photochemistry - Stark-Eistein law, Beer-Lamberts law, quantum efficiency-determination, photochemical processes - Jablonsky diagram, internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo sensitization, photopolymerization**.**

REFERENCE BOOKS:
1.   Principles of Physical Chemistry, B.R. Puri, L.R. Sharma & M.S. Pathania, Vishal Publications, 46th, 2013.
2.   Principles of Inorganic Chemistry, B. R. Puri, L. R. Sharma, Vishal Publications, 2008

18CHY181   **CHEMISTRY LAB**   **0 0 2 1**

1.   Acid base titration (double titration)
2.   Complexometric titration (double titration)
3.   Redox (permanganimetry) titration (double titration)
4.   Conductometric titration
5.   Potentiometric titration
6.   Colourimetric titration

18CSA100   PROBLEM SOLVING AND COMPUTER PROGRAMMING   3 0 0 3

Introduction to problem solving: algorithm development and flowchart. Introduction to Computer terminologies and computer languages. C Fundamentals: structure of C program: directives, functions, statements, printing strings, comments; compilation and execution, Programming errors and debugging. Variables and assignment, reading input; data types, constants, identifiers, keywords, operators - arithmetic, logical, relational, assignment; expressions - precedence and associativity, type cast-implicit and explicit; selection statements:- if, if else, nested if, if else ladder, switch. Case.
Iterative structures: entry controlled and exit controlled loop, exiting from a loop: break, continue, goto; nested loops. Functions: library functions, user defined functions: defining and calling functions, function declaration, passing arguments to a function, returning values from function. Storage classes - auto, extern, static, register variables, scope of a variable. Recursion. Number systems: binary, octal and hexadecimal. Bitwise operators and enumeration.

Arrays: one dimensional numeric arrays, initialization, accessing and usage, two dimensional numeric arrays, initialization, accessing and usage. Introduction to multidimensional arrays. Strings: literal, variables: initialization, reading, writing and accessing. String handling functions. Array of strings. Passing arrays and strings to functions.

TEXTBOOK:
Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

REFERENCE:
Reema Thareja, "Computer Fundamentals and programming in C", Oxford University Press, 2012.

18CSA116   ADVANCED COMPUTER PROGRAMMING   3 0 0 3

Unit 1
Structures: structures variables - declaration, bit fields, initialization and operation on structures, typedef, nested arrays and structures: arrays in structures, nested structures, arrays of structures.

Unit2
Pointers– Declarations, Passing arguments by call by reference, Functions returning pointer, Pointer Arithmetic. Pointer to pointer, Pointers and Arrays – pointer to array, array of pointers, Dynamic memory allocation – malloc(), calloc(), deallocation: free(), dangling pointers.

Unit 3
Pointers and structures, structures and functions: passing structure as argument and returning structure from functions, self-referential structure, unions.

Unit 4
Files - file pointers, standard streams and redirection, text files, binary files, file operations: open, mode, close; Input and output - character I/O, line I/O, formatted I/O. Random file access, Command line arguments.

Unit 5
Preprocessor – Macros. User defined libraries and headers, introduction to the graphics library.

TEXTBOOK:
Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

REFERENCE:
Reema Thareja, "Computer Fundamentals and programming in C", Oxford University Press, 2012.

18CSA180   PROBLEM SOLVING AND COMPUTER PROGRAMMING LAB
0 0 2 1

Basic Linux commands, programs using input/output statements, operators, control structures and loops. Programs using functions and recursions. Programs using numeric one-dimensional array, two-dimensional array. Programs using strings, string handling functions and string arrays. Programs using passing arrays and strings to functions.

18CSA181   ADVANCED COMPUTER PROGRAMMING LAB   0 0 2 1

Programs to demonstrate functions call by reference and returning values by reference. Programs using pointer arithmetic operations and handling pointers. Programs to demonstrate dynamic memory allocation and de-allocation. Programs to show structure and union operations. Programs using files, command line arguments and macros. Programs using user defined libraries and graphics library.

18CUL101   CULTURAL EDUCATION I   2 0 0 2

Unit 1
Introduction to Indian Culture - Introduction to Amma's life and Teachings - Symbols of Indian Culture.

Unit 2
Science and Technology in Ancient India - Education in Ancient India - Goals of Life – Purusharthas - Introduction to Vedanta and Bhagavad Gita.

Unit 3
Introduction to Yoga - Nature and Indian Culture - Values from Indian History - Life and work of Great Seers of India.

TEXTBOOKS:
1.   The Glory of India (in-house publication)
2.   The Mother of Sweet Bliss, (Amma's Life & Teachings)

18CUL111   CULTURAL EDUCATION II   2 0 0 2

Unit 1
1.   Relevance of Sri Rama and Sri Krishna in this Scientific Age
2.   Lessons from the Epics of India
3.   Ramayana & Mahabharata

Unit 2
4.   Who is a Wise Man?
5.   A Ruler's Dharma
6.   The Story of King Shibi

Unit 3
7.   Introduction to the Bhagavad Gita
8.   Bhagavad Gita – Action without Desire

Unit 4

9.   Role and Position of Women in India
10.   The Awakening of Universal Motherhood

Unit 5

11.   Patanjali's Astanga - Yoga System for Personality Refinement
12.   Examples of Heroism and Patriotism in Modern India

TEXTBOOKS:
Common Resource Material II (in-house publication)
Sanatana Dharma - The Eternal Truth (A compilation of Amma's teachings on Indian Culture)

18AVP201 /   AMRITA VALUES PROGRAMME I   1 0 0 1

18AVP211   AMRITA VALUES PROGRAMME II   1 0 0 1

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Courses offered under the framework of Amrita Values Programmes I and II

Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,- Sapta talas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the Abhinava Bharati. The course introduces various styles of Indian classical dance such as Bharatanatyan, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala's traditional Kalari Payattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

Social Awareness Campaign

The course introduces the students into the concept of public social awareness and how to transmit the messages of social awareness through various media, both traditional and modern. The course goes through the theoretical aspects of campaign planning and execution.

Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the vasthupurusha.

Organic Farming in Practice

Organic agriculture is the application of a set of cultural, biological, and mechanical practices that support the cycling of farm resources, promote ecological balance, and conserve biodiversity. These include maintaining and enhancing soil and water quality; conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering. This factsheet provides an overview of some common farming practices that ensure organic integrity and operation sustainability.

Ayurveda for Lifestyle Modification:

Ayurveda aims to integrate and balance the body, mind, and spirit which will ultimately leads to human happiness and health. Ayurveda offers methods for finding out early stages of diseases that are still undetectable by modern medical investigation. Ayurveda understands that health is a reflection of when a person is living in harmony with nature and disease arises when a person is out of harmony with the cycles of nature. All things in the universe (both living and non-living) are joined together in Ayurveda. This leaflet endow with some practical knowledge to rediscover our pre- industrial herbal heritage.

Life Style and Therapy using Yoga

Yoga therapy is the adaptation of yogic principles, methods, and techniques to specific human ailments. In its ideal application, Yoga therapy is preventive in nature, as is Yoga itself, but it is also restorative in many instances, palliative in others, and curative in many others. The therapeutic effect comes to force when we practice daily and the body starts removing toxins and the rest is done by nature.

18ENV300   ENVIRONMENTAL SCIENCE AND SUSTAINABILITY   3 0 0 3

Unit 1
State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.

Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity

Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action.

Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/ land degradation/ pollution

Unit 2
Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

Discuss the interrelation of environmental issues with social issues such as:
Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3
Common goods and public goods, natural capital/ tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment (EIA), Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes/ Green buildings, Sustainable communities, Sustainable Cities.

Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

TEXTBOOKS/ REFERENCES:
1.   R. Rajagopalan, Environmental Studies: From Crisis to Cure. Oxford University Press, 2011, 358 pages. ISBN: 9780198072089.
2.   Daniel D. Chiras, Environmental Science. Jones & Bartlett Publishers, 01-Feb-2012, 669 pages. ISBN: 9781449645311.
3.   Andy Jones, Michel Pimbert and Janice Jiggins, 2011. Virtuous Circles: Values, Systems,   Sustainability.   IIED   and   IUCN   CEESP,   London. URL:http://pubs.iied.org/pdfs/G03177.pdf
4.   Annenberg Learner, The Habitable Planet, Annenberg Foundation 2015. URL: http://www.learner.org/courses/envsci/unit/pdfs/textbook.pdf.

18ENV300   ENVIRONMENTAL SCIENCE AND SUSTAINABILITY   3 0 0 3

Unit 1
State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem

Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.

Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action.

Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/ land degradation/ pollution

Unit 2
Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

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Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

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Common goods and public goods, natural capital/ tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment (EIA), Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes/ Green buildings, Sustainable communities, Sustainable Cities.

Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

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4.   R. Rajagopalan, Environmental Studies: From Crisis to Cure. Oxford University Press, 2011, 358 pages. ISBN: 9780198072089.
5.   Daniel D. Chiras, Environmental Science. Jones & Bartlett Publishers, 01-Feb-2012, 669 pages. ISBN: 9781449645311.
6.   Andy Jones, Michel Pimbert and Janice Jiggins, 2011. Virtuous Circles: Values, Systems,   Sustainability.   IIED   and   IUCN   CEESP,   London. URL:http://pubs.iied.org/pdfs/G03177.pdf
4.   Annenberg Learner, The Habitable Planet, Annenberg Foundation 2015. URL: http://www.learner.org/courses/envsci/unit/pdfs/textbook.pdf.

18MAT101   **CALCULUS**   **3 1 0 4**

Unit 1

Differentiation: The Derivative as a Function – Differentiation Rules – The Derivative as a Rate of Change – Derivatives of Trigonometric Functions – The Chain Rule and Parametric Equations – Implicit Differentiation – Linearization and Differentials.
Chapter 2- Sec: 2.1 to 2.7 and Chapter 3- Sec: 3.1 to 3.6, 3.7, Self Study - Sec: 3.7.

Unit 2

Application of Derivatives: Extreme values of Functions – The Mean Value Theorem – Monotonic Functions and the First Derivative Test – Concavity and Curve Sketching – Intermediate Forms and L' Hospital's Rule – Anti Derivatives.
Chapter 4- Sec: 4.1 to 4.4, 4.6 to 4.8, Self Study - Sec: 4.5

Unit 3

The Definite Integral – The Fundamental Theorem of Calculus – Indefinite Integrals and the Substitution Rule – Substitution and Area between Curves.
Chapter 5- Sec: 5.1 to 5.6

Unit 4

Techniques of Integration: Basic Integration Formulas – Integration by Parts – Integration of Rational Functions by Partial Fractions – Trigonometric Integrals – Trigonometric Substitutions – Numerical Integration – Improper Integrals.
Chapter 8: 8.1 to 8.5, 8.7,8.8, Self Study - Sec: 8.6

Unit 5

Application of Definite Integrals: Volumes by Slicing and Rotation about an Axis – Volumes by Cylindrical Shells – Lengths of Plane Curves – Moments and Centre of Mass – Areas of Surface of Revolution and the Theorems of Pappus – Work – Fluid Pressure and Forces.
Chapter 6 – Sec: 6.1 to 6.7

TEXTBOOK:
1. Finney and Thomas, "Calculus", Pearson, Eleventh Edition, 2008.

REFERENCE BOOKS:
1. Howard Anton, IRl Bivens, Stephens Davis, "Calculus" Wiley, 10th Edition, 2016 Reprint.
2. M. J. Strauss, G. L. Bradley and K. J. Smith, "Calculus", 3rd Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2007.
3. James Stewart, "Calculus: Early Transcendentals", Cengage (India), 8th Edition, 2016.

18MAT103   **Discrete Structures**   **3 1 0 4**

Unit-I

Review: Matrices

Linear System of Equations, Gauss Elimination, Consistency of a linear system of equations, Vectors, Linear independence and dependence of vectors, Rank of a Matrix.
Text Book: 1

Unit-II

Eigen values, Eigen vectors, Properties of eiven values and eigen vectors, Cayley-Hamilton theorem, Some Applications of Eigen value Problems, Similarity of Matrices, Diagonalization of a matrix, Power of a matrix, Diagonalization by orthogonal transformation, Quadratic forms, Canonical form of a quadratic form, Nature of quadratic forms.
Text Book: 1

Unit-III

Propositional Logic, Equivalences, Predicates and Quantifiers, Sets, Functions and growth of functions.
Text Book: 2

Unit-IV

Advanced Counting Techniques: Recurrence relations, Solving Linear Recurrence relations. Generating Functions.
Text Book: 2

Unit -V

 Relations and their properties, n-ary relations, Equivalence relations, partial order relations.
Text Book: 2

TEXT BOOKS:
1. 'Elementary Linear Algebra', Howard Anton and Chris Rorres, John Wiley & Sons, 1994, Seventh Edition.
2. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw Hill.

REFERENCES
1. R. P. Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2007.
2. Thomas Koshy, "Discrete Mathematics with Applications", Academic Press, 2005.

18MAT122   **Real Analysis**   **3-1-0-4**

Unit 1:

Sets and Functions – Mathematical Induction – Finite and Infinite Sets – The Algebraic and Order Properties of $\mathbb{R}$ – AbsoluteValue and Real Line – The Completeness Property of $\mathbb{R}$ – Applications of the Supremum Property – Applications of the Supremum Property, Intervals. (Text Book: Chapter 1, 2- Sec: 1.1 to 1.3 and 2.1 to 2.5)

Unit 2:

Sequence and Series: Sequences and their Limits – Limits Theorems – Monotone sequences – Subsequences and Balzano – Weierstrass Theorem. The Cauchy criterion – Properly divergence sequences – Introduction to series – Absolute Convergence – Tests for Absolute Convergence – Tests for Non absolute Convergence. (Text Book : Chapter 3, 9- Sec: 3.1 to 3.7 and Sec: 9.1 to 9.3).

Unit 3:

Limits of Functions – Limit Theorem – Some Extensions of the Limit Concept – Continuous Functions – – Combinations of Continuous Functions – Continuous Functions on Intervals – Uniform Continuity – Continuity and Gauges – Monotone and Inverse Functions (Text Book : Chapter 4, 5- Sec: 4.1 to 4.3 and Sec: 5.1 to 5.6).

Unit 4:

The Derivative – The Mean Value Theorem – L'Hospital Rules– Taylor's Theorem (Text Book : Chapter 6- Sec: 6.1 to 6.4).

Unit 5:

The Riemann Integral – Riemann Integrable Functions – The Fundamental Theorem – Approximate Integration (Text Book : Chapter 7- Sec: 7.1 to 7.4).

TEXTBOOK:

1. *Robert G. Bartle and Donald R. Sherbert, "Introduction to Real Analysis", John Wiley and Sons, Third Edition,2000.*

REFERENCE BOOKS:

1. *S. C. Malik and Savita Arora, "Mathematical Analysis", New Age International Publishers, Fourth Edition, 2012.*
2. *H.L. Royden and P. M. Fitzpatrick , "Real Analysis", Pearson Education Asia Limited, Fourth Edition, 2010.*
3. S. Kumaresan and Ajit Kumar, *A Basic Course in Real Analysis*, CRC Press.

18MAT111   **Groups and Rings**   **3 1 0 4**

Unit 1

Sets-Operations on Sets and their properties, equivalence relation, Mappings-injective and surjective mapping, composition of mappings and its properties, the Integers–Euclidean Algorithm, Unique factorization theorem and congruence modulo of a given integer. **(Sec. 1.1 to 1.3)**

Unit 2

Definition of Groups, Basic Examples of Groups including Symmetric Groups, Matrix Groups, Groups of Rigid Motions of a Plane, Finite Groups of Motions, Subgroups, Cyclic Group and Factor Groups, Lagrange's Theorem.   **(Sec. 2.1 to 2.5)**

Unit 3

Normal Subgroups. Quotients of Groups, Homomorphisms, Kernal of a homomorphism, Automorphisms, Cauchy's Theorem and Sylow's Theorem for Abelian Groups, Cayley's Theorem and , Permutation Groups.   **(Sec. 2.6 to 2.10)**

Unit 4

Definition of Rings, Examples including Polynomial Rings, Formal Power Series Rings, Matrix Rings and Group Rings. Commutative Rings, Integral Domain, Division Ring, Characteristics of an Integral domain, Fields.   **(Sec. 3.1 to 3.2)**

Unit 5

Homomorphisms, kernel, Isomorphism, Ideals, Quotient Rings.   **(Sec. 3.3 to 3.4)**

TEXTBOOK:

1. I. N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.

REFERENCES:

1. John B. Fraleigh, 'A First Course in Abstract Algebra', Narosa Publishing House, 2003.
2. Joseph A. Gallian, 'Contemporary Abstract Algebra', Cengage Learning, 2013.
3. M.Artin, 'Algebra', Prentice Hall inc., 1994.

Note: The Problems are to be referred from Reference Book 1.

18MAT203   **Rings, Vector Spaces and Fields**   **3 1 0 4**

Unit 1

Maximal Ideals, the Field of Quotients of an Integral Domain, Euclidean Rings, Principal Ideal, Unit Element, Greatest Common Divisor, Prime Elements, Unique Factorization Theorem.   **(Sec. 3.5 to 3.7)**

Unit 2

The ring of Gaussian integers, Fermat's Theorem, Polynomial Rings – F[x], Degree of a Polynomial, The Division Algorithm, Principal Ideal Ring, Irreducible Polynomial a principal ideal ring, Irreducible polynomial.   **(Sec. 3.8 to 3.9)**

Unit 3

Definition of vector spaces and Examples, Subspace, Homomorphism, Isomorphism, Quotient Space, Internal and External Direct Sum, Linear Independence and Bases, Dimension of a Vector Space, Dual Spaces. **(Sec. 4.1 to 4.3)**

Unit 4

Sub Fields, Field Extensions, Finite Extensions, Algebraic Extensions and Their Properties. The Transcendence of 'e'.   **(Sec. 5.1 to 5.2)**

Unit 5

Roots of Polynomials, Remainder Theorem, Splitting Field and its Uniqueness, The concept of constructible numbers and its Applications, Distinct and Multiple Roots, Simple Extension of a Field.   **(Sec. 5.3, 5.4, 5.5).**

TEXTBOOKS:

1. I.N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.

REFERENCES:

1. John B. Fraleigh, 'A First Course in Abstract Algebra', Narosa Publishing House, 2003.
2. Joseph A. Gallian, 'Contemporary Abstract Algebra', Cengage Learning., 2013.
3. Howard Anton and Chris Rorres,'Elementary Linear Algebra', 9th Edition, Wiley, 2005.

Note: The Problems are to be referred from Reference Book 1.

18MAT204   **Real Analysis in Higher Dimension**   **3-1-0-4**

Unit 1

Elements of Point Set Topology: Introduction – Euclidean Space $\mathbb{R}^n$ - Open balls and open sets in $\mathbb{R}^n$ - The structure of open sets in $\mathbb{R}^1$ - Closed sets – Adherent points, Accumulation points – Closed sets and adherent points – The Bolzano-Weierstrass theorem – The Cantor intersection theorem – Lindelof covering theorem – Heine-Borel covering theorem – Compactness in $\mathbb{R}^n$ – Metric Spaces – Point set topology in metric spaces – Compact subsets of a metric space –Boundary of a set.

Chapter 3: Sections 3.1 to 3.16

Unit 2

Limits and Continuity: Introduction – Convergent sequences in a metric space – Cauchy sequences – Complete metric Spaces – Limit of a function – Limits of vector – valued functions - Continuous functions – Continuity of composite functions – Continuous vector-valued functions.

Chapter 4: Sections 4.1 to 4.5, 4.7 to 4.10.

Unit 3

Limits and Continuity: Examples of continuous functions – Continuity and inverse images of open or closed sets – Functions continuous on compact sets – Topological mappings (homeomorphisms) - Bolzano's theorem – Connectedness – Components of a metric space – Arcwise connectedness – Uniform continuity – Uniform continuity and compact sets – Fixed-point theorem for contractions – Discontinuities of real-valued functions – Monotonic functions.

Chapter 4: Sections 4.11 to 4.23

Unit 4

Derivatives: Introduction – Definition of derivative –Derivatives and continuity – Algebra of derivatives – The chain rule – One-sided derivatives and infinite derivatives – Functions with nonzero derivative – Zero derivatives and local extrema – Rolle's theorem – The Mean-value theorem for derivatives – Intermediate-value theorem for derivatives.

Chapter 5: Sections 5.1 to 5.11

Unit 5

Functions of Bounded Variation: Introduction, Properties of monotonic functions, Functions of bounded variation, Total Variation, Additive property of total variation, Total variation on $[a,x]$ as a function of x. Functions of bounded variation expressed as the difference of increasing functions, Continuous functions of bounded variation.

(Chapter 6: 6.1-6.8)

TEXTBOOK:

Tom M. Apostol,"Mathematical Analysis", Narosa publishing house, New Delhi, Second Edition,1989.

REFERENCE BOOKS:

1. *Rudin. W, "Principles of Mathematical Analysis", McGraw-Hill International Editions, Third Edition, 1976.*
2. *H.L. Royden and P.M.Fitzpatrick, "Real Analysis", Pearson Education Asia Limited, Fourth Edition, 2010.*
3. S. Kumaresan-"Topology of Metric Spaces"- Narosa Publishing House, New Delhi, 2011-Second Reprint..

18MAT115   **VECTOR CALCULUS**   **3 1 0 4**

Unit-1

Calculus of vector-valued functions: Vector-valued functions of a real variable-Algebraic operations. Components- Limits, derivatives and integrals-Applications to curves. Tangency-Applications to curvilinear motion-Velocity, speed and acceleration-The unit tangent, the principal normal -The definition of arc length.

Vol.1, Chapter 14- Sec. 14.1 to 14.10.

Unit-2

Differential calculus of scalar and vector fields: Functions of R^n to R^m. Scalar and vector fields-Open balls and open sets-Limits and continuity-The derivative of a scalar field with respect to a vector-Directional derivatives and partial derivatives-Partial derivatives of higher order-Directional derivatives and continuity-The total derivative-The gradient of a scalar field-A chain rule for derivatives of scalar fields- Applications to geometry. Level sets. Tangent planes

Vol.2, Chapter-8-Sec. 8.1 to 8.17.

Unit-3

Line Integrals: Introduction-Paths and line integrals-Other notations for line integrals-Basic properties of line integral-Open connected sets. Independence of paths-The second fundamental theorem of calculus for line integrals-The first fundamental theorem of calculus for line integrals-Necessary and sufficient conditions for a vector field to be gradient-Necessary conditions for a vector field to be gradient-Special methods for constructing potential functions.

Vol.2, Chapter-10-Sec 10.1 to 10.5, 10.10 and 10.11, 10.14 to10.18.

Unit-4

Multiple Integrals: Introduction-Green's theorem in the plane-Some applications of Green's theorem-A necessary and sufficient condition for a two-dimensional vector field to be a gradient-Change of variables in double integral-Special cases of transformation formula.

Vol.2, Chapter-11-Sec. 11.19 to 11.22, 11.26 to 11.28.

Unit-5

Surface Integrals: Parametric representation of a surface-The fundamental vector product-The fundamental vector product as a normal to the surface-Surface integrals-Other notations for surface integrals-The theorem of Stokes-The curl and divergence of a vector field- Further properties of the curl and divergence-The divergence theorem (Gauss' theorem)

Vol.2, Chapter-12-Sec. 12.1 to 12.4, 12.7,12.9 to12.15, 12.19 and 12.21.

TEXTBOOKS:

1. Howard Anton, IRl Bivens, Stephens Davis, "Calculus" Wiley, 10th Edition, 2016 Reprint.
2. Tom M. Apostol, CalculusVolume1, John Wiley & Sons, Second edition, 2007.

3. Tom M. Apostol, Calculus Volume 2, John Wiley & Sons, Second edition, 2007.

REFERENCE BOOKS:

1. Howard Anton "Calculus" John Wiley and Sons
2. Murray R Spiegel, Theory and problems of vector analysis, Schaum's outline series, McGraw-Hill Book Compnay 1974.
3. Finney and Thomas , Calculus, Pearson, Eleventh Edition, 2008.

18MAT201   **DIFFERENTIAL EQUATIONS**   **3 1 0 4**

Unit 1
Review of differential equations (order, degree, linear, nonlinear, implicit and explicit form of solution, general solutions, particular solution, singular solution). Exactness, nonexact equations reduce to exact form.
Part I: 1.1-1.9, 2.12-2.22 (5 hours)

Equations solvable for $\frac{dy}{dx}$, y, x, equations in Clairaut's form, equations reducible to Clairaut's form.
Part I: 4.1-4.11 (4 hours)

Unit 2
Linear homogeneous differential equations with constant coefficients, Euler- Cauchy equation, Linear Nonhomogeneous Differential Equations: Wronskian, linear independence, Method of undetermined coefficients. Method of variation of parameters.
Part I: 5.1-5.5, 6.1-6.3, 1.12,1.13, 5.26-5.27, 7.1-7.5 (9 hours)

Unit 3
Conversion of nth order differential equation to n first order differential equations, homogeneous linear system with constant coefficients, fundamental matrices, complex eigen values, repeated eigenvalues. simultaneous linear differential equations with constant coefficients, simultaneous linear differential equations with variable coefficients,

PART I: 8.1-8.3, 2.1- 2.7(8 hours)

Review of partial differential equations (order, degree, linear, nonlinear).
Unit 4
Formation of equations by eliminating arbitrary constants and arbitrary functions.
General, particular and complete integrals.Lagrange's linear equation, Charpit's method, Methods to solve the first order partial differential equations of the forms f(p,q) = 0, f(z,p,q) = 0, f_1(x,p) = f_2(y,q) and Clairut's form z = px + qy + f(p,q) where $p = \frac{\partial z}{\partial x}$ and $q = \frac{\partial z}{\partial y}$.

Part III: 1.1 – 1.5, 2.3-2.12, 3.1-3.2, 3.7-3.8, 3.10-3.18 (13 hours)
Unit 5
Homogeneous linear partial differential equations with constant coefficient of higher order. Non-homogeneous linear partial differential equations of higher order, method of separation of variables.
Part III: 4.1-4.12 (13 hours)
TEXTBOOKS:
1. M.D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand, 18th edition, 2016.

References:
1. William E. Boyce and Richard C.DiPrima, Elementary differential equations and boundary value problems, Wiley india, 9ᵗʰ edition, 2012.

2. Nita H, Shah, Ordinary and Partial Differential Equations : Theory and Applications, PHI learning, 2ⁿᵈ edition, 2015.
3. Dennis Zill, A First Course in Differential Equations, Cengage Learning, 9ᵗʰ edition, 2009.

18MAT206   **STATICS**   **2 1 0 3**

Unit 1
Forces – Resultants - Law of parallelogram of forces – Triangle of Forces – Polygon of Forces – Lami's theorem – Resolution of forces – Any number of forces acting on a point – Conditions of Equilibrium.

Unit 2
Like Parallel forces – Unlike Parallel forces – Moments – Varignon's theorem of Moments – Generalized theorem of Moments – Couples – Definition – Equilibrium of couples – resultant of coplanar couples.

Unit 3
Equilibrium of three forces acting on a rigid body – three coplanar forces – conditions of equilibrium – Coplanar forces – Reduction of coplanar forces – Equation to the line of action of the resultant.

Unit 4
Forces of friction – Laws of Friction – Limiting Friction – Limiting equilibrium – Cone of Friction – Angle of Friction – Centre of Gravity – Centre of Gravity of a thin uniform rod – Centre of Gravity of a thin plate or Lamina in the form of a parallelogram – Centre of Gravity of a uniform triangular Lamina – Centre of Gravity of three rods forming a triangle – General formulae for determination of the Centre of Gravity – Centre of Gravity by Integration.

Unit 5
Equation to Common Catenary – Tension at any point – Geometrical properties of Common Catenary.

TEXTBOOK:
Venkatraman M.K , Statics, Agasthiar Publishers, 17ᵗʰ Edition July 2015.

REFERENCE BOOKS:
1.   John L Synge,' Principles of Mechanics', Milward Press, 2008, Second Edition.
2.   P. Duraipandian, LaxmiDuraipandian, Muthamizh Jayapragasam, Mechanics, 6ᵗʰ Edition, S. Chand and Company Ltd, 2005.
3.   S. Narayanan, R. Hanumantha Rao, K. Sitaraman, P. Kandaswamy, Statics, S. Chand and Company Ltd, New Delhi

18MAT212   **Linear Algebra**   **3 1 0 4**

Unit 1
        Review: Vector Spaces.
        Inner Products, Angle and Orthogonality in Inner Product Spaces, Length of a Vector, Schwarz Inequality, Orthogonal Vectors, Orthogonal Complement, Orthogonal Bases: Gram-Schmidt Process.   **(Sec. 4.4)**

Unit 2

        The Algebra of Linear Transformations, Characteristic Roots, Invertible Linear transformations, Characteristic Roots, Characteristic Vector, Minimal Polynomial, Matrices, Matrix of a Linear Transformation.   **(Sec. 6.1 to 6.3).**

Unit 3

        Canonical Forms: Triangular, Nilpotent Transformations, Jordan and Rational Canonical Form, invariant subspaces, cyclic subspaces, Invariants of a nilpotent Linear Transformation
(Sec. 6.4 to 6.7).

Unit 4

        Trace and Transpose, Determinants, Symmetric and Skew Symmetric Matrices, Adjoint and Hermitian Adjoint of a Matrix, Hermitian, Unitary and Normal Transformations, Self Adjoint and Normal Transformations, Real Quadratic Forms.   **(Sec. 6.8 to 6.11)**

Unit 5
        Problems in Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections.   **(Sec. 7.1 to 7.3 and 9.5 to 9.6 from Reference Book 2)**

The Jordan Form, the generalized eigen vectors   **(Appendix B from Reference Book 1)**

TEXTBOOKS:

1. I. N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.

REFERENCES:

1. David C. Lay, *Linear Algebra and its Applications*, Pearson.
2. Gilbert Strang,' Linear Algebra and its Applications, Fourth Edition, Cengage Learning, 2014.
3. Howard Anton and Chris Rorres, 'Elementary Linear Algebra', 9th Edition, Wiley, 2005.
4. Nabil Nassif, Jocelyne Erhel, Bernard Philippe, Introduction to Computational Linear Algebra, CRC press, 2015.

18MAT215   **DYNAMICS**   **2 1 0 3**

Unit 1
Kinematics – Velocity – Relative Velocity –Angular Velocity – Acceleration – Acceleration of falling bodies – Motion of a particle down a smooth inclined plane – the laws of motion – Newton's Laws of Motion.

Unit 2
Projectile – Path of a projectile – Motion of a projectile - Horizontal range– Velocity of a projectile – Range of an inclined plane.

Unit 3
Fundamental laws of impact – Impact of a smooth sphere on a fixed smooth plane – Direct impact of smooth spheres – oblique impact of smooth elastic spheres.

Unit 4
Simple Harmonic Motion – Composition of Simple Harmonic Motion of the same period and in the same line – Composition of Simple Harmonic Motion of the same period and in two perpendicular directions – Moment of inertia – Theorem of parallel axes – Theorem of perpendicular axes – Moment of Inertia in some particular cases.

Unit 5
Radial and transverse components of velocity and acceleration – Differential equation of a central orbit – Given the orbit to find the law of force – Given the law of force to find the orbit.

TEXTBOOK:
Venkatraman M. K. Dynamics, Agasthiar Publishers. 17ᵗʰ Edition July 2015.

REFERENCE BOOK:
P. Duraipandian, Laxmi Duraipandian, Muthamizh Jayapragasam, Mechanics, 6ᵗʰ Edition, S. Chand and Company Ltd, 2005.

18MAT221 **NUMERICAL METHODS** **2 1 0 3**

Unit I:

Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, system of nonlinear equations.

Solution of System of Linear Algebraic Equations: Iteration methods

Eigenvalues and Eigenvectros: Jacobi Method for symmetric matrices, Power method for arbitrary matrices.

Sections : 2.2, 2.3, 2.5, 2.7, 3.4, 3.5, 3.6

Unit II:

Interpolation and Approximation: Lagrange and Newton interpolation for unequal intervals, Finite difference operators, Interpolating polynomials using finite differences.

Sections: 4.2, 4.3, 4.4.

Unit III:

Differentiation and Integration: Numerical differentiation, Methods based on interpolation, Numerical integration, Methods based on undetermined coefficients.

Sections: 5.2, 5.6, 5.7, 5.8

Unit IV:

Solutions of Ordinary Differential Equations: Initial Value problems, single step methods, Taylor series method, Second, Third and Fourth order Runge-Kutta methods.

Sections: 6.1, 6.3, 6.4

Unit V:

Solutions of Partial Differential equations: Elliptic partial Differential equations, Parabolic partial differential equations, Hyperbolic partial differential equations.

Sections: 12.1, 12.2, 12.3

TEXTBOOKS:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for scientific and Engineering computation, New Age International Publishers, 2007, 5th edition.
2. R.L. Burden, J. D. Faires, Numerical Analysis, Richard Stratton, 2011, 9th edition.

REFERENCE BOOKS:

1. S.D. Conte and Carl de Boor, 'Elementary Numerical Analysis; An Algorithmic Approach'. International series in Pune and Applied Mathematics, McGraw Hill Book Co., 1980.

2. Kandasamy P, Thilagavathi.K and Gunavathi. K. 'Numerical Methods'- S. Chand and Company Ltd., New Delhi- Revised Edition 2007.

18MAT214 **FOURIER SERIES AND INTEGRAL TRANSFORMS** **3 1 0 4**

Unit 1

Fourier series, Complex Form of Fourier Series, Parseval's Identity, Fourier Integrals, Fourier Integral theorem. Gibbs Phenomenon (Example 2), Sine and Cosine Integrals.
Sections: 11.1, 11.2, 11.7

Unit 2

Infinite Complex Fourier Transforms, Sine and Cosine Transforms, Properties, Convolution theorem and Parseval's theorem.
Sections: 11.8, 11.9

Unit 3

Modeling: Vibrating String, Solution by Separation of Variables, Solution of one Dimensional Wave Equation. Solution of one Dimensional Heat Equation.
Sections: 12.1, 12.2, 12.3, 12.4, 12.5

Unit 4

Laplace Transforms, Inverse Transforms, Properties, Transforms of Derivatives and Integrals, Second Shifting Theorem, Unit Step Function and Dirac-Delta Function, Differentiation and Integration of Transforms.
Sections: 6.1, 6.2, 6.3, 6.4

Unit 5

Convolution, Initial and Final Value Theorems, Periodic Functions, Solving Linear Ordinary Differential Equations with Constant Coefficients, System of Differential Equations and Integral Equations.
Sections: 6.5, 6.6, 6.7, 6.8

TEXTBOOK

Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, Tenth Edition, 2016.

REFERENCE BOOKS

1) LokenathDebnath, Dambaru Bhatta, Integral Transforms and their Applications, CRC Press, Taylor &Fransis Group, Boca Raton, Third Edition, 2015.
2) Abdul J. Jerri, Integral and Discrete Transforms with Applications and Error Analysis,
   Monographs and text books in Pure and Applied Mathematics, Marcel Dekker,1992.
3) Joel L. Schiff, The Laplace Transform: Theory and Applictions, Springer-Verlag, Newyork, 1999.

18MAT202   **Probability and Statistics**   3 1 0 4

Unit – I
Sample Space and Events, Interpretations and Axioms of Probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Independence, Bayes theorem.
Book 1 :   Sections : 2.1-2.8

Unit – II
Discrete Random variables, Probability Distributions and Probability mass functions, Cumulative Distribution functions, mathematical expectation, moment generating function and characteristic function, Standard distributions- discrete distributions- binomial, Poisson and geometric distributions- continuous distributions- uniform, exponential, Gamma, Normal distributions - Chebyshev's theorem.
Book 1 :   Sections : 3.1-3.7.1,4.1-4.8,
Book 2 :   Section :   4.4

Unit – III
Joint, marginal and conditional probability distributions for discrete and continuous cases, independence, expectation of two dimensional random variables, conditional mean and variance, transformation of one and two random variables.
Book 1 :   Section : 5.1
Book 2 :   Sections : 7.1-7.2
Unit – IV
Simple linear Regression, Properties of least square estimators, least squares method for estimation of regression coefficients, Correlation, properties of correlation coefficient, rank correlation coefficient.
Book 1 : Sections: 11.2-11.3,11.8

Unit – V
Point Estimation, Sampling Distributions and Central limit theorem, Methods of point estimation: Method of Moments and Method of Maximum likelihood Estimation, - Confidence Interval on the mean of a Normal Distribution with Variance known and unknown, -Confidence interval on the variance and ratio of variances. Confidence interval for Population Proportion.
Book 1 : Sections: 7.1,7.2,7.4,8.1- 8.4

 TEXT BOOKS:
   1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005
   2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.
REFERENCES:
   3. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

18MAT281   **Numerical Lab – MATLAB**   0 0 2 1

Unit-I :

Preliminaries of MATLAB

Matrices, operations, and basic MATLAB functions; M-files, logical-relational operators and IF statements; Functions in MATLAB; FOR and WHILE loops in MATLAB; Graphics in MATLAB; Efficiency of algorithms in MATLAB; Useful functions and commands in MATLAB.

Unit-II

Linear Algebra

Roots of the function: Bisection method, fixed point iteration method, secant method, Regula-falsi method, Newton-Raphson method;

Interpolation: Lagrange's method, divided difference, finite difference;

System of equations: Gauss elimination, Gauss Jordan elimination, Gauss Jacobi method, Gauss Seidel method, Newton's method for nonlinear systems of equations;

Least squares and eigenvalue problems.

Unit-III

Ordinary Differential Equations

Euler's method, Modified Euler's method, Runge-Kutta fourth order method, system of ordinary differential equations.

Partial Differential Equations

Classification of Partial differential Equations, Elliptic, Parabolic, Hyperbolic PDEs.

TEXT / REFERENCE BOOKS:

1. Rudra Pratap, Getting started with MATLAB 7: A Quick introduction for Scientists and Engineers, Oxford University Press, 2005.
2. Stephen J Chapman, MATLAB Programming for Engineers, Thomson Learning, 4rd Edition, 2007.
3. Sukanta Nayak and Snehashish Chakraverty, Interval Finite Element Method with MATLAB, Academic Press, 1st edition, 2018.

  18MAT307   **Applied Statistics**   **3   1   0   4**

Unit – I

Hypothesis Testing, Tests on a Population Proportion- Tests on the Mean of a Normal Distribution with Variance known and unknown, Tests on the variance –Test for Goodness of fit, Contingency table tests -Nonparametric tests mean and median.
 Sections: 9.1-9.9

Unit – II

Inference on the Difference in Means of Two Normal Distributions, Variance Known and Unknown , A nonparametric tests for difference in Two means, Paired t test, Inference on the variances of the Two Normal Distributions, Inference on Two Population Proportions.
 Sections: 10.1-10.6

Unit – III

Introduction design of experiment of single factor , Completely Randomized Single Factor Experiment, computation of sum of squares, Random effect models, Randomized complete block design, computation of sum of squares – estimation of variance components.
Sections: 13.1-13.4

Unit – IV

Introduction to design of experiment with several factors – Latin Square Design – statistical model for LSD, computation of sum of squares – two factor factorial experiment – main and interaction effects, data and statistical model- computation of sum of squares – estimation of variance components.
Sections : 14.1-14.5

Unit –V

Quality improvement and statistics, Introduction to control limits - control charts for variables – X-bar chart, R-chart, S chart for individual observations- attribute control charts – Control charts for Proportions and for defects per unit.
Sections : 15.1-15.6

TEXT BOOK

1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005

REFERENCES:
1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007

2. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

18MAT 306   **Operations Research**   **3 1 0 4**

Unit – I

Introduction to Operations Research, Models in Operations Research - Introduction to Linear Programming Problems, Formulation of Linear Programming Problems -Graphical solution to Linear Programming Problems - Simplex method. (Sections from Book 1: 1.1, 2.1, 2.2, 3.1, 3.2, 3.3)

Unit- II

Penalty method, two phase method- special cases in Simplex method - Duality in Linear Programming Problem - Primal-Dual relationships, Dual simplex method. (Sections from Book 1: 3.4, 3.5, 4.1, 4.2, 4.4.1)

Unit – III

Introduction to Transportation problem- Mathematical formulation of transportation problem, Initial basic feasible solution (IBFS), MODI method for Optimal solution – unbalanced transportation problems, degeneracy in transportation problem - Introduction to assignment problem, Mathematical formulation of assignment problem, comparison between assignment problem and transportation problem, Optimal solution based on Hungarian method. (Sections from Book 1: 5.1, 5.3, 5.4)

Unit – IV

Network Representation, Critical Path (CPM) computations, Construction of the Time Schedule, Linear programming formulation of CPM - PERT calculations. (Sections from Book1: 6.5)

Unit – V

Problem of sequencing, n jobs through 2 machines - two jobs through m machines - n jobs through m machines (Sections from Book 2: 12.1 to 12.6)
Integer Programming Algorithms: Branch and Bound Algorithms and Cutting Plane Algorithm. (Sections from Book 1: 9.2)

Text Books:
1. Hamdy A. Taha, "Operations Research - An Introduction", Eighth Edition, Prentice Hall India, 2007.
2. KantiSwarup, P.K. Gupta and Man Mohan, "Operations Research", Ninth Edition,Sultan Chand and Sons, 2001.

Unit I

Graphs and Sub graphs, isomorphism, matrices associated with graphs, degrees, walks, connected graphs, shortest path algorithm.

Text Book-1

Unit II

Trees: Trees, cut-edges and cut-vertices, spanning trees, minimum spanning trees, DFS, BFS algorithms. Connectivity: Graph connectivity, k-connected graphs and blocks.

Text Book-1

Unit III

Colorings: Vertex colorings, greedy algorithm and its consequences. Edge-colorings, Vizing theorem on edge-colorings. Planar graphs: Euler formula.

Text Book-1

Unit IV

Some Essential Problems, Binomial Coefficients, Multinomial Coefficients, Pigeonhole Principle, Principle of Inclusion and Exclusion.

Generating Functions, Double Decks, Counting with Repetition, Fibonacci Numbers, Recurrence Relations.

Text Book-2

Unit V

Polya's Theory of Counting, Permutation Groups, Burnside's Lemm, Cycle Index. Polya's Enumeration Formula, deBruijn's generalization.

Text Book-2

TEXTBOOKS:

1. J. A. Bondy and U. S. R. Murty, Graph Theory and Applications, Springer, 2008.
2. Richard A. Brualdi, Introductory Combinatorics, Pearson, 2012

REFERENCES BOOKS

1. D. B. West, Introduction to Graph Theory, P.H.I. 2010.
2. J. H. van Lint and R. M. Wilson, A Course in Combinatorics, Cambridge University Press, 2001.
3. Bollobás, B. Modern Graph Theory (Graduate Texts in Mathematics). New York, NY: Springer-Verlag, 1998.

18MAT303   **COMPLEX ANALYSIS**   **3 1 0 4**

Unit 1
Review: Algebra of complex numbers, operations of absolute value and conjugate, standard inequalities for absolute value (Chapter 1)
Limits, Continuity, derivatives and analytic functions, Cauchy-Riemann equations, ,
Harmonic functions and harmonic conjugates, Power series, Exponential and Logarithmic functions(Chapters 2 and 3).

Unit 2
Contour Integrals - Some Examples -Examples with Branch Cuts -Upper Bounds for Moduli of Contour Integrals – Anti derivatives, Line integrals – Line integrals as functions of arcs, Cauchy-Goursat theorem-Simply Connected Domains- Multiply Connected Domains, Cauchy's theorem for rectangle – Cauchy's theorem in a disk, An Extension of the Cauchy Integral Formula -Liouville's Theorem and the Fundamental Theorem of Algebra with proof -Maximum Modulus Principle with proof, Schwarz lemma.(Chapter 4, Sec: 39-51, 53, 54).

Unit 3
Isolated singularities: removable singularities, poles and essential singularities-Examples; Taylors series, Laurent series; Cauchy's residue theorem, Residues at Infinity, evaluation of definite integrals using Cauchy's residue theorem, Argument principle and Rouche's theorem. (Chapter 5, Sec: 57, 58, 60,61, Chapter 6, Sect:68, 69-72).

Unit 4
Evaluation of Improper Integrals -Improper Integrals from Fourier Analysis - Jordan's Lemma - Indented Paths - - Definite Integrals Involving Sines and Cosines - Argument Principle (Chapter 7, Sec: 78, 80-82, 85-87).

Unit 5
Linear Transformations-The Transformation w = 1/z - Mappings by 1/z -Linear Fractional Transformations -An Implicit Form -Mappings of the Upper Half Plane, The transformation w=sinz, Mapping by z^2 and Branches of $z^{1/2}$(Chapter 8, Sec: 90-96, 97).

TEXTBOOK
James ward Brown, Ruel V. Churchill, Complex Variables and Applications, Eighth Edition, McGrawHill.

REFERENCES
1. S. Ponnusamy, Foundations of Complex Analysis, 2nd Edition, Narosa Publishing House, 2005.
2. J.W. Brown and R.V. Churchil, Complex Variable and Applications, McGraw Hill, 2008
3. Conway, John B., Functions of One Complex Variable, II, Graduate Texts in Mathematics, 159, Springer-Verlag, New York, 1995.
4. Lars V. Ahlfors, Complex Analysis, 2ndEdition, McGrawHill, New York, 1966.

18MAT308   **Number Theory**   **3 1 0 4**

Unit 1
Divisibility: Definition, properties, division algorithm, greatest integer function (Sec 1.1)
Primes: Definition, Euclid's Theorem, Prime Number Theorem (statement only), Goldbach and Twin Primes conjectures, Fermat primes, Mersenne primes. The greatest common divisor: Definition, properties, Euclid's algorithm, linear combinations and the GCD - The least common multiple: Definition and properties. The Fundamental Theorem of Arithmetic: Euclid's Lemma, canonical prime factorization, divisibility, gcd, and lcm in terms of prime factorizations. Primes in arithmetic progressions: Dirichlet's Theorem on primes in arithmetic progressions (statement only) (Sec 1.2 to 1.5)

Unit 2
Congruences
Definitions and basic properties, residue classes, complete residue systems, reduced residue systems - Linear congruences in one variable, Euclid's algorithm - Simultaneous linear congruences, Chinese Remainder Theorem - Wilson's Theorem - Fermat's Theorem, pseudoprimes and Carmichael numbers - Euler's Theorem (Sec 2.1 to 2.6).

Unit 3
Arithmetic functions
Arithmetic function, multiplicative functions: definitions and basic examples - The Moebius function, Moebius inversion formula - The Euler phi function, Carmichael conjecture - The number-of-divisors and sum-of-divisors functions - Perfect numbers, characterization of even perfect numbers (Sec 3.1 to 3.6).

Unit 4
Quadratic residues
Quadratic residues and nonresidues - The Legendre symbol: Definition and basic properties, Euler's Criterion, Gauss' Lemma - The law of quadratic reciprocity (Sec 4.1 to 4.3).

Unit 5
Primitive roots:
The order of an integer - Primitive roots: Definition and properties - The Primitive Root Theorem: Characterization of integers for which a primitive root exists (Sec 5.1 to 5.3).

Diophantine Equations
Linear Diophantine Equations - Pythagorean triples – Representation of an integer as a Sum of squares (Sec 6.1, 6.3, 6.5).

TEXTBOOK:
James Strayer, 'Elementary Number Theory', Waveland Press, 1994/2002, ISBN 1-57766-224-5

REFERENCE BOOKS:
1. Tom M. Apostol,' Introduction to Analytic Number Theory', Springer, Under Graduate Studies in Mathematics, 1976.
2. Kenneth Rosen, Elementary Number Theory and its Applications, 5th Edition, McGraw Hill.
3. I. Niven, H. Zuckerman, H. Montgomery, An Introduction to the Theory of Numbers, 5th Edition, Wiley.
4. Burton, David M. *Elementary Number Theory*. Allyn and Bacon, 1976.

18MAT381   **Statistics Lab**   **0 0 2 1**

1. Various charts, like, BAR chart, Pi-chart..,
2. Find the central measures for given data.
3. Correlations and regressions
4. Test of Hypothesis
5. ANOVA
6. Control charts

SEMESTER VI

18MAT 311   **Optimization Theory**   **3-1-0-4**

Unit-I

Introduction, Conditions for local minimization. One dimensional Search methods: Golden search method, Fibonacci method, Newton's Method, Secant Method, Remarks on Line Search Sections 7.1 -7.5

Unit II

Gradient-based methods- introduction, the method of steepest descent, analysis of Gradient Methods, Convergence, Convergence Rate. Analysis of Newton's Method, Levenberg-Marquardt Modification, Newton's Method for Nonlinear Least-Squares.

Sections 8.1 - 8.3 and 9.1 – 9.4

Unit-III

Conjugate direction method, Introduction The Conjugate Direction Algorithm, The Conjugate Gradient Algorithm for Non-Quadratic Quasi Newton method – Approximating the inverse Hessian.

Sections 10.1 - 10.4 and 11.1, 11.2

Unit IV

Nonlinear Equality Constrained Optimization- Introduction, Problems with equality constraints Problem Formulation, Tangent and Normal Spaces, Lagrange Condition, Second-Order Conditions, Minimizing Quadratics Subject to Linear Constraints

Sections 19.1 -19.6

Unit V

Nonlinear Inequality Constrained Optimization **-**Introduction - Problems with inequality constraints: Kuhn-Tucker conditions, introduction to projections, Projected Gradient methods, Penalty methods.

Sections 20.1, 20.2, 22.1 – 22.4

Text Book

1. Edwin K.P. Chong, Stanislaw H. Zak, "An introduction to Optimization", 2nd edition, Wiley, 2013.

Reference Books

1. Mokhtar S. Bazarra, Hamit D sherali, C.M. Shetty, "Nonlinear programming Theory and applications", 2nd edition, Wiley , 2004.
2. Mohan C. Joshi and Kannan M. Moudgalya, Optimization: Theory and Practice, Narosa Publishing House, New Delhi, 2004 (Reference)
3. Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", Prentice Hall of India, New Delhi, 2004.
4. S.S. Rao, "Optimization Theory and Applications", Second Edition, New Age International (P) Limited Publishers, 1995.

18MAT312   **Topology**   **3 1 0 4**

Unit 1

Infinite sets, Countable and Uncountable sets, the Axiom of Choice - continuum hypothesis, Well-ordered sets, The maximum principle.

Chapter 1: Sec 7 to 11(Text Book 2)

Unit 2

Metric spaces – Definition and examples - open balls and closed ball – Open Sets, Closed Sets and Convergence Sequences – Continuous Mappings between Metric Spaces – Examples – Complete Metric Spaces.

Chapter 9: Sec 9.1 to 9.4 (Text Book 1)

Unit 3

Compact spaces and their properties – Continuous functions on Compact spaces-Characterization of Compact Metric spaces -Separable Metric Spaces.

Chapter 9: Sec 9.5 and 9.6 (Text Book 1)

Unit 4

Three Fundamental Theorems: The Arzela-Ascoli Theorem – The Baire Category Theorem – The Banach Contraction Principle.

Chapter 10: Sec 10.1 to 10.3 (Text Book 1)

Unit 5

Topological spaces - Basis for a topology - The order topology - The product topology on

$X \times Y$ - The subspace topology-Closed sets and limit points.

Chapter 2: Sec 12 to 17(Text Book 2)

TEXTBOOK:

1. H.L. Royden and P.M.Fitzpatrick - "Real Analysis"-Pearson Education Asia Limited - 2010 - Fourth Edition.

2. *J.R. Munkers- "Topology" -Prentice Hall of India -2002- Second Edition.*

REFERENCE BOOKS :

1.J. Dugundji -" Topology" Allyn and Bacon, Boston-1966.

2.K. D. Joshi -"Introduction to General Topology" Wiley Eastern Limited -2012- Revised Edition

3. Fred H. Croom, Principles of Topology, Cengage Learning.

4.G.F.Simmons-"Introdution to Topology and Modern Analysis" McGraw Hill Education-2004

18MAT313	Special Functions	3-1-0-4

Unit 1

Gamma and Beta Functions and Elliptic Functions.

Part II: 4.1 – 4.11

Unit 2

Special functions , power series solution of differential equations, ordinary point ; Solution about singular points , Frobenius method. Bessel's equation, solution of Bessel's equation, Bessel's functions $J_n(x)$.

Part II: 8.5-8.6, 8.8- 8.10, 11.1, 11.2.

Unit 3

Recurrence Formulae, Equations reducible to Bessel's equation, orthogonalityof Bessel's Functions, A generating function for $J_n(x)$.

Part II: 11.8, 11.10, 11.11.

Unit 4

Legendre's equation, Legendre's polynomial $P_n(x)$, Legendre's function of the second kind [Qn(x)], General solution of Legendre's equation, Rodrigue's formula, Legendre polynomials, A generating function of Legendre's polynomial.

Part II: 9.1-9.4.

Unit 5

Orthogonality of Legendre polynomials, Recurrence formulae for $P_n(x)$ Green's function – Green's Identities – Generalized functions.

Part II: 9.8-9.9, 9.22-9.25.

TEXTBOOK:
M.D. Raisinghania , Ordinary and Partial Differential Equations, S.Chand, 18th edition, 2016

REFERENCES:
1. I. N. Sneddon - Special Functions of mathematical Physics & Chemistry, 3 Oliver & Boyd, London.

2. N. N. Lebedev - Special Functions and Their Applications , PHI.
3. Special Functions, R. Askey and R. Roy, Cambridge.

18MAT314   **Calculus of Variations**   **3 1 0 4**

Calculus of Variations.

Unit 1: ELEMENTS OF THE THEORY: Functionals. Some Simple Variational Problems, Function Spaces, The Variation of a Functional- A Necessary Condition for an Extremum, The Simplest Variational Problem. Euler's Equation, The Case of Several Variables, A Simple Variable End Point Problem, The Variational Derivative, Invariance of Euler's Equation.

FURTHER GENERALIZATIONS: The Fixed End Point Problem for n Unknown Functions, Variational Problems in Parametric Form, Functionals Depending on Higher-Order Derivatives, Variational Problems with Subsidiary Conditions.

THE GENERAL VARIATION OF A FUNCTIONAL Derivation of the Basic Formula, End Points Lying on Two Given Curves or Surfaces, Broken Extremals, The Weierstrass-Erdmann Conditions.

Unit 2: THE CANONICAL FORM OF THE EULER EQUATIONS AND RELATED TOPICS: The Canonical Form of the Euler Equations, First Integrals of the Euler Equations, The Legendre Transformation, Canonical Transformations, Noether's Theorem, The Principle of Least Action, Conservation Laws, The Hamilton-Jacobi Equation. Jacobi's Theorem.

Unit 3: THE SECOND VARIATION. SUFFICIENT CONDITIONS FOR A WEAK EXTREMUM: Quadratic Functionals. The Second Variation of a Functional, The Formula for the Second Variation. Legendre's Condition, Analysis of the Quadratic Functionals $\int_a^b (Ph'^2 + Qh^2)\, dx$, Jacobi's Necessary Condition. More on Conjugate Points, Sufficient Conditions for a Weak Extremum, Generalization to n unknown functions, Connection Between Jacobi's Condition and the Theory of Quadratic Forms. Sufficient conditions for a strong extremum: Consistent Boundary Conditions. General Definition of a Field, The Field of a Functional, Hilbert's Invariant Integral, The Weierstrass E-Function. Sufficient Conditions for a Strong Extremum.

Unit 4: DIRECT METHODS IN THE CALCULUS OF VARIATIONS: Minimizing Sequences, The Ritz Method and the Method of Finite Differences. The Sturm-Liouville Problem.

Integral Equations

Unit 5: Introduction and basic examples, Classification, Conversion of Volterra Equation to ODE, Conversion of IVP and BVP to Integral Equation, The Green's function. Decomposition, direct computation, Successive approximation, Successive substitution methods for Fredholm Integral Equations, series solution, successive approximation, successive substitution method for Volterra Integral Equations, Volterra Integral Equation of first kind, Integral Equations with separable Kernel, Fredholm's first, second and third theorem, Integral Equations with symmetric kernel, Eigen function expansion, Hilbert-

Schmidt theorem, Fredholm and Volterra Integro - Differential equation, Singular and nonlinear Integral Equation.

TEXTBOOKS
*1. I.M.Gelfand and S. V. Francis. Calculus of Variation, Prentice Hall, 1991.(**All the chapters except chapter 7 are included**)*
2. F. G. Tricomi, Integral equations, Dover, 1985.

REFERENCES
1. A. S. Gupta, Calculus of Variations with Applications, PHI 2006.
2. Weinstock, Robert, Calculus of Variations with Applications to Physics and Engineering, Dover, 1974.
3. Cordumeanu, C., Integral Equations and Applications, Cambridge University Press, 1991

18MAT213   Formal Languages and Automata Theory   3 1 0 4

Unit 1
Fundamentals: Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non deterministic finite automaton, transition diagrams and Language recognizers.
Finite Automata: NFA with Î transitions - Significance, acceptance of languages.
Conversions and Equivalence: Equivalence between NFA with and without Î transitions, NFA to DFA conversion, minimisation of FSM, equivalence between two FSM's, Finite Automata with output - Moore and Melay machines.

Unit 2
Regular Languages: Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets (proofs not required).
Unit 3
Grammar Formalism: Regular grammars - right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, sentential forms. Right most and leftmost derivation of strings.

Unit 4
Context Free Grammars: Ambiguity in context free grammars. Minimisation of Context Free Grammars. Chomsky normal form, Greiback normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted).

Push Down Automata: Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion. (Proofs not required). Introduction to DCFL and DPDA.
Unit 5
Turing Machine: Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines (proofs not required).

TEXTBOOKS
1. Hopcroft, Motwani and Ullman, Introduction to Automata Theory Languages andComputation. Third Edition, 2007, Pearson Education, Addison-Wesley.

2. Peter Linz - An Introduction to Formal Languages and Automata (Feb 14, 2011), Fifth Edition Jones & Bartlett.

REFERENCES
1. Daniel I.A. Cohen, Introduction to Computer Theory, John Wiley.
2. John C Martin, Introduction to languages and the Theory of Computation, TMH.
3. Lewis H.P. & Papadimition Elements of Theory of Computation C.H. Pearson /PHI.
4 Mishra and Chandrashekaran, Theory of Computer Science – Automata Languages and Computation 2nd Edition, PHI.

18MAT502   **Advanced Algebra**   **3 1 0 4**

Review: Groups and Rings

Unit 1

Conjugate Elements, Normalizer of an Element, Index of Normalizer, Center of a Group, Cauchy's Theorem on Prime Order, the Number of Conjugate Classes $p(n)$ for a Permutation Group, Counting Principles, Cauchy Theorem, p- Sylow subgroups, Sylow's Theorems. **(Sec. 2.11 and 2.12).**

Unit 2

Normal Subgroups, Isomorphic Groups, External and Internal Direct Products, Cyclic Groups, Abelian Groups, Invariants of a Group, Fundamental Theorem on Finite Abelian Groups **(Sec. 2.13 and 2.14).**

Unit 3

Polynomial Rings over the Rational Field, Primitive Polynomials, The Content of a Polynomial, Integer Monic Polynomial, Eisenstein Criterion, Polynomial Rings over Commutative Rings. Unique Factorisation domain   **(Sec. 3.10 to 3.11).**

Unit 4
Euclidean Domains, Principal Ideal Domains, Unique Factorization Domains, Polynomials in Several Variables over a Field and Grobner Bases. **(Sec. 8.1 to 8.3, 9.6 from Reference Book 1).**

Unit 5
The Elements of Galois Theory, Group of Automorphisms and its fixed field, Galois Group, The Fundamental Theorem of Galois Theory, Solvable Groups, Solvability by Radicals, Galois Groups over the Rationals.
 (Sec. 5.6 to 5.8).

TEXTBOOKS:

1. I. N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.

REFERENCES

1. D.S. Dummit and R. M. Foote, 'Abstract Algebra', 2nd Ed., John Wiley, 2002.
2. M.Artin, 'Algebra', Prentice Hall inc 1994.
3. Joseph Rotman,'Galois Theory', 2nd Ed., Springer, 2001.

Note: The Problems are to be referred from Reference Book 1.

18MAT503   **Advanced Real Analysis**   **3-1-0-4**

Unit 1

Riemann-Stieltjes Integral: Definition and Existence of the Integral, Properties of the Integral, Integration and Differentiation, Integration of vector-valued functions, Rectifiable curves.
(Chapter 6: 6.1 to 6.5)

Unit 2

Sequences and Series of Functions: Sequence of functions and its point-wise limit, Discussion of main problems, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation, Equicontinuous Families of Functions, The Stone-Weierstrass Theorem.
(Chapter 7: 7.1 to 7.7)

Unit 3

Some Special Functions: Introduction to power series, The Exponential and Logarithmic Functions, The Trigonometric Functions, The Algebraic Completeness of the Complex Field.
(Chapter 8: 8.1 to 8.4)

Unit 4

Some Special Functions and Functions of Several Variables: Fourier series, Gamma function and its properties. Linear Transformation, Differentiation.
(Chapter 8 & 9: 8.5 to 8.6. 9.1 to 9.2)

Unit 5

Functions of Several Variables: The Contraction principle, The inverse function theorem, The implicit function theorem
(Chapter 9: 9.3 to 9.5)

TEXTBOOK:

1. *Rudin. W, "Principles of Mathematical Analysis", McGraw-Hill International Editions, Third Edition, 1976.*

REFERENCE BOOKS:

1. *H.L. Royden and P.M.Fitzpatrick, "Real Analysis", Pearson Education Asia Limited, Fourth Edition, 2010.*
2. *Tom M. Apostol, "Mathematical Analysis", Narosa publishing house, New Delhi, Second Edition, 1989.*

18MAT504   **ORDINARY DIFFERENTIAL EQUATIONS**   **3 1 0 4**

Prerequisite: The students must know the basic concepts on ordinary differential equation.

Unit 1
Linear differential equations: Introduction, initial value problems, the wronskian and linear independence, reduction of order of a homogeneous equation, non-homogeneous equation.

TB2 (3.1-3.6)(4 hours)

Existence - Uniqueness of Solutions to First Order Equations: Equations with variable separated, Exact equations, the method of successive approximations, Lipschitz condition, Convergence of successive approximations, Non–local existence of solutions, Approximations to, and uniqueness, of solutions.

TB2 (5.2- 5.8)(10hours)

Unit 2
Systems of first order equations, Existence and uniqueness theorem, fundamental matrix, nonhomogenous linear systems, linear systems with constant coefficients. **TB3 (4.2-4.7)(10 hours)**

An example – central forces and planetary motion, Some special equations.
TB2 (6.2- 6.3)(4 hours)

Unit 3

Complex n-dimensional space, Systems as vector equations, Existence and uniqueness of solutions to systems, Existence and Uniqueness of linear systems, Equations of order n.
TB2 (6.4- 6.8) (10 hours)

Unit 4
Nonlinear equations: Autonomous Systems, The Phase plane and its phenomena, Types of critical points. Stability, critical points and stability for linear systems, Stability by Liapunov's Direct method, stability by eigen values, Simple critical points of nonlinear systems.**TB1 (11.58- 11.62) (10 hours)**

Unit 5
Nonlinear mechanics, Conservative systems, Periodic solutions, The Poincaré–Bendixson theorem.
Oscillations and the Sturm Separation theorem, The Sturm comparison theorem.
TB1 (11.63- 11.64), (4.24-4.25) (7 hours)

TEXTBOOKS:
1. George F. Simmons and John S Robertson, Differential equations with applications and historical notes, Tata McGraw Hill Education Private Limited, Second Edition, 2003.
2. E.A. Coddington, An introduction to ordinary differential equations, PHI learning, 1999.
3. S. G. Deo, V. Lakshmikantham and V Raghavendra, Text book of Ordinary differential equations, McGraw Hill Education Private Limited, second edition, 2013.

REFERENCE:

1. William E. Boyce and Richard C. DiPrima, Elementary differential equations and boundary value problems Wiley india, 9th edition, 2012.

Unit – I Introduction to Probability and Stochastic Processes:

Definition of Stochastic Processes, specification of Stochastic processes, Stationary processes– Markov Chains: definition and examples, higher transition probabilities, Generalization of Independent Bernoulli trails, classification of states and chains.
(Sections: 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4)

Unit – II Markov Processes with Discrete State Space:

Poisson process, Poisson process related distributions, properties of Poisson process, Generalizations of Poisson Processes, Birth and death processes, continuous time Markov Chains.
(Sections: 4.1, 4.2, 4.3, 4.4, 4.5)

Unit – III Markov processes with continuous state space:

Brownian motion – Wiener Process - Differential equations for a Wiener process – Kolmogorov equations – first passage time distribution for Wiener process – Ornstein-Uhlenbech process.
(Sections: 5.1 to 5.6)

Unit – IV Renewal processes and theory:

Renewal process – Renewal processes in continuous time – Renewal equation – stopping time – Wald's equation – Renewal theorems.
(Sections: 6.1 to 6.5)

Unit – V Branching Processes:

Introduction, properties of generating functions of Branching process, Distribution of the total number of progeny, Continuous-Time Markov Branching Process, Age dependent branching process: Bellman-Harris process.
(Sections: 9.1, 9.2, 9.4, 9.7, 9.8)

Text Book:
   1. J. Medhi, "Stochastic Processes", 2nd Edition, New Age International Private limited, 2006.

Book for Reference:
   1. Sheldon M. Ross, "Stochastic Processes", 2ndEdition, Wiley, 1995.
   2. J. Ravichandran, "Probability and Random Processes for Engineers", 1st Edition, IK International, 2015.

18MAT581   **Mathematics Lab**   **0   0   2   1**

- **Introduction to a Mathematical software**
- **Explorations of various applications**
- **Implementation of Mathematical techniques.**

18MAT511   **ADVANCED COMPLEX ANALYSIS**   **3 1 0 4**

Unit 1:
Schwarz Reflection: Schwarz Reflection by complex conjugation, Reflection along analytic Arcs, Application of Schwarz Reflection (Chapter 9)

Unit 2
The Riemann Mapping Theorem: Compact sets in Function Spaces, Statement and Proof of the the Riemann Mapping Theorem, Behaviour at the Boundary (Chapter 10).

Unit 3
Analytic Continuation: Analytic Continuation along a curve, Monodromy Theorem, the Dilogrithm, Bloch-Wigner Function, Picard's Theorem and its Application (Chapter 11)

Unit 4
Entire and Meromorphic Functions: Infinite Products, Absolute Convergence, Weierstrass Products, Functions of Finite Order, Canonical product, Minimum Modulus Theorem, Hadamard's Theorem, Mittag-Leffler Theorem (Chapter 13) .

Unit 5
Elliptic Functions: Liouville Theorem, Fundamental Parallelogram, Elliptic Function, Weierstrass Function, Addition Theorem, Sigma and Zeta Functions (Chapter 14)

TEXTBOOK
Serge Lang, 'Complex Analysis' Springer, 4th Edition, First Indian Reprint 2005.

REFERENCES
1. S. Ponnusamy and H. Silverman, Complex Variables with Applications, Springer, 2006.

2. R. Roopkumar, Complex Analysis, Pearson Education, 2014, Chennai

3. *Lars V. Ahlfors, Complex Analysis, 2ndEdition, McGrawHill, New York, 1966*

18MAT512   **Advanced Topology**   **3 1 0 4**

Unit 1

Continuous Functions :

Continuous functions , homeomorphisms, Rules for Constructing continuos Functions, Pasting Lemma, the product topology, Projection, Box and Product topologies, the metric topology, Metrizable Space, Uniform metric and Uniform Topology, Sequence Lemma, Uniform Convergence, Uniform Limit Theorem.

Chapter 2: Sections 18 to 21

Unit 2 Connectedness:

Connected spaces, separation, connected subspaces of the Real line, Linear Continuum, Intermediate Value Theorem, Path and Pathe connectedness , Components, Path Components, locally connected, Locally Path Connected.

Chapter 3: Sections 23 to 25.

Unit 3 Compactness:

Compact spaces , Covering and Open Covering, Tube Lemma, Finite Intersection Property, Compact subspaces of the Real line, Extreme Value Theorem, Lebesgue Number Lemma, Uniform Continuity Theorem, Limit Point Compactness , Sequentially Compact, Local Compactness Compactification, One Point Compactification,.

Chapter 3: Sections 26 to 29

Unit 4 Countability and Separation Axioms

The First and Second Countability Axioms , The separation Axioms, Regular and Normal spaces, The Urysohn Lemma, Completely Regular Spaces, The Urysohn metrization

Theorem , Imbedding Theorem, The Tietze extension theorem.

Chapter 4: Sections 30 to 35

Unit 5 The Tychonoff Theorem and Baire Space

Tychonoff's Theorem , Baire Spaces, Baire Category Theorem.

 Chapter 5: Section 37 and Chapter 8: Section 48

TEXTBOOK:

J.R. Munkers- "Topology" -Prentice Hall of India -2002- Second Edition.

REFERENCE BOOKS :

1.J. Dugundji -" Topology" Allyn and Bacon, Boston-1966.

2.K. D. Joshi -"Introduction to General Topology" Wiley Eastern Limited -2012- Revised Edition

3.M. A. Armstrong "Basic Topology" Springer (India) – 2005

4.S. Kumaresan-"Topology of Metric Spaces"- Narosa Publishing House, New Delhi, 2011-Second Reprint.

5.G.F.Simmons-"Introdution to Topology and Modern Analysis" McGraw Hill Education-2004

18MAT513   PARTIAL DIFFERENTIAL EQUATIONS   4 0 0 4

Prerequisite: The students must know the basic concepts on Calculus (both differential and integral), Differential Equations (ODE and PDE at UG Level), either metric space or topology to understand the words open set, closed set, compact, connected, region, continuous function, Vector Calculus in which the notion of curves, surfaces, tangent plane, normal, surface integral and volume integral and their evaluation, Fourier series and Fourier transforms.

Unit 1
Geometrical interpretation of a first-order pde, method of characteristics and general solutions, Monge cone, Lagrange's equations, canonical forms of first-order linear equations, method of separation of variables.
Tb1:(2.4-2.8)
Unit 2
Second-order equations in two independent variables, canonical forms, equations with constant coefficients, general solutions.
Tb1: (4.1-4.6)

Unit 3
The Cauchy problem, the Cauchy-Kowalewskaya theorem, homogeneous wave equations, the D'Alembert solution of wave equation, initial boundary-value problems, equations with nonhomogeneous boundary conditions, vibration of finite string with fixed ends,.(review) nonhomogeneous wave equations.
Tb1:(5.1-5.7)

Unit 4

Basic concepts, types of boundary-value problems, maximum and minimum principles, uniqueness and continuity theorems. Dirichlet problem for a circle, Dirichlet problem for a circular annulus, Neumann problem for a circle, Dirichlet problem for a rectangle, Dirichlet problem involving the Poisson equation, the Neumann problem for a rectangle
Tb1:(9.1-9.10)
Unit 5
Derivation of the heat equation and solutions of the standard initial and boundary value problems, uniqueness and the maximum principle, time-independent boundary conditions, time-dependent boundary conditions.**TB2: (3.1-3.4) (10 hours)**

TEXTBOOKS:
  1. Tyn Myint-U, Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers,
      Birkhauser,   Boston, Fourth Edition, 2007.
  2. D. Bleecker, G. Csordas, Basic Partial Differential Equations, Van Nostrand Reinhold, New York, 1992.

REFERENCES:
1. L.C. Evans, Partial Differrential Equations, Graduate Studies in Mathematics, Vol. 19, AMS, Providence, 1998.
2. I.N. Sneddon, Elements of partial differential equations, McGraw Hill, New York, 1986.
3. E. Zauderer, Partial Differential Equations of Applied Mathematics, John Wileys & Sons, New York, 2nd edition, 1989.
4. E. C. Zachmanoglou and D. W. Thoe, Introduction to Partial Differential Equations with Applications, Dover Publication, New York, 1986.

18MAT514   **MEASURE THEORY**   **3 1 0 4**

Unit 1 (Sections: 2.1 to 2.5 of [1])
Measure on the Real Line: Lebesgue Outer Measure - Measurable Sets – Regularity - Measurable Functions - Borel and Lebesgue Measurability

Unit 2 (Sections: 3.1 to 3.4 of [1])
Integration of Functions of a Real Variable: Integration of Non-Negative Functions - The General Integral - Integration of Series - Riemann and Lebesgue Integrals.

Unit 3 (Sections: 5.1 to 5.6 of [1])
Abstract Measure Spaces: Measures and Outer Measures - Extension of a Measure - Uniqueness of the Extension - Completion of a Measure - Measure Spaces - Integration with Respect to a Measure.

Unit 4 (Sections: 6.1 to 6.5 of [1])
Inequalities and the L^p Spaces: The L^p Spaces - Convex Functions - Jensen's Inequality - The Inequalities of Holder and Minkowski - Completenessof$L^p(\mu)$.

Unit 5 (Sections: 8.1 to 8.4 of [1])
Signed Measures and their Derivatives: Signed Measures and the Decomposition - The Jordan Decomposition - The Radon-Nikodym Theorem - Some Applications of the Radon-Nikodym Theorem.

TEXTBOOK:
1. Measure Theory and Integration by G.de Barra. First Edition. New Age International Publishers, Reprint 2000.

Reference Book:

1. Real Analysis by H.L. Royden and P.M.Fitzpatrick. Fourth Edition. Pearson Education Asia Limited, 2010.
2. Elias M. Stein & Rami Shakarchi**,** Real Analysis Measure Theory, Integration, and Hilbert Spaces (Princeton Lectures in Analysis), Princeton university press, 2007.

18MAT515   **NUMERICAL ANALYSIS**   **3 0 0 3**

Prerequisites: Calculus and Algebra

Unit I:

Review of errors and error propagation theorem;

(Roots of Transcendental and Polynomial Equations, Solution of equations in one variable: Rate of convergence for fixed point iteration method and Newton-Raphson method etc.;

System of nonlinear equations: Newton's Method, Steepest-Descent Method; (B1-10.2 and 10.4)

Solution of System of Linear Algebraic Equations: Decomposition method (LU), Ill-conditioned system, Iteration methods: Gauss-Jacobi method, Gauss- Seidel method; (B2-2.2, B2-2.4, B2-2.5)

Eigenvalues and Eigenvectors: Ghershgorin theorem, Inverse power method. (B1-7.2, B3-3.6)

12 Hours

Unit II:

Interpolation, Extrapolation and Approximation: Interpolating polynomials using finite differences, Hermite interpolation, Cubic-Spline interpolation, Richardson's Extrapolation. (B1-3.3, B1-3.4, B1-3.5, B1-4.2)

Numerical Differentiation: Numerical differentiation (Methods based on Interpolation, Finite difference operators, undetermined co-efficient); (B3-5.2)

Numerical integration: Trapezodial, Simpson's 1/3rd, 3/8th rule, Gaussian Quadrature, Multiple integrals. (B1-4.3)

10 Hours

Unit III:

Solutions of Ordinary Differential Equations: System of higher order differential equations, Stability, Stiff Differential equations; (B1-5.9, B1-5.10, B1-5.11)

Boundary value Problems of ODE: Shooting Method (B1-11.1, B1-11.2).

8 Hours

Unit IV:

Solutions of Differential equations: Introduction to Finite element method: Mathematical Background, Finite Elements for ordinary differential equations, Finite Elements for ordinary differential equations, (B2-9.1, 9.2).

10 Hours

Unit V:

Finite Elements for partial differential equations: Heat equations (Parabolic and Elliptic PDE) and Wave equations (Hyperbolic PDE) (B2- 9.3).

10 Hours

TEXTBOOKS:

1. R.L. Burden, J. D. Faires, Numerical Analysis, Richard Stratton, 2011, 9th edition.

2. C. F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Pearson Publishers, 2013,7th edition.

3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for scientific and Engineering computation, New Age International Publishers, 2007, 5th edition.

Reference Books:

4. E. Kreyszig, Advanced Engineering Mathematics, Wiley Publishers, 2015, 10th edition.

5. R.R. Bhat, S. Chakraverty, Numerical Analysis in Engineering, Narosa Publishing House, 2011.

18MAT582   **Numerical Computations Lab**   **0 0 2 1**

- Finite Element Methods using MAT LAB or Finite element tools.

<mark>**SEMESTER IX/SEMESTER III**</mark>

18MAT601   **Advanced Graph Theory**   **3 1 0 4**

Unit 1
Review of Graphs: Graphs and Sub graphs, isomorphism, matrices associated with graphs, degrees, walks, connected graphs, shortest path algorithm.
Trees: Trees, cut-edges and cut-vertices, spanning trees, minimum spanning trees, DFS, BFS algorithms.

Unit 2
Connectivity: Graph connectivity, k-connected graphs and blocks.
Euler and Hamilton Graphs: Euler graphs, Euler's theorem. Fleury's algorithm for Eulerian trails. Necessary / sufficient conditions for the existence of Hamilton cycles, Chinese-postman problem, approximate solutions of traveling salesman problem
Unit 3
Matching: Matchings, maximal matchings. Coverings and minimal coverings. Berge's theorem, Hall's theorem, Tutte's perfect matching theorem, Job assignment problem. Coverings, Independent Sets and Cliques; Basic Relations.

Unit 4
Colorings: Vertex colorings, greedy algorithm and its consequences, Brooks' theorem. Edge-colorings, Vizing theorem on edge-colorings.

Unit 5

Planar graphs: Euler formula. Dual graphs. Kuratowaski's Characterization, Planarity testing algorithm.

TEXTBOOKS
J.A. Bondy and U.S.R. Murty, Graph Theory and Applications, Springer, 2008.

REFERENCES BOOKS
   1. *D.B. West, Introduction to Graph Theory, P.H.I. 2010.*
   2. *Frank Harary, Graph Theory, New York Academy of Sciences, 1979.*
   3. *Russel Merris, Graph Theory, John Wiley, 2011.*

18MAT602   **FUNCTIONAL ANALYSIS**   **3 1 0 4**

Unit 1(Sections: 3.1 to 3.5 of [1])
Normed Linear Spaces: Linear Spaces – Normed Linear Spaces – The Metric on a Normed Linear Space – Linear Subspaces – Bounded Linear Transformations.

Unit 2(Sections: 3.7 to 3.9 and 4.1 to 4.2 of [1])
Linear Homeomorphisms – An Elementary Integral – Regulated Mappings – Integration and Differentiation - Review of Compact Metric Spaces – Basic Results on Compact Subsets of a Metric Space – Separability of Compact Metric Spaces – Conditions Equivalent to Compactness - Borel – Lebesgue Theorem.

Unit 3(Sections: 4.3 to 4.6 of[1])
Compactness and Continuity – Dini's Theorem - Finite Dimensional Normed Linear Spaces – Completeness – Stone Weierstrass Theorem – Weierstrass Theorem on approximation of periodic functions by trigonometric polynomials – Extension of Stone-Weirstrass Theorem to $C_G(X)$ - Separability of $C_K(X)$ - Ascoli-Arzela Theorem – Peano's Theorem.

Unit 4(Sections: 5.1 to 5.4 of [1])
Bounded Linear Functionals – Some Dual Spaces – The Hahn-Banach Theorem – The Existence of Bounded Linear Functionals – Reflexivity of the Banach Space l^p - Annihilators.

Unit 5(Sections: 5.5 to 5.7 of[1])
A Theorem on Convex Sets – The Riesz Representation Theorem – Hergoltz's Theorem.

TEXTBOOKS:
1.   Elements of Functional Analysis by A.L. Brown and A. Page, Van Norstrand Reinhold Company, London,1970.

References:
1. Functional Analysis by Balmohan V Limaye, New Age International Publishers, Third
   Edition, Reprint 2014.
2. Introduction to Topology and Modern Analysis by G. F. Simmons, McGraw Hill Education,
   2004
3.Thamban Nair, Functional Analysis: A First Course, PHI, 2001.

18MAT603   **Basics of Fluid Dynamics**   **3 1 0 4**

Unit 1

Kinematics of Fluids in motion – Lagrangian and Eulerian methods – Equation of continuity – Boundary conditions – Kinematic and physical – steam line, path line and streak line – velocity potential – vorticity - rotational and irrotational motion.

Unit 2

Equation of Motion of Compressible Viscous Fluid (Navier-Stokes Equations) - General Properties – Equation of motion of inviscid fluid – Euler's equation – impulsive force – physical meaning of velocity potential - energy equation.

Unit 3

Lagrange's hydrodynamical equations - Bernoulli's equation and its applications - Motion in two-dimensions and sources and sinks – irrotational motion – complex potential - Milne-Thomson circle theorem – Blasius theorem.

Unit 4

General theory of irrotational motion – flow and circulation – Stoke's theorem – Kelvin's Circulation theorem – Permanence of irrotational motion - Kelvin's minimum energy theorem - Viscous Incompressible flow - Dimensional Analysis – Buckingam π theorem.

Unit 5

Exact Solutions of Navier Stokes Equations – Small Reynold's number flows – flow past a sphere – Stokes flow – Whitehead's paradox - Flow past a circular cylinder – Stoke's Paradox.

TEXT BOOKS / REFERENCES:
1. G.K.Batchelor, "An Introduction to Fluid Dynamics", Cambridge University Press, 1997.
2. L.M. Milne-Thompson, "Theoretical Hydrodynamics", Dover Publications, 1968.
3. Victor L. Streeter and E.Benjamin Wylie, "Fluid Mechanics", Mc Graw Hill, 1983.
4. S.W. Yuan, "Foundations of Fluid Mechanics", Prentice Hall, New Jersey, 1970.

18MAT611   **Operator Theory**   **4 0 0 4**

Compact operators on Hilbert Spaces. (a) Fredholm Theory (b) Index, $C*$- algebras - noncommutative states and representations, Gelfand-Neumark representation theorem, Von-Neumann algebras; projections, double commutant theorem, $L\infty$ functional calculus, Toeplitz operators.

Reference Books:

1. W. Arveson, "An invitation to C*-algebras", Graduate Texts in Mathematics, No. 39. Springer-Verlag, 1976.
2. N. Dunford and J. T. Schwartz, "Linear operators. Part II: Spectral theory. Self adjoint operators in Hilbert space", Interscience Publishers John Wiley i& Sons 1963.
3. R. V. Kadison and J. R. Ringrose, "Fundamentals of the theory of operator algebras. Vol. I. Elementary theory", Pure and Applied Mathematics, 100, Academic Press, Inc., 1983.
4. V. S. Sunder, "An invitation to von Neumann algebras", Universitext, Springer-Verlag, 1987.

SEMESTER X

Two Electives and Dissertation

Electives

18MAT631   **ALGEBRAIC GEOMETRY**   **3 0 0 3**

Unit 1 AFFINE AND PROJECTIVE VARIETIES
Noetherian rings and modules; Emmy Noether's theorem and Hilbert's Basissatz; Hilbert's Nullstellensatz; Affine and Projective algebraic sets; Krull's Hauptidealsatz; topological irreducibility, Noetherian decomposition; local ring, function field, transcendence degree and dimension theory; Quasi-Compactness and Hausdorffness; Prime and maximal spectra; Example: linear varieties, hypersurfaces, curves.

Unit 2 MORPHISMS
Morphisms in the category of commutative algebras over a commutative ring; behaviour under localization; morphisms of local rings; tensor products; Product varieties; standard embeddings like the segre- and the d-uple embedding.

Unit 3 RATIONAL MAPS
Relevance to function fields and birational classification; Example: Classification of curves; blowing-up.

Unit 4 NONSINGULAR VARIETIES
Nonsingularity; Jacobian Criterion; singular locus; Regular local rings; Normal rings; normal varieties; Normalization; concept of desingularisation and its relevance to

Classification Problems; Jacobian Conjecture; relationships between a ring and its completion; nonsingular curves.

Unit 5 INTERSECTIONS IN PROJECTIVE SPACE
Notions of multiplicity and intersection with examples.

TEXTBOOKS / REFERENCES BOOKS
1. Robin Hartshorne, Algebraic Geometry, Graduate Texts in Mathematics (GTM) 8th Printing, Springer, 1997.
2. C. Musili, Algebraic Geometry for Beginners, Texts and Readings in Mathematics 20,   Hindustan Book Agency, 2001.

18MAT633   **ALGEBRAIC TOPOLOGY**   **3 0 0 3**

Unit 1
Geometric Complexes and Polyhedra: Introduction. Examples. Geometric Complexes and Polyhedra; Orientation of geometric complexes.
Simplicial Homology Groups: Chains, cycles, Boundaries and homology groups, Examples of homology groups; The structure of homology groups.

Unit 2
The Euler Poincare's Theorem; Pseudomanifolds and the homology groups of Sn.
[Chapter 1 Sections 1.1 to 1.4 & Chapter 2 Sections 2.1 to 2.5 from the text].
Unit 3
Simplicial Approximation: Introduction; Simplicial approximation; Induced homomorphisms on the Homology groups; The Brouwer fixed point theorem and related results;

Unit 4
The Fundamental Group: Introduction; Homotopic Paths and the Fundamental Group; The Covering Homotopy Property for S1;
[Chapter 3 Sectins 3.1 to 3.4; Chapter 4 Sections 4.1 to 4.3]

Unit 5
Examples of Fundamental Groups; The Relation Between H1(K) and p1(iKi); Covering Spaces: The definition and some examples. Basic properties of covering spaces. Classification of covering spaces. Universal covering spaces. Applications.
[Chapter 4: Sections 4.4, 4.5; Chapter 5 Sections 5.1 to 5.5 from the text]

TEXT BOOK
Fred H. Croom: Basic Concepts of Algebraic Topology, UTM, Springer, NY, 1978.

REFERENCES BOOKS:
1. Eilenberg S and Steenrod N: Foundations of Algebraic Topology, Princetion Univ. Press, 1952.

2. S.T. Hu: Homology Theory, Holden-Day, 1965.
3. S.T. Hu: Homology Theory, Academic Press, 1959.

18MAT634   **CODING THEORY**   **3 0 0 3**

Unit 1 Introduction to linear codes and error correcting codes. Encoding and decoding of a linear code,

Unit 2 Dual codes. Hamming codes and perfect codes.

Unit 3 Cyclic codes. Codes with Latin Squares, Introduction to BCH codes.

Unit 4 Weight ennumerators and MDS codes.

Unit 5 Linear coding theory problems and conclusions.

TEXT BOOKS:
1.   Raymond Hill, A first course in Coding Theory, Clarandon Press, Oxford (1986).
2.   J.H. Van Lint, Introduction to Coding Theory, Springer (1998).
REFERENCES
1. W. Cary Huffman and Versa Pless, Fundamentals of Error Correcting Codes,
*   Cambridge University Press (2003).*
2. W.W. Peterson, Error Correcting Codes, Cambridge, MA MIT Press (1961).
3. V. Pless, W.C. Huffman and R.A. Brualdi, An Introduction to Algebraic Codes, in Hand book of coding theory, Eds. Amsterdam Elsevier (1998).

18MAT635   **COMMUTATIVE ALGEBRA**   **3 0 0 3**

Unit 1 Rings and ideals, modules and operations on them (tensor product, Hom, direct sum and product).

Unit 2 Rings and modules of Fractions, primary decomposition.

Unit 3 Integral dependence and Valuations, Chain Conditions.

Unit 4 Noetherian Rings and Artin Rings.

Unit 5 Discrete valuation Rings and Dedekind Domains, Dimension theory.

TEXT BOOKS / REFERENCES
1. Atiyah-Macdonald, Commutative Algebra, Westview Press, 1994.
2. Zariski and Samuel, Commutative Algebra I, II , Springer, 1991.
3. Eisenbud, Commutative Algebra with a View Towards Algebraic Geometry,
Springer, 1995.
4. Bourbaki, Commutative Algebra, Springer, 1989.

18MAT636　　　　　　**LIE ALGEBRA**　　　　　**3 0 0 3**

Unit 1 Basic Concepts - Definition and Examples, Lie Algebra of Derivations, Adjoint Representation, Structure Constants, Direct Sums, Homomorphism and Isomorphisms, Ideals, Centre and Derived Algebra of a Lie Algebra, Simple Lie Algebras, The Normalizer of a Subalgebra and Centralizer of a Subset in Lie Algebras, Automorphism and Inner Automorphism of a Lie Algebra. (Book 1, Chapters 1 and 2).

Unit 2 Descending Central Series of a Lie Algebra, Nilpotent Lie Algebras. Derived Series of a Lie Algebra, Radical of a Lie Algebra, Solvable Lie Algebras, Engel's Theorem. (Book 1, Chapter 3).

Unit 3 Semisimple Lie Algebras - Theorems of Lie and Cartan, Jordan-Chevalley Decomposition, Cartan's Criterion. (Book 1, Chapter 4)

Unit 4 Killing Form, Inner Derivations, Abstract Jordan Decomposition, Complete Reducibility of Lie algebras. (Book 1, Chapter 5)

Unit 5 The Weyl Group, Root Systems. (Book 1, Chapter 10)

TEXT BOOKS / REFERENCES BOOKS
1. Jacobson, Lie Algebras, Dover, 1979.
2. J.P. Serre, Lie Algebras and Lie Groups, Benjamin, 1965 (Translated from French).
3. J.E. Humphreys, Introduction to Lie Algebras and Representation Theory, Springer-Verlag, 1980.

18MAT637　　　　　**THEORY OF MANIFOLDS**　　　　　**3 0 0 3**

Unit 1
Definition of Manifolds, Differentiable and Analytic Manifolds, Examples of Manifolds, Product of Manifolds, Mappings between Manifolds, Submanifolds, Tangent Vectors.

Unit 2
Differentials, The Differential of a Function, Infinitesimal Transformation, Tangent Space, Tangent Vector.

Unit 3
Cotangent Space, Vector Fields, Smooth Curve in a Manifold. Differential Forms− k-forms, Exterior Differential, its Existence and Uniqueness.

Unit 4
Exact Differential Forms. De Rham Cohomology Group, Betti Number, Poincare's Lemma, Inverse Function Theorem, Implicit Function Theorem and its Applications,

Integral Curve of a Smooth Vector Field.

Unit 5
Orientable Manifolds− Definition and Examples. Smooth Partition of Unity− Definition and Existence. Riemannian Manifolds− Definition and Examples.

TEXTBOOKS / REFERENCES:
1.   *P.M.Cohn, "Lie Groups", Cambridge University Press, 1965.*
2.   *Claude Chevalley, "Theory of Lie Groups", Fifteenth Reprint, Princeton University Press, 1999.*

18MAT638   Linear Algebra and its Applications   3 0 0 3

Unit 1 Review: Vector Spaces.
Inner Products, Angle and Orthogonality in Inner Product Spaces, Length of a Vector, Schwarz Inequality, Orthogonal Vectors, Orthogonal Complement, Orthogonal Bases: Gram-Schmidt Process.   **(Sec. 4.4)**

Unit 2 The Algebra of Linear Transformations, Characteristic Roots, Invertible Linear transformations, Characteristic Roots, Characteristic Vector, Minimal Polynomial, Matrices, Matrix of a Linear Transformation.   **(Sec. 6.1 to 6.3).**

Unit 3 Canonical Forms: Triangular, Nilpotent Transformations, Jordan and Rational Canonical Form, invariant subspaces, cyclic subspaces.
(Sec. 6.4 to 6.6).

Unit 4 Trace and Transpose, Determinants, Symmetric and Skew Symmetric Matrices, Adjoint and Hermitian Adjoint of a Matrix, Hermitian, Unitary and Normal Transformations, Self Adjoint and Normal Transformations.   **(Sec. 6.8 to 6.10)**

Unit 5 Problems in Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections.
(Sec. 7.1 to 7.3 and 9.5 to 9.6 from Reference Book 2)

TEXT BOOK:
1. I. N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.
REFERENCES:
1. David C. Lay, Linear Algebra and its Applications, Pearson.
2. Gilbert Strang,' Linear Algebra and its Applications, Fourth Edition, Cengage
   Learning, 2014.
3. Howard Anton and Chris Rorres, 'Elementary Linear Algebra', 9th Edition, Wiley,
   2005.
4. Nabil Nassif, Jocelyne Erhel, Bernard Philippe, Introduction to Computational Linear
   Algebra, CRC press, 2015.

18MAT641   **FIXED POINT THEORY**   **3 0 0 3**

Unit 1 Contraction Principle, and its variants and applications;

Unit 2 Fixed points of non-expansive maps and set valued maps, Brouwer-Schauder fixed point theorems,

Unit 3 Ky Fan Best Approximation Theorem, Principle and Applications of KKM - maps, their variants and applications.

Unit 4 Fixed Point Theorems in partially ordered spaces and other abstract spaces.

Unit 5 Application of fixed point theory to Game theory and Mathematical Economics.

TEXTBOOKS / REFERENCES BOOKS
1. *M.A. Khamsi and W.A. Kirk, An Introduction to Metric Spaces and Fixed Point Theory, Wiley - Inter Sci. (2001).*
2. *Sankatha Singh, Bruce Watson and Pramila Srivastava, Fixed Point Theory and Best Approximation: The KKM - map Principle, Kluwer Academic Publishers, 1997.*
3. *Kim C. Border, Fixed Point Theorems with Applications to Economics and Game Theory, Cambridge University Press, 1985.*

18MAT642   **FRACTALS**   **3 0 0 3**

Unit 1 Classical Fractals, Self-similarity - Metric Spaces, Equivalent Spaces.

Unit 2 The Space of Fractals, Transformation on Metric Spaces.

Unit 3 Contraction Mapping and Construction of fractals from IFS.

Unit 4 Fractal Dimension, Hausdorff measure and dimension, Fractal Interpolation Functions.

Unit 5 Hidden Variable FIF, Fractal Splines, Fractal Surfaces, Measures on Fractals.

TEXT BOOKS
1. *M.F. Barnsley, Fractals Everywhere, Academic Press, 1993.*
2. *P.R. Massopust, Interpolation and Approximation with Splines and Fractals, Oxford University Press, 2009.*
3. *K. Falconer, Fractal Geometry (Mathematical Foundations and Applications), John Wiley & Sons, 2003.*

REFERENCES
1. P.R. Massopust, Fractal Functions, Fractal Surfaces and Wavelets, Academic Press, 1994.

2. *Heinz-Otto Peitgen and Peter Richter, The Beauty of Fractals, Springer, 1986.*
3. *Richard M. Crownover, Introduction to Chaos and Fractals, Jones and Bartlett Publishers, 1995.*
4. *Gerald A. Edgar, Measure, Topology and Fractal Geometry, Springer, 1990.*
5. *M.F. Barnsley, Superfractals, Academic Press, 2006.*
6. *B.B. Mandelbrot, The Fractal Geometry of Nature, Freeman, 1981.*

18MAT643   **HARMONIC ANALYSIS**   **3 0 0 3**

Unit 1 Fourier series and integrals – Definitions and easy results – The Fourier transform – Convolution – Approximate identities – Fejer's theorem – Unicity theorem – Parselval relation – Fourier Stieltjes Coefficients – The classical kernels.

Unit 2 Summability – Metric theorems – Pointwise summability – Positive definite sequences – Herglotz;s theorem – The inequality of Hausdorff and Young.

Unit 3 The Fourier integral – Kernels on R. The Plancherel theorem – Another convergence theorem – Poisson summation formula – Bachner's theorem – Continuity theorem.

Unit 4 Characters of discrete groups and compact groups – Bochners' theorem – Minkowski's theorem.

Unit 5 Hardy spaces - Invariant subspaces – Factoring F and M. Rieza theorem – Theorems of   Szego and Beuoling.

TEXT BOOK:
Content and Treatment as in Henry Helson, Harmonic Analysis, Hindustan Book Agency, Chapters 1.1 to 1.9, 2.1 to 3.5 and 4.1 to 4.3

 18MAT644   NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS   3 0 0 3

Review of first order equations and characteristics.
Unit 1 Weak solutions to hyperbolic equations - discontinuous solutions, shock formation, a formal approach to weak solutions, asymptotic behaviour of shocks.

Unit 2 Diffusion Processes - Similarity methods, Fisher's equation, Burgers' equation, asymptotic solutions to Burgers' equations.

Unit 3 Reaction diffusion equations - traveling wave solutions, existence of solutions, maximum principles and comparison theorem, asymptotic behaviour.

Unit 4 Elliptic equations - Basic results for elliptic operators, eigenvalue problems, stability and bifurcation.

Unit 5 Hyperbolic system.

TEXT BOOK
J David Logan, An Introduction to Nonlinear Partial Differential Equations, John Wiley and Sons, Inc., 1994

18MAT645   **WAVELETS ANALYSIS**   **3 0 0 3**

Unit 1 Basic Properties of the Discrete Fourier Transform, Translation - Invariant Linear Transformations. The Fast Fourier Transform.

Unit 2 Construction of Wavelets on z_N, The First Stage Construction of Wavelets on z_N, The Iteration Step"s. Examples and Applications, $l2(Z)$

Unit 3 Complete Orthonormal Sets in Hilbert Spaces, $L_2([-\pi, \pi))$ and Fourier Series, The Fourier Transform and Convolution on $L_2(Z)$, First-Stage Wavelets on z
The Iteration Step for Wavelets on Z , Implementation and Examples.

Unit 4 $L_2(R)$ and Approximate Identities, The Fourier Transform on R, Multiresolution Analysis and Wavelets,

Unit 5 Construction of Multiresolution Analyses, Wavelets with Compact Support and Their Computation.

TEXT BOOK:
Michael W. Frazier, An Introduction to Wavelets Through Linear Algebra, Springer, 1999.

REFERENCES:
1.   Daubechis, Ten Lectures on Wavelets, SIAM, 1992.
2.   S. Mallat, A Wavelet Tour of Signal Processing, Elsevier, 2008.

18MAT646   **MATHEMATICAL PHYSICS**   **3 0 0 3**

Objective: This course intends to introduce applications of various mathematical techniques to problems of Theoretical Physics. Examples could be chosen from all 4 traditional divisions of Modern Fundamental Theoretical Physics – Classical Mechanics, Electrodynamics, Quantum Mechanics and Statistical Physics.

Unit 1

Vector calculus and applications in electromagnetic theory and fluid mechanics.

Unit 2
Introduction to tensor calculus: review of basics, index notation, tensors in physics and geometry, Levi-Civita tensor, transformations of vectors, tensors and vector fields, covariance of laws of physics.

Unit 3
Calculus of variations and extremal problems, Lagrange multipliers to treat constraints, Introduction to the Lagrangian and Hamiltonian formulations of classical mechanics with applications.

Unit 4
Gamma and Beta functions, Dirac delta function, Special functions, Review of Legendre, Bessel functions and spherical harmonics (with applications to Quantum mechanics), series solutions, generating functions, orthogonality and completeness,

Unit 5
Applied linear algebra: Dirac notation, dual vectors, projection operators, symmetric hermitian, orthogonal and unitary matrices in physics, diagonalization, orthogonality and completeness of eigenvectors, spectral decomposition and representation, simultaneous diagonalization, normal matrices, applications to coupled vibrations, Schrodinger equation in matrix form.

TEXT BOOKS:
1. *Arften and Weber, Mathematical Methods for Physics, Elsevier, 6th Ed., 2005.*
2. *Riley, Hobson and Bence, Mathematical Methods for Physics and Engineering, Cup, 3rd Edition, 2010.*

18MAT651   QUEUING THEORY AND INVENTORY CONTROL THEORY   3 0 0 3

Unit 1 Inventory concept – Components of Inventory model.

Unit 2 Deterministic Continuous Review model - Deterministic Periodic Review model.

Unit 3 The classical EOQ – Non zero lead time – EOQ with shortages allowed.

Unit 4 Deterministic Multiechelon Inventory models for supply chain management.

Unit 5
A stochastic continuous review model – A stochastic single period model for perishable products.

TEXT BOOKS

1. F S Hillier and Gerald J Lieberman, *Introduction to Operations research, 8th edition, McGraw Hill.*
2. *Ravindran, Phillips and Solberg, Operations research Principles and Practice, 2nd Edition, John Wiley & Sons.*

18MAT653   STATISTICAL PATTERN CLASSIFICATIONS   3 0 0 3

Unit 1 Introduction and Bayesian Decision Theory
Introduction – Pattern recognition systems – the design cycle – learning and adaptation – Bayesian decision theory – continuous features – Minimum error rate classification – discriminant functions and decision surfaces – the normal density based discriminant functions.

Unit 2 Maximum-likelihood and Bayesian Parameter Estimation
Maximum likelihood estimation – Bayesian estimation - Bayesian parameter estimation – Gaussian case and general theory – problems of dimensionality – components analysis and discriminants – hidden Markov models.

Unit 3 Nonparametric Techniques and Linear Discriminant Functions
Nonparametric techniques – density estimation – Parzen windows – nearest neighborhood estimation – rules and metrics – linear discriminant functions and decision surfaces – generalized linear discriminant functions – two-category linearly separable case – minimizing the perception criterion function.

Unit 4 Nonmetric methods and Algorithm-independent Machine Learning
Nonmetric methods – decision trees – CART methods – algorithm-independent machine learning – lack of inherent superiority of any classifier – bias and variance for regression and classification – resampling or estimating statistics – estimating and comparing classifiers.

Unit 5 Unsupervised Learning and Clustering
Unsupervised learning and clustering – mixture densities and identifiability – maximum likelihood estimates – application to normal mixtures – unsupervised Bayesian learning – data description and clustering – criterion functions for clustering – hierarchical clustering – component analysis – low-dimensional representations and multi-dimensional scaling.

TEXT AND REFERENCE BOOKS:

1. *Richard O. Duda, Peter E. Hart and David G. Stork, Pattern Classification, Second Edition, 2003, John Wily & Sons.*
2. *Earl Gose, Richard Johnson baugh and Steve Jost, Pattern Recognition and Image Analysis, 2002, Prentice Hall of India.*

18MAT654   STATISTICAL QUALITY CONTROL AND SIX SIGMA QUALITY ANALYSIS   3 0 0 3

Unit 1 Introduction to Quality Management – Japanese System of Total Quality Management.

Unit 2 Quality Circles - 7 Quality Control tools - 7 New Quality Control tools.

Unit 3 ISO 9000 Quality system Standards - Project Planning, Process and measurement system capability analysis - Area properties of Normal distribution.

Unit 4 Metrics of Six sigma, The DMAIC cycle - Design for Six Sigma - Lean Sigma – Statistical tools for Six Sigma.

Unit 5 Taguchi methods. Loss functions and orthogonal arrays and experiments.

TEXT AND REFERENCE BOOKS
*1.	Ravichandran. J, Probability and Statistics for Engineers, 1st Edition 2012 (Reprint), Wiley India.*
*2.	Montgomery Douglas C., Introduction to Statistical Quality Control, Sixth Edition. John Wiley & Sons, (2008).*
*3.	Ishikawa K., Guide to Quality Control, 2nd Edition: Asian Productivity Organization, Tokyo (1983).*
*4.	Taguchi G, Introduction to Quality Engineering: Designing Quality into Products and Processes Second Edition. (1991).*
*5.	Harry, M and Schroeder R., Six Sigma: The Breakthrough Management Strategy. Currency Publishers, USA. (2000).*

**18MAT655	THEORY OF SAMPLING AND DESIGNS OF EXPERIMENTS	3 0 0 3**

Unit 1
Stratified random sampling, estimation of the population mean, total and proportion, properties of estimators, various methods of allocation of a sample, comparison of the precisions of estimators under proportional allocation, optimum allocation and srs. Systematic sampling. Comparison of systematic sampling - srs and stratified random sampling for a population with a linear trend.

Unit 2
Unbiased ratio type estimators - Hartly-Ross estimator, regression method of estimation. Cluster sampling, single stage cluster sampling with equal and unequal cluster sizes, estimation of the population mean and its standard error. Two-stage cluster sampling with equal and unequal cluster sizes, estimation of the population mean and its standard error.

Unit 3
Unequal probability sampling, PPS sampling with and without replacement, cumulative total method, Lahiris method, Midzuno-Zen method, estimation of the

population total and its estimated variance under PPS wr sampling, ordered and unordered estimators of the population total under PPS wor, Horwitz – Thomson estimator.

Unit 4
Elementary concepts (one and 2 way classified data) Review of elementary design (CRD, RBD, LSD) Missing plot technique in RBD and LSD with one and two missing values, Gauss-Markov theorem, BIBD: Elementary parametric relations, Analysis, PBIBD.

Unit 5
General factorial experiments, factorial effects, best estimates and testing the significance of factorial effects, study of 2^3 and 2^4 factorial experiments.

TEXT AND REFERENCE BOOKS

1. Cochran, W.C. Sampling Techniques, Third Edition, Wiley Eastern, (1977).
2. Des Raj, Sampling Theory, Tata McGraw Hill, New Delhi, (1976).
3. Murthy, M.N., Sampling Theory, Tata McGraw Hill, New Delhi, (1967).

18MAT656	TIME SERIES ANALYSIS	3 0 0 3

Unit 1 Time series, components of time series, additive and multiplicative models, determination of trend, analysis of seasonal fluctuations.

Unit 2 Test for trend and seasonality, exponential and moving average smoothing, holt-winter smoothing, forecasting based on smoothing.

Unit 3 Time series as a discrete parameter stochastic process, auto covariance and auto correlation functions and their properties, stationary processes, test for stationarity, unit root test, stationary processes in the frequency domain, spectral analysis of time series.

Unit 4 Detailed study of the stationary processes: moving average (MA), autoregressive (AR), autoregressive moving average (ARMA) and autoregressive integrated moving average (ARIMA) models.

Unit 5 Estimation of ARMA models, maximum likelihood method (the likelihood function for a Gaussian AR(1) and a Gaussian MA(1)) and Least squares, Yule-Walker estimation for AR Processes, choice of AR and MA periods, forecasting, residual analysis and diagnostic checking.

TEXT BOOKS
1. Anderson, T.W. The Statistical Analysis of Time Series, John Wiley, New York, 1971.

2. Box, G.E.P. and Jenkins, G.M. Time Series Analysis- Forecasting and Control, Holden-day, San Francisco,1976.
3. Kendall, Sir Maurice and Ord, J.K., Time Series, Edward Arnold, London, 1990.

18MAT661   **ADVANCED BOUNDARY LAYER THEORY   3 0 0 3**

Unit 1
Introduction – limitations of ideal fluid dynamics – Importance of Prandtl's boundary layer theory - boundary layer equations in two dimensional flows – boundary layer flow over a flat plate – Blasius solution – Boundary layer over a wedge.

Unit 2
Energy integral equation for two-dimensional laminar boundary layers in incompressible flow – application of Von Karman's integral equations to boundary layer with pressure gradient.

Unit 3
Displacement, momentum, energy thickness – axially symmetric flows – momentum equation for laminar boundary layer by von Karman – Wall shear and drag force on a flat plate due to boundary layer – coefficient of drag. Boundary layer equations for a 2D viscous incompressible fluid over a plane wall – Similar solutions – Separation of boundary layer flow.

Unit 4
Hydromagnetic Boundary layers – Hartman Layer – MHD Blasius flow. Thermal boundary layers – thermal boundary layer equation in two dimensional flow – Thermal boundary layers with and without coupling of velocity and temperature field – forced convection in a laminar boundary on a flat plate.

Unit 5
Polhausen's method of exact solution for the velocity and thermal boundary layers in free convection from a heated plate – thermal energy integral equation. Boundary layer control using suction and injection.

TEXT BOOKS / REFERENCES:
1. H.Schlichting and K.Gersten, "Boundary Layer Theory", Eighth Edition, Springer, 2000.
2. L. Rosenhead, "Laminar Boundary Layers", Dover, 1988.
3. G.K.Batchelor, "An Introduction to Fluid Dynamics", Cambridge University Press,1993.
4. P.H.Roberts , "An Introduction to MHD" , Longmans, 1967.

18MAT662   **COMPUTATIONAL FLUID DYNAMICS**   **3 0 0 3**

Unit 1 Review of Conservation equations for mass, momentum and energy; coordinate systems; Eulerian and Lagrangian approach, Conservative and non-conservative forms of the equations, rotating co-ordinates.

Unit 2 Classification of system of PDEs: parabolic elliptic and hyperbolic; Boundary and initial conditions; Overview of numerical methods; Review of Finite Difference Method, Introduction to integral method, method of weighted residuals, finite elements finite volume method & least square method.

Unit 3 Numerical Grid Generation: Basic ideas, transformation and mapping, unstructured grid generation, moving grids, unmatched meshes. Finite Volume Method: Basic methodology, finite volume discretization, approximation of surface and volume integrals, interpolation methods - central, upwind and hybrid formulations and comparison for convection-diffusion problem; Basic computational methods for compressible flows.

Unit 4 Advanced Finite Volume methods: FV discretization in two and three dimensions, SIMPLE algorithm and flow field calculations, variants of SIMPLE, Turbulence and turbulence modelling, illustrative flow computations.

Unit 5 Introduction to turbulence modelling, CFD methods for compressible flows.

TEXT BOOKS / REFERENCE BOOKS:
1. Anderson D A, Tannehill J C, and Pletcher R H, Computational Fluid Mechanics and Heat Transfer, 2nd edition, Taylor & Francis, 1997.
2. Ferziger, J. H. and Peric, M., Computational Methods for Fluid Dynamics, 3rd edition, Springer. 2003.

18MAT663   **FINITE ELEMENT METHOD**   **3 0 0 3**

Unit 1 Finite Element Method: Variational formulation - Rayleigh-Ritz minimization - weighted residuals - Galerkin method applied to boundary value problems.

Unit 2 Global and local finite element models in one dimension - derivation of finite element equation.

Unit 3 Finite element interpolation - polynomial elements in one dimension, two dimensional elements, natural coordinates, triangular elements, rectangular elements, Lagrangian and Hermite elements for rectangular elements - global interpolation functions.

Unit 4 Local and global forms of finite element equations - boundary conditions - methods of solution for a steady state problem - Newton-Raphson continuation.

Unit 5 One dimensional heat and wave equations.
TEXT AND REFERENCE BOOKS

1.   *J.N .Reddy, An Introduction to the Finite Element Method, McGraw Hill, NY.*
2.   *Chung, Finite Element Analysis in Fluid Dynamics, McGraw Hill Inc.*

18MAT664   **MAGNETO-HYDRO DYNAMICS**   **3 0 0 3**

Unit 1
Electromagnetic field equations – Maxwell's equations - Electromagnetic effects and the magnetic Reynolds number – induction equation. Alfven's Theorem – Ferraro's Law of irrotation – Electromagnetic stresses.

Unit 2
Magnetohydrostatics and steady states – Hydromagnetic equilibria and Force free magnetic fields ——Chandrasekhar's theorem – General solution of force free magnetic field when**Error! Objects cannot be created from editing field codes.** is constant – Some examples of force free fields.

Unit 3
Steady laminar motion – Hartmann flow. Tensor electrical conductivity, Hall current and ion slip – simple flow problems with tensor electrical conductivity.

Unit 4
Magnetohydrodynamic waves - Alfven waves – Stability of hydromagnetic systems - Normal mode analysis - Squire's theorem – Orr-Sommerfield equation – Instability of linear pinch – Flute instability – A general criterion for stability.

Unit 5 Bernstein's method of small oscillations – Jeans Criterion for Gravitational stability – Chandrasekhar's generalization for MHD and rotating fluids.

TEXT BOOKS / REFERENCES:
1. Ferraro, V.C.A and Plumpton, C., "An Introduction to Magneto-Fluid Mechanics",
Clarendon Press, Oxford, 1966.
2. M.R. Crammer, and Shi-I Pai, "Magneto-Fluid Dynamics for Engineers and Applied
Physicists", Scripta Publishing Company, Washington, 1973.
3. P.H. Roberts, "An Introduction to Magnetohydrodynamics", Longmans, Green and Co,
London, 1967.

4.S. Chandrasekhar, "Hydrodynamic and Hydromagnetic Stability", Dover Publications, 1981.

18MAT665   MATHEMATICAL FOUNDATIONS OF INCOMPRESSIBLE FLUID FLOW   3 0 0 3

Unit 1 Kinematics of Fluids in motion – Lagrangian and Eulerian methods – Equation of continuity – Boundary conditions – Kinematic and physical – steam line, path line and streak line – velocity potential – vorticity - rotational and irrotational motion.

Unit 2 Equation of Motion of Compressible Viscous Fluid (Navier-Stokes Equations) - General Properties – Equation of motion of inviscid fluid – Euler's equation – impulsive force – physical meaning of velocity potential - energy equation.

Unit 3 Lagrange's hydrodynamical equations - Bernoulli's equation and its applications - Motion in two-dimensions and sources and sinks – irrotational motion – complex potential - Milne-Thomson circle theorem – Blasius theorem.

Unit 4 General theory of irrotational motion – flow and circulation – Stoke's theorem – Kelvin's Circulation theorem – Permanence of irrotational motion - Kelvin's minimum energy theorem - Viscous Incompressible flow - Dimensional Analysis – Buckingam**Error! Objects cannot be created from editing field codes.** theorem.

Unit 5 Exact Solutions of Navier Stokes Equations – Small Reynold's number flows – flow past a sphere – Stokes flow – Whitehead's paradox - Flow past a circular cylinder – Stoke's Paradox.

TEXT BOOKS / REFERENCES:
1. G.K. Batchelor, "An Introduction to Fluid Dynamics", Cambridge University Press, 1997.
2. L.M. Milne-Thompson, "Theoretical Hydrodynamics", Dover Publications, 1968.
3. Victor L. Streeter and E. Benjamin Wylie, "Fluid Mechanics", Mc Graw Hill, 1983.
4. S.W. Yuan, "Foundations of Fluid Mechanics", Prentice Hall, New Jersey, 1970.

18MAT671   DATA STRUCTURES AND ALGORITHMS   3 0 0 3
(Pre-requisite: Data Structures and Algorithms.

Unit 1 Introduction: growth functions – recurrence relation – methods – master method. Sorting: bubble – insertion sort – selection sort.

Unit 2 Divide and conquer: quick sort – merge sort – bucket sort – lower bounds – heap sort – comparisons of sorting.

Unit 3 Greedy algorithm: fractional knapsack problem – task scheduling problem. Dynamic programming: matrix multiplication problem – 0-1 knapsack.

Unit 4 Graph algorithms: graph traversal (DFS, BFS with analysis) – biconnected components – strong connectivity; shortest path algorithms (along with analysis) –

Dijkstra – Bellman Ford – Floyd Warshall. All pairs shortest path algorithm – minimum spanning tree (with analysis) – Kruskal – Prim's – Baruvka's.

Unit 5
NP problems: definition, P, NP, NP complete, NP hard & co-NP, examples – P, NP.

TEXT BOOK
Goodrich M T and Tamassia R, Algorithm Design Foundations, Analysis, and Internet Examples, John Wiley and Sons, 2002.

REFERENCES
1.   Baase S and Gelder A V, ``Computer Algorithms – Introduction to Design and Analysis, Pearson Education Asia, 2002.
2.   Cormen T H, Leiserson C E, Rivest R L and Stein C, Introduction to Algorithms, Prentice Hall of India Private Limited, 2001.
3.   Dasgupta S, Papadimitriou C and Vazirani U, Algorithms, Tata McGraw-Hill, 2009.
4.   Horowitz E, Sahni S and Rajasekaran S, Fundamentals of Computer Algorithms, Galgotia, 1998.

18MAT673   COMPUTER AIDED DESIGN OF VLSI CIRCUITS   3 0 0 3

Unit 1
Introduction of Design Methodologies and Graph Theory: The VLSI Design Problems - Design Methods – Design Cycle – Physical Design Cycle - Design Styles.

Unit 2
Algorithmic and System Design - Structural and Logic Design - Layout Design. Graph terminologies – Data structures for the representation of Graphs – Algorithms: DFS – BFS - Dijkstra's shortest path algorithm – Prim's algorithm for minimum spanning trees. Combinatorial Optimization Problems – Complexity Class – P - NP Completeness and NP Hardness problems.

Unit 3
Placement, Partitioning and Floor Planning: Types of Placement Problems – Placement Algorithms – K-L Partitioning Algorithm. Optimization Problems in Floor planning - Shape Function and Floor plan Sizing.

Unit 4
Routing and Compaction: Types of Routing Problems – Area Routing – Channel Routing – Global Routings.

Unit 5 1D and 2D Compaction. Gete level – Switch level Modeling and Simulations.

TEXT BOOK / REFERENCES:
1.   Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2000.

2. *Naveed Sherwani, "Algorithms for VLSI Physical Design Automation", Second Edition, Kluwer Academic Publishers, 1995.*
3. *Sadiq M Sait and Habib Youssef, "VLSI Physical Design Automation: Theory and Practice", IEET, 1999.*
4. *M. Sarrafzadeh and C. K. Wong, An Introduction to VLSI Physical Design, McGraw- Hill, New York, NY, 1996.*
5. *Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, Tata McGraw Hill, 1994*

18MAT674   **CRYPTOGRAPHY**   **3 0 0 3**

Unit 1 Classical ciphers: Cryptanalysis of classical ciphers, Probability theory, Perfect security.
Block ciphers: DES, AES, Block cipher modes of operation.

Unit 2 Private-key encryption: Chosen plaintext attacks, Randomised encryption, Pseudorandomness, Chosen cyphertext attacks.

Unit 3 Message authentication codes: Private-key authentication, CBC-MAC, Pseudorandom functions, CCA-secure private-key encryption.

Unit 4 Hash function: Integrity, Pre-image resistance, 2nd pre-image resistance, Collision freeness.
Key distribution: Key distribution centres, Modular arithmetic and group theory, Diffie-Hellman key exchange.

Unit 5 Public-key Distribution: ElGamal encryption, Cramer-Shoup encryption, Discrete logarithm problem.
Digital Signatures: RSA signatures, RSA-FDH and RSA-PSS signatures, DSA signatures.

TEXT / REFERENCE BOOKS:
1. Katz and Lindell, Introduction to Modern Cryptography. Second Edition, Chapman & Hall/ CRC Press, 2014.
2. Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press.
3. Hans Delfs, Helmut Knebl, "Introduction to Cryptography, Principles and Applications", Springer Verlag.

18MAT675   **FUZZY SETS AND ITS APPLICATIONS**   **3 0 0 3**

Unit 1 Fuzzy Sets
Crisp Sets - an Overview, Fuzzy Sets - Definition and Examples, α - Cuts and its Properties, Representations of Fuzzy Sets, Extension Principles of Fuzzy Sets, Operations on Fuzzy Sets - Fuzzy Complements, Fuzzy Intersections, Fuzzy Unions, Combinations of Operations, Aggregation Operations.

Unit 2 Fuzzy Arithmetic
Fuzzy Numbers, Arithmetic Operations on Intervals, Arithmetic Operations on Fuzzy Numbers.

Unit 3 Fuzzy Relations
Binary Fuzzy relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations.

Unit 4 Fuzzy Logic
Classical Logic, Multivalued Logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy Propositions, Conditional and Qualified Propositions and Quantified Propositions.

Unit 5 Uncertainty-based Information
Information and Uncertainty, Non Specificity of Crisp Sets – Non Specificity of Fuzzy Sets, Fuzziness of Fuzzy Sets, Uncertainty In Evidence Theory, Principles of Uncertainty.

TEXT AND REFERENCE BOOKS:

1.	George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic- Theory and Applications, Prentice Hall of India, 1997.
2.	Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, 1997.
3.	H.J. Zimmermann, Fuzzy Sets and its Applications, Allied publishers, 1991.

| 18MAT676 | INTRODUCTION TO SOFT COMPUTING | 3 0 0 3 |

Unit 1 Soft Computing
Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

Unit 2 Artificial Intelligence
Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies.

Unit 3 Fuzzy Logic
Crisp set and Fuzzy set, basic concepts of fuzzy sets, membership functions. Basic operations on fuzzy sets, Properties of fuzzy sets, Fuzzy relations. Propositional logic and Predicate logic, fuzzy If - Then rules, fuzzy mapping rules and fuzzy implication functions, Applications.

Unit 4 Neural Networks
Basic concepts of neural networks, Neural network architectures, Learning methods, Architecture of a back propagation network, Applications.

Unit 5 Genetic Algorithms
Basic concepts of genetic algorithms, encoding, genetic modeling.
Hybrid Systems: Integration of neural networks, fuzzy logic and genetic algorithms.

TEXT AND REFERENCE BOOKS

1.   S. Rajasekaran and G. A. Vijaylakshmi Pai. Neural Networks Fuzzy Logic, and Genetic Algorithms, Prentice Hall of India.
2.   K. H. Lee. First Course on Fuzzy Theory and Applications, Springer-Verlag.
3.   J. Yen and R. Langari. Fuzzy Logic, Intelligence, Control and Information, Pearson Education.

18MAT677   OBJECT- ORIENTED PROGRAMMING AND PYTHON   3 0 0 3

Unit 1 Object-oriented programming concepts – objects – classes – methods and messages – abstraction and encapsulation – inheritance – abstract classes – polymorphism.

Introduction to C++ – classes – access specifiers – function and data members – default arguments – function overloading – friend functions – const and volatile functions - static members – Objects - pointers and objects – constant objects – nested classes – local classes.

Unit 2 Constructors – default constructor – Parameterized constructors – Constructor with dynamic allocation – copy constructor –destructors – operator overloading – overloading through friend functions – overloading the assignment operator – type conversion – explicit constructor.

Unit 3 Function and class templates - Exception handling try-catch-throw paradigm – exception specification – terminate and Unexpected functions – Uncaught exception.

Unit 4 Inheritance – public, private, and protected derivations – multiple inheritance - virtual base class – abstract class – composite objects Runtime polymorphism – virtual functions – pure virtual functions – RTTI – typeid – dynamic casting – RTTI and templates – cross casting – down casting.

Unit 5 Python Programming.

TEXT BOOK
1. B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.

REFERENCES BOOKS
1. Ira Pohl, "Object Oriented Programming using C++", Pearson Education, Second Edition Reprint 2004.

2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", Fourth Edition, Pearson Education, 2005.
3. B. Stroustrup, "The C++ Programming language", Third edition, Pearson Education, 2004.

18MAT657   STATISTICAL TECHNIQUES FOR DATA ANALYTICS   3-0-0-3

Data Collection, classification and analysis - Sampling methods, classification of data and representation of data- bar and pie charts – histogram frequency polygon - Data Analysis Measures of Central tendency and dispersion - Mean, median, mode, absolute, quartile and standard deviations, skewness and kurtosis for both grouped and ungrouped data. Association of attributes.

Curve fitting and interpolation - Fitting of straight lines and curves - Correlation, regression, fitting of simple linear lines, polynomials and logarithmic functions - Interpolation and extrapolation methods - Binomial expansion, Newton and Gauss methods.

Index numbers and time series analysis - Types of index numbers, construction of index numbers such as simple aggregate, weighted aggregate index numbers, chain index numbers and consumer price indices - Time series and its components and computation of trends and variations - Seasonal variations - Trend analysis methods.

Decision analysis and Game theory - Payoffs, regrets, maximin and minimax criteria and loss and risks – Games – payoff matrix, saddle point, value of game and methods of solving – two-person-zero-sum games, dominance method, sub-game method

Text Books:
1. Pillai R.S. N. andBagavathi. "Statistics", S. Chand, New Delhi, 2001.
2. Kanti Swarup, Gupta, P.K., and Man Mohan. "Operations Research" (Chapters 16 and 17), S. Chand, New Delhi, 2001.

References Book
 1. Amir D Aczel, Jayavel Soundarapandian , Palanisamy Saravanan, Rohit Joshi, Complete Business Statistics,7edition,McGraw Hill, New Delhi

18MAT672   ALGORITHMS FOR ADVANCED COMPUTING   3-0-0-3

Unit I Issues regarding classification and prediction, Bayesian Classification, Classification by back propagation, Classification based on concepts from association rule mining, Other Classification Methods, Classification accuracy.

Unit II Introduction to Decision trees - Classification by decision tree induction – Various types of pruning methods – Comparison of pruning methods – Issues in decision trees – Decision Tree Inducers – Decision Tree extensions.

Unit III Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction

Unit IV Soft Computing: Rationale, motivations, needs, basics: examples of applications in diverse fields, Basic tools of soft computing: Neural Networks, Fuzzy Logic Systems, and Support Vector Machines, Statistical Approaches to Regression and Classification - Risk Minimization, Support Vector Machine Algorithms.

Unit V Single-Layer Networks: The Perceptron, The Adaptive Linear Neuron (Adaline) and the Least Mean Square Algorithm - Multilayer Perceptrons: The Error Backpropagation Algorithm – The Generalized Delta Rule, Heuristics or Practical Aspects of the Error Backpropagation Algorithm.

Text Books:
1. *Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.*
2. *Jared Dean, "Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners", Wiley India Private Limited, 2014.*

References Books :
1. *LiorRokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010.*
2. *Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2006.*
3. *Vojislav Kecman, "Learning and Soft Computing", MIT Press, 2010.*

18MAT696   **DISSERTATION**   **10 cr**