Minutes of Meeting of 12th Board of Studies (BoS) of School of Mathematics

Date: 05/03/2024

Workshop combined with a Board of Studies (BOS) was convened on 26th-27th February, 2024, at School of Mathematics, Shri Mata Vaishno Devi University.

During the meeting following were present.

S. No.	Name / BoS Participants	Affiliation
1.	Dr. Kuldip Raj	Head, School of Mathematics and Chairman, Board of Studies.
2.	Dr. Gauree Shanker	Professor & Head, Department of Mathematics, Central University, Punjab ***(External Expert member)***
3.	Dr. Wali Mohamad Shah	Professor & Head, Department of Mathematics, Central University, Kashmir, ***(External Expert member)***
3.	Prof. V K Bhat	Professor, School of Mathematics (Member)
5.	Dr. A K Das	Associate Professor, School of Mathematics (Member)
6.	Dr. Sandeep Bhougal	Assistant Professor & Member Secretary of BoS, School of Mathematics
7.	Dr. Surender Singh	Assistant Professor, School of Mathematics (Member)
8.	Dr. Sandeep Sharma	Assistant Professor, School of Mathematics (Member)
9.	Dr. Sunil Kumar Sharma (Contractual)	Assistant Professor, School of Mathematics (Member)
10.	Dr. Nitin Bisht (Contractual)	Assistant Professor, School of Mathematics (Member)

As per the agenda of BoS meeting, following items were discussed and recommended:

Item:12.1	To confirm the minutes of the 11th meeting of Board of Studies (BoS), held on 03rd August, 2023. Chairman, BoS, welcomed external expert members and appraised the house about the compliance status of decisions taken during 11th BoS meeting and efforts made towards the same were appreciated. Minutes of last BoS meeting was confirmed.
Item: 12.2	To discuss / review the program structure and syllabus of four year undergraduate program (FYUG) as per the NEP 2020 guidelines *(The same is Annexed as Annexure-I)* Thorough discussions were held on the proposed programs, with valuable input and insights provided by the external experts. The course structure of the said program was discussed, approved and recommended to be included in the next meeting of Academic Council. *(The finalized syllabus with course code (Semester-I to Semester-X) of the said program is Annexed as Annexure-I)*
Item: 12.3	To discuss / review the comprehensive course structure for the B.Tech program in Mathematics and Computing. Integration of recommendations from external experts concerning course structures of the said program was discussed, approved and recommended to be included in next meeting of Academic Council. *(Syllabus with courses code is annexed as Annexure-II)*
Item: 12.4	Any other item with the permission of chair

The meeting ended with vote of thanks to Chair.

7/3/2024.

Dr. Sandeep Bhougal
(Member Secretary, BoS)

7/3/24

Dr. Kuldip Raj
(Chairman, BoS)

Shri Mata Vaishno Devi University

(Approved Under Section 2(f) and 12(B) of UGC act of 1956)

School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

No.: SMVDU/SOM/23/ Date: 12th Dec. 2023

Proposed Name of the Programme in the School of Mathematics:

B. Tech in Mathematics and Computing

Background and Motivation

Mathematics indeed serves as a foundational framework for many scientific disciplines, providing the language and tools necessary to model, analyze, and understand various phenomena. Computer science complements Mathematics by providing computational power, algorithms, and techniques to enhance our understanding of mathematical concepts and solve mathematical problems efficiently. The relationship between these two fields is mutually beneficial, with each supporting and enriching the other in various ways. In today's job market, there is a high demand for Computer Science graduates who possess a strong mathematical background, both in the corporate and public sectors. Additionally, computer-assisted technologies have become an integral part of our daily lives.

In recognition of these trends, the School of Mathematics at SMVDU has joined forces with the School of Computer Engineering to offer a four-year B. Tech Program in Mathematics and Computing. This program aims to equip students with a powerful blend of mathematical and computer science skills, focusing on areas where these two disciplines intersect. Graduates of this program will be well-prepared to pursue careers across a diverse range of fields in both the corporate and public sectors.

Ultimately, the goal of launching this program is to cultivate a workforce capable of addressing the challenges posed by the modern age of artificial intelligence and digital technology, where a strong foundation in mathematics is essential.

Scope of job opportunities:

1. We believe that the students who complete this program will have chances to work for famous companies in areas like technology, digital technology, banking, and finance.
2. After finishing this course, graduates can also consider careers in teaching advanced technical subjects.
3. Graduates can even start their own businesses with small partners and open up new opportunities for startup companies.

Programme Educational objectives

1. To prepare graduates with a strong foundation in Mathematics, computer science and technology.
2. To prepare graduates more effective and attractive so that they can meet the challenges of modern day's real life.
3. To enrich graduates with integrity and ethical values.

Shri Mata Vaishno Devi University

(Approved Under Section 2(f) and 12(B) of UGC act of 1956)

School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

Proposed Engineering Structure for 'B-Tech in Mathematics & Computing' under NEP 2020

School of Mathematics

Proposed Engineering Structure under NEP 2020 'B-Tech in Mathematics & Computing'

First Year							
1st Semester							
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**	**Category**
1	MTL BS 101	Engineering Mathematics-I	3	1	0	4	BSC
2	PHL BS 101	Engineering Physics- I	3	0	0	3	BSC
3	PHP BS 101	Engineering Physics -I Lab	0	0	2	1	BSC
4	BTL BS 101	Applied Chemistry	3	0	0	3	BSC
5	BTP BS 101	Applied Chemistry Lab	0	0	2	1	BSC
6	CSL DC 101	Introduction to 'C' Programming	3	0	0	3	ESC
7	CSP DC 101	'C' Programming Lab	0	0	2	1	ESC
8	MEP SExxx	Engineering Workshop	1	0	2	2	SEC
9	LNL 1241	Professional Communication	2	1	0	3	
10		AEC 1/ VAC 1				2	
		Total Credits				**23**	
2nd Semester							
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**	**Category**
1	MTL BS 102	Engineering Mathematics-II	3	1	0	4	BSC
2	PHL BS 102	Engineering Physics- II	3	0	0	3	BSC
3	PHP BS 102	Engineering Physics -II Lab	0	0	2	1	BSC
4	EEL 1006	Fundamental of Electrical Engineering	3	0	0	3	ESC
5	EEP 1006	Fundamental of Electrical Engineering Lab	0	0	2	1	ESC
6	CSL DC 102	Introduction to 'Python' Programming	3	0	0	3	ESC
7	CSP DC 102	Introduction to 'Python' Programming Lab	0	0	2	1	ESC
8	MEP SE 102	Engineering Graphics with CAD	1	0	3	2.5	SEC
9	----	Introduction to Environmental Science	3	0	0	3	AEC
		Total Credits				**21.5**	

Second Year						
3rd Semester						
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	CSL DC 201	Data Structure	3	0	0	3
2	CSP DC 201	Data Structure Lab	0	0	2	1
3	MTL DC 201	Discrete Mathematics	3	1	0	4
4	MTL DC 203	Integral Transforms and Complex Analysis	3	1	0	4
5	MTL DC 205	Probability & Statistics	3	1	0	4
6	MTL DC 207	Algebra	3	1	0	4
7		Fundamentals of Managements	3	0	0	3
		Total Credits				**23**
4th Semester						
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	CSL DC 202	Algorithm Design & Analysis	3	1	0	4
2	MTL DC 202	Real Analysis	3	1	0	4
3	CSL DC 204	Theory of Computation	3	1	0	4
4	CSL DC 206	Computer Organization & Architecture	3	1	0	4
5	MTL DC 204	Linear Algebra and Applications	3	1	0	4
6		Engineering Economics	3	0	0	3
		Total Credits				**23**

Third Year						
5th Semester						
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	CSL DC 301	Operating System	3	0	0	3
2	CSP DC 301	Operating System Lab	0	0	2	1
3	MTL DC 301	Number Theory	3	1	0	4
4		Departmental Elective Course - 1	3	0/1	2/0	4
5	MTL DC 303	Stochastic Processes	3	1	0	4
6		Open Elective Course	3	0	0	3
7		Technical Communication	2	0	0	2
		Total Credits				**21**
6th Semester						
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	CSL DC 302	Data Base Management System	3	0	0	3
2	CSP DC 302	Data Base Management System Lab	0	0	2	1
3	MTL DC 302	Scientific Computing	3	0	0	3
4	MTP DC 302	Scientific Computing Lab	0	0	2	1
5	CSL DC 304	Machine Learning	3	0	0	3
	CSP DC 304	Machine Learning Lab	0	0	2	1
6		Departmental Elective Course -2	3	0/1	2/0	4
7		Departmental Elective Course -3	3	0/1	2/0	4
8		Course from Humanities	2	0	0	2
		Total Credits				**22**

Fourth Year						
7th Semester						
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	CSD PR 401	B.Tech. Project-I				4
2	CSS PR 401	Training Seminar				2
3	MTL DC 401	Optimization Techniques	3	1	0	4
4	CSL DC 403	Cryptography & Network Security	3	1	0	4
5	MTL DC 403	Mathematical Modeling & Simulation	3	0	0	3
6	MTP DC 403	Mathematical Modeling & Simulation Lab	0	0	2	1

7		Departmental Elective Course -4	3	0/1	2/0	4
		Total Credits				**22**
8th Semester						
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	CSD PR 402	B.Tech. Project-II (Minor)				8
2		Departmental Elective Course – 5	3	0/1	2/0	4
3		Departmental Elective Course – 6	3	0/1	2/0	4
4		Departmental Elective Course- 7	3	0/1	2/0	4
		Total Credits				**20**

List of School Electives Courses

S. No.	SubjectCode	Subject	ElectiveNo.
1.	MTL DE 301	Operations Research	SEC– 1
2.	CSL DE 301	Object Oriented programming	
3.	MTL DE 303	Complex Analysis	
4.	CSL DE 302	Computer Networks	SEC – 2
5.	CSL DE 304	Software Engineering	
6.	CSL DE 306	Artificial Intelligence.	
7.	CSL DE 308	Computer Graphics	SEC– 3
8.	CSL DE 310	Web Technology	
9.	CSLDE 312	Cluster & Grid Computing	
10.	CSL DE 314	Big Data Analytics	
11.	CSL DE 401	Data Warehousing & Data Mining	SEC – 4
12.	CSL DE 403	Compiler Design	
13.	CSL DE 405	Wireless & Mobile Computing	
14.	CSL DE 407	Multimedia System	
15.	MTL DE 402	Matrix Computation	SEC– 5
16.	MTL DE 404	Partial Differential Equations	
17.	MTL DE 406	Dynamical Systems	
18.	MTL DE 408	Topology	
19.	MTL DE 410	Functional Analysis	
20.	CSL DE 402	Immersive Computing	SEC– 6
21.	MTL DE 412	Information Theory & Coding	
22.	MTL DE 414	Finite element methods	
23.	MTL DE 416	Game Theory	
24.	MTL DE 418	Differential Geometry	
25.	MTL DE 420	Fuzzy set & Fuzzy logic	SEC– 7

26.	MTL DE 422	Applied Algebra	
27.	MTL DE 424	Tensor Calculus	
28.	MTL DE 426	Statistical Inference	

****Open Elective Courses to be offered by other Schools.**

Details of Courses Offered by School of Mathematics for B. Tech Program

Semester I

MTL BS 101			Engineering Mathematics-I				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

Course outcome:

After successful completion of this course, students will be able to;

1. Solve the problems based on differentiation of functions of two or more variables.
2. Understand and apply the concepts of Integral calculus.
3. Solve problems based on matrix techniques.
4. Apply concepts of calculus and matrix to solve relevant problems of engineering

Course Contents:

Section - A

Differential Calculus: Partial differentiation, asymptotes, concavity, convexity, point of inflexion, curvature, radius of curvature, curve tracing, envelopes and evolutes, change of variables, Jacobian, expansion of functions of several variables, chain rule, mean value theorem, Taylor series with remainder term, maxima & minima, saddle point.

Section - B

Integral Calculus: Fundamental theorem of Integral calculus, reduction formulae, properties of definite integral, applications to length, area, volume, surface of revolution. Moments, Centre of gravity, improper integrals, β-γ functions.

Section - C

Ordinary Differential Equation (ODE): Formation of ODE, definition of order and degree of ODE and solution, ODE's of first order, method of separation of variables, homogenous and non-homogenous differential equations and their solution, exactness and integrating factor,

Bernoulli's equation, linear ODE's of n^{th} order, operator method, method of undetermined coefficients, method variation of parameters, solution of simple simultaneous ODE's.

Recommended Books:

1. E. Kreysig, Advanced Engineering Mathematics, Wiley 1oth edition, 2011.
2. A. K. Gupta, Engineering Mathematics, Macmillan 7th edition 2013.
3. McQuarri Macmillan, Mathematical Methods by Scientists & Engineers, 1st edition 2003.
4. Shanti Narayan, Differential Calculus, S Chand; 30th revised edition, 2005.

PHL BS101			Engineering Physics-I				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	1	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcome:

1.

Course Contents:

UNIT I:

Force and electric field due to continuous charge distribution, Field lines Flux Gauss's Law (differential and integral forms) and its applications, Electric potential, Work done in assembling a charge distribution. **[8]**

UNIT II:

Force Law line current, surface current and volume current densities (Equation of Continuity), Biot-Savart's law, Properties of B, Magnetic flux Div B, Curl B, Magnetic vector potential A, Ampere's law (differential and integral forms), Faraday's laws of electromagnetic induction, displacement current, Modified Ampere's law, Four Maxwell's equations in differential and integral forms. **[10]**

UNIT III:

Electromagnetic Spectrum, Brief introduction to black body radiation, Photo-electric Effect and Compton Effect, Wave particle duality (de Broglie waves), Davisson-Germer Experiment, Concept of wave function and its physical significance, Phase and Group velocities, Uncertainty Principle. **[10]**

UNIT IV:

Bohr Theory of atom (with finite and infinite nuclear mass), Derivation of time dependent and time independent Schrödinger wave equations, Expectation values and operators

(momentum, energy and angular momentum operators) and commutators, Particle in a box of infinite height (One dimensional). **[10]**

UNIT V:

Free electron theory free electron gas, Energy levels and density of states in one dimension, Band theory of solids, Classification of metals, semiconductors and insulators on the basis of band theory. **[7]**

Text Books:

1. Introduction to Electrodynamics, D. J. Griffiths, Pearson.
2. Concepts of Modern Physics, Arthur Beiser, Tata McGraw Hills
3. Introduction to Solid State Physics, Charles Kittel, Wiley

Reference Books:

1. Electromagnetics, B. B. Laud, New Age International Publisher.
2. Introduction to Solid State Physics, Charles Kittel, Wiley
3. Solid State Physics, Puri and Babbar, S. Chand (2010).
4. Perspective of Quantum Mechanics, S.P. Kuila, NCBA (2013).
5. Fundamentals of Physics, Resnick Halliday, Wiley.

Engineering Physics Lab

PHP BS101 **0 – 0 – 2 = 1**

All the students are required to do any six experiments from the list given below:

1. To study the measuring instruments (Vernier Calipers, Screw Gauge & Spherometer)
2. To find the angle of prism by the rotating telescope method.
3. To find the refractive index of the material of given prism using a spectrometer.
4. To determine the refractive index of the given liquid (water) using a hallow prism and spectrometer.
5. To study the Newton's interference rings and to determine the wavelength of sodium light.
6. To determine the wavelength of sodium light using a plane diffraction grating.
7. To determine the frequency of A.C. mains with a sonometer using non- magnetic wire.
8. To draw the characteristics curves of a semiconductor diodes (Si or Ge).
9. To study the V-I characteristics of a Zener diode.
10. To study the performance of a half-wave, full-wave & bridge type full-wave rectifier (without filters).
11. To verify Stefan's law by estimating the temperature of a torch bulb filament from resistance measurement.
12. To study the Hall-effect and to calculate the Hall coefficient and charge carrier Concentration of a given sample.
13. To study the dependence of refractive index of the material of the prism on the wavelength of light; and hence (1) to determine the dispersive power of the material

of prism; (2) verify the Cauchy relationship $\mu = a + b/\lambda^2$, and estimate the values of a & b (3) plot a graph of $d\mu/d\lambda$ versus λ.

14. To determine the band gap by measuring the resistance of a thermistor at different temperatures.
15. To determine the energy band gap of a semiconductor diode (Ge) using Four probe method.
16. To study the wavelength of He-Ne laser.

Reference Books:

1. Practical Physics by G L Squires Cambridge University Press.
2. Advanced Practical Physics for Students by Worsnop and Flint.
3. B. Sc Practical Physics by C. L. Arora.
4. Practical Physics by R K Shukla.
5. B.Sc Practical Physics by Harnam Singh.
6. An Advanced Course in Practical Physics by D. Chattopadhyay, P.C. Rakshit.
7. A Text Book of Practical Physics, S.K. Ghosh, 2015, New Central Book Agency.

BTL BS 101			Applied Chemistry				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcome:

After successful completion of this course, students will be able to;

1. Acquire basic knowledge of atomic structure, bonding and spectroscopic techniques.
2. Apply their knowledge to solve various physical and chemical problems.
3. Selectively apply these methods for analysis, evaluation and interpretation of the results.

Course Contents:

Atomic and Molecular Structure: Principles of atomic structure (Review), molecular orbitals of diatomic molecules. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band

Intermolecular forces and periodic properties: Ionic, dipolar and van Der Waals interactions, Equations of state of real gases and critical phenomena. Effective nuclear charge, penetration of orbitals, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Use of free energy in chemical equilibria: Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and EMF. Cell potentials, the

Nernst equation and applications. Acid-base, oxidation-reduction and solubility equilibria. Corrosion causes, effects and prevention.

Instrumental methods of chemical analysis and applications: Spectroscopy: Principle of spectroscopy, Principle and simple applications of UV-visible spectroscopy. Flame spectroscopy, atomic absorption spectroscopy, Infrared spectroscopy, Principle and simple application of nuclear magnetic resonance and magnetic resonance imaging. Chromatography: Types, Principle and applications.

Recommended Books:

1. Engineering Chemistry, Satya Prakash & Manisha Agrawal, Khanna Book Publishing,2012.
2. University chemistry, B. H. Mahan, Pearson,2009.
3. Chemistry: Principles and Applications, M. J. Sienko & R. A. Plane, McGraw-Hill International, 1979.
4. Fundamentals of Molecular Spectroscopy, C. N. Banwell, McGraw Hill Education, 2017.
5. A Textbook of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Limited, 2017.

Applied Chemistry Lab

BTP BS 101 **0-0-2=1**

List of Exercises / Experiments:

List of Experiments

Sr	Contents
1	Determination of the enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2	Determination of integral enthalpy of solution of salts (endothermic and exothermic).
3	Determination of the rate constant of a reaction.
4	Verification of Lambert-Beer's Law for potassium dichromate/potassium permanganate solution.
5	Determine the pH of the given aerated drinks fruit juices, shampoos and soaps using digital pH meter and pH paper.
6	Estimation of hardness of water using EDTA titration.
7	Standardization of KMnO4 solution by Mohr's salt.
8	Conductometric titration for a) Determination of the strength of a given HCl solution by titration against a standard NaOH solution. b) Analysis of a mixture of strong and weak acid by strong base.
9	Thin layer chromatographic separation.
10	Synthesis and purification of polymer/drug.

Recommended Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
1	AICTE's Prescribed Textbook: Chemistry – I with Lab Manual, Manisha Agrawal, Khanna Book Publishing.	2022
2	Laboratory Manual for Engineering and Physical Chemistry, Rao M. V. B., Studium Press (India) PVT. Ltd.	2013
3	Vogel's Qualitative Inorganic Analysis, G. Svehla, Prentice Hall.	1996

Course Outcome:

1. Function on research areas in multidisciplinary subjects.
2. Design economically, environmentally friendly and new methods of synthesis for various needful products.
3. Perform titration for various kinds such as acid-base titration etc.

CSL DC 101			Introduction to 'C' Programming				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Knowledge and understanding of programming.
2. Ability to write simple programs in C language by using basic control structures (conditional
   statements, loops, switches, branching, etc.).
3. Understanding the concept of programming using functions, arrays, strings, pointers and structures, and implement the various operations on them.
4. Ability to create a programmable model for a problem given.

Course Contents

Introduction: History of Programming Languages and their constructs, approach, Basics of computer systems, programs, flowchart, algorithms.

Fundamentals: Different Number systems, Algorithms and flow charts, types of algorithms, properties of good algorithm, examples, use of flow chart. C- fundamentals, constants, variables, data types and ranges, Different, expressions operators Methods of writing C program. C-fundamentals, constants, variables, data types and ranges, Different, expressions operators. Methods of writing C program. Input output statements, format conversions.

Control Statements: Character operation, control statements simple, if-, if else, ternary, compound, nested. Switch case statements, different programs on the topic Looping statements FOR, WHILE, Do- WHILE, Nested FOR, Parallel FOR, Goto, continue, break statement, programs on the topic. Looping statements FOR, WHILE, Do- WHILE, Nested FOR, Parallel FOR. Programs on the covered topics

Introduction to functions: different types of functions in C, Recursion, function as argument, Nesting of functions. Call by reference and call by value=s, Various programs with usage of different function in C

Arrays: Arrays in C , Numeric array, single dimensional, multi-dimensional arrays printing of arrays supply of values to array , character array , matrix , input output formats for String peration , Types of operations , string functions , length of string , comparing of string Auxiliary statements and operations , types of variables automatic static , global , register variables

User defined data types and Additional Features of C: User defined data types, Enumerated , Typedef Unions Pointers in C , Declaration of pointer , concept of pointer , types of pointers pointer as argument of function program. Use of pointer in an array, character operation using pointer, function pointer Use of pointer in multi-dimensional array, Pointers as a main variable of structure, Structure of pointers. Structure of normal variables and pointers Nested structure programs on structure and pointers.

File Operations: File operations, Creation of files, file organization Sequential, direct, indexed, Random access file organization, file pointers, file input output functions. Error in opening file end of file Fgets, Exit, Fread, Fputs, Eof, Fprintf, Stdin Stdout, Stdeer file pointer

Reference Books:

1. Let's C, Y. Kantitkar, BPB
2. Programming in ANSI C, Balagurusamy, TMH
3. C The Complete Reference, Scholdt, TMH
4. Programming with C, Gottafried, Schaum Series

'C' Programming Lab

CSP DC 101 **0-0-2=1**

List of Exercises / Experiments:

S.No.	List of Programs
1.	Write a program to print "Hello World" on the screen
2.	Write a program to find sum of the two numbers
3.	Write a program to find average of two numbers
4.	Write a program to know the number of bytes of data type contains
5.	Write a program to display the ASCII code of a variable on the screen
6.	Writ a program to determine the area of a circle

7. Write a program to find the area of a square
8. Write a program to find the sum of digits of a 4 digit number
9. Write a program to reverse a 4 digit number
10. Write a program to swap the values of two variables with/without using third variable
11. Write a program to display if a number is even or odd
12. Write a program to display if a number is positive or negative
13. Write a program to display that a person is eligible for voting
14. Write a program to display greatest among two numbers
15. Write a program to display subject of 5 marks & compute percentage and display pass or fail
16. Write a program to read number between 1-7 & display corresponding day of week
17. Write a program to read marks of five subjects and compute percentage and display grade of students based on percentage
18. Write a program to check whether the year entered is leap year or not
19. Write a program to print the relation between 2 numbers as equal to, less than or greater than
20. Write a program to read lower case character and display it in upper case
21. Write a program to convert dollar into rupees
22. Write a program to convert Celsius into Fahrenheit
23. Write a program to swap the values to two variables with the help of temporary variable
24. Write a program to make a calculator
25. Write a program to print “Hello world” 10 times using while loop
26. Write a program to print “Hello world” n times using while loop
27. Write a program to print 1 to 10 on screen
28. Write a program to print 10 to 1 on screen
29. Write a program to print sum of all even numbers between 1 to 100
30. Write a program to print sum of all odd numbers between 1 to n
31. Write a program to print multiplication table of n
32. Write a program to find factorial of a number
33. Write a program to find sum of all numbers between m to n
34. Write a program to read a number and print each digit on separate line
35. Write a program to find the sum of digits of a number
36. Write a program to reverse a number
37. Write a program to find if the number is Palindrome or not
38. Write a program to read +ve numbers from user till user enters 0 & display for each number whether it is even or odd
39. Write a program to find the reverse of a number
40. Write a program to read +ve number from user till user enters 0 and display count of even numbers and odd numbers.
41. Write a program to read character from user till user enters special character and display count of vowels and digits
42. Write a program to read a number from user and display whether it is prime or not
43. Write a program to print all leap years between year m to n
44. Write a program to read a number and find if it is an Armstrong number or not

45. Write a program to print all prime number between n to m
46. Write a program to print 1st n prime numbers.
47. Write a program using switch case to read one number and perform 1. Sum of digit 2. Reverse of number 3. Number is palindrome or not
48. Write a program using switch case to read operator and perform (+, -, /, *) operators of operands
49. Write a program using switch case to read a number and perform 1. Factorial of a number 2. Number is prime 3. Number is Armstrong 4. Even or odd
50. Write a program to sort an array of type integer
51. Write a program to reverse an array element in the array
52. Write a program to check if the array is palindrome or not
53. Write a program to reverse an array element in the array
54. Write a program to check of the array is palindrome or not
55. Write a program to insert an element in sorted array at its right place
56. Write a program to delete all the duplicate numbers from the array
57. Write a program to read temperature recorded for the month of September. Display the highest and lowest temperature recorded
58. Write a program to read total marks of 90 students. Find the average marks scored by the class. Display the number of students having marks below average and total number of students marks equal to or above average.
59. Write a program to read n numbers in an array. Display the count of total –ve numbers, +ve numbers and total zero. Your program must derive m which should be added to all –ve numbers so as they are converted to either zero or +ve number.
60. Write a program to sum the two arrays into another array.
61. Write a program to add two matrix using multi-dimensional arrays
62. Write a program to multiply to matrix using multi-dimensional arrays
63. Write a program to find transpose of a matrix
64. Write a program to print the characters of a string in vertical order
65. Write a program to find the length of a string
66. Write a program to find the frequency of characters in string
67. Write a program to find the total number of vowels in the string
68. Write a program to find the number of vowels, consonants, digits and white space in string using Switch - case
69. Write a program to concatenate two strings
70. Write a program to find the total number of words in a sentence
71. Write a program to reverse a sentence
72. Write a program to remove all characters in a string except alphabet
73. Write a program to sort elements in different orders in string
74. Write a program to insert a character in a string
75. Write a program to search a character in a string
76. Write a program to delete a character in a string
77. Write a program to insert a word in a string
78. Write a program to search a word in a sentence
79. Write a program to delete a word in a sentence

80. Write a program to find the length of each string in a 2-dimensional array
81. Write a program to find sort each string in a 2-dimensional array
82. Write a program to change the case of each string in a 2-dimensional array
83. Write a program to change the reverse each string in a 2-dimensional array
84. Write a program to display prime numbers between m and n using function
85. Write a program to check Armstrong number using user-defined function
86. Write a program to check whether a number can be expressed as sum of two prime numbers using function
87. Write a program to find the sum of n natural numbers using function
88. Write a program to calculate factorial of a number using function
89. Write a program to reverse a sentence using function
90. Write a program to calculate power of a number using function
91. Write a program to convert binary number to decimal and vice-versa using function
92. Write a program to store information (name, roll and marks) of student using structure
93. Write a program to add two distances (in inch-feet) system using structure
94. Write a program to add two complex numbers by passing structure to a function
95. Write a program to calculate between two time period
96. Write a program to store information of 10 students using structure and display the roll no, name and total marks of each student
97. Write a program to access elements of an array using pointer
98. Write a program to swap numbers of an array using call by reference
99. Write a program to find largest number in an array using function
100. Write a program to multiply two matrices by passing matrix to function

Semester II

MTL BS 102			Engineering Mathematics-II				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

Course outcome:

After successful completion of this course, students will be able to;

1. Solve the problems based on Vector calculus.
2. Understand and apply the concepts of Ordinary Differential Equation (ODE).
3. Solve problems based on Partial Differential Equation (PDE).
4. Apply concepts of ODE and PDE to solve relevant problems of engineering.

Section – A

Partial Differential Equation (PDE): Formation of (PDE), Solution of PDE by direct integration, Lagrange's linear equation, Non-linear PDE of first order, Method of separation of variables, Heat, Wave & Laplace's equations (Two dimensional Polar & Cartesian Co-ordinates).

Section – B

Vector Calculus: Beta & Gamma functions. Differentiation of vector functions of scalar variables. Gradient of a scalar field, Divergence & Curl of a vector field and their properties. Line & surface integrals. Green's theorem, Stokes' theorem & Gauss' theorem both in vector & Cartesian forms (statement only) with simple applications.

Section – C

Matrices: Elementary row and column transformation, linear dependence, rank of a matrix, consistency of system of linear equations, solution of linear system of equations, characteristic equations, Cayley Hamilton theorem, eigen values and eigen vectors, diagonalization, complex matrices.

Recommended Books:

1. E. Kreysig, Advanced Engineering Mathematics, Wiley 10th edition 2011.
2. Frank Ayres, Vector Analysis, Mc Graw Hills, 6th edition 2011.
3. T. Marsden and W.H. Freeman,Vector Calclus, Freeman, 6 edition 2011.
4. G. Simons, Differential Equations with Applications, TMH, McGraw-Hill Higher Education; 2 edition 1991.
5. S.L. Ross, Differential Equations, Wiley 3rd edition 1984.
6. R. Zalman, A Course in Ordinary and PDEs, Academic Press, 1st edition 2014.

EEL 1006			Fundamental of Electrical Engineering				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hours	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Solve the electrical circuits (DC & AC).
2. Solve and analyze the electrical circuits using network theorems and understand the behavior of AC electrical circuits and resonance.
3. Understand the three phase electrical systems and apply the concepts of measurements in measuring electrical quantities.
4. Solve and analyze the behavior of magnetic circuits and understand the concept of transformers and their applications.
5. Study the working principles of basic electrical machines including DC as well as AC machines.

Unit I Introduction and Electrical Circuit Analysis: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation,

AC fundamentals: Sinusoidal, square and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasors, Phasor representation of sinusoidally varying voltage and current.

Unit II Steady- State Analysis of Single-Phase AC Circuits: Analysis of series and parallel RLC Circuits, Concept of Resonance in series & parallel circuits, bandwidth and quality factor; Apparent, active & reactive powers, Power factor, Concept of power factor improvement and its improvement (Simple numerical problems).

Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem (Simple numerical problems).

Unit III Three Phase AC Circuits: Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, Three-phase power and its measurement (simple numerical problems).

Measuring Instruments: Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Use of shunts and multipliers (Simple numerical problems on shunts and multipliers).

Unit IV Magnetic Circuit: Magnetic circuit concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis and eddy current losses, Magnetic circuit calculations (Series & Parallel).

Single Phase Transformer: Principle of operation, Construction, EMF equation, Equivalent circuit, Power losses, Efficiency (Simple numerical problems), Introduction to auto transformer.

Unit V DC Machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems).

Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only).

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Reference Books:

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. L.S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
3. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
4. V.D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
5. B Dwivedi and A Tripathi, "Fundamentals of Electrical Engineering", Wiley India.
6. Kuldeep Sahay, "Basic Electrical Engineering", New Age International Publishers.
7. J. B. Gupta, "Electrical Engineering", Kataria and Sons.
8. C L Wadhwa, "Basic Electrical Engineering", New Age International.
9. W.H. Hayt and J.E. Kimerly, "Engineering Circuit Analysis", Mc Graw Hill.

Shri Mata Vaishno Devi University

(Approved Under Section 2(f) and 12(B) of UGC act of 1956)

School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

CSL DC 102			Introduction to 'Python' Programming				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Know the basic syntax and Data Structures in Python.
2. Think and Design solution in Object Oriented way as well as Procedural way
3. Enjoy coding and compete at online programming sites like CodeChef, HackerEarth etc.

Course Contents:

Unit-1 Introduction: Introduction to importance of IDEs like Spyder (Anaconda)/PyCharm for professional programming, explore Python shell as a calculator and for inputting Python expressions directly, HelloWorld program in Python script, Python keyword and Identifiers, Indentation, Comments, Data Types. Operators in Python: comparison, arithmetic, logical, Boolean, bitwise, assignment. Python: numbers, list, tuple, strings, set, dictionary, conversion between various data types

Unit-2 Basic constructs: Input and Output in Python, if-else , for loop, while loop, break, pass, continue, creating Functions, functions with arguments, returning values form functions, lambda expressions, recursion, global and local variables, Importing other modules/packages and using

their functions, creating random numbers/random-choice to create programs for simple guessing games like Rock –Paper-Scissors. Problems on 1D/2D/3D arrays using list. Problem solving using dictionary as look-up table.

Unit-3 Object Oriented Programming: Basics of Object-oriented programming: Class and Object. Defining variables and functions inside class. Creating objects, Inheritance, Multiple and Multi Level Inheritance, Function over-riding, the concept of composing objects of a different class in an object, problems on object composition.

Unit-4 GUI creation in Python: GUI creation using Python‘s de-facto GUI package like tkinter or alternative packages like: wxPython, PyQt (PySide), Pygame, Pyglet, and PyGTK. Creating labels, buttons, entry (textbox), combobox, checkbutton, radiobutton, scrolledText (textarea), spinbox, progressbar, menubar, filedialog, tabs etc. Creating GUI simple games like Tic-Tac-Toe. Dicussion about implementation of python in Machine learning Algorithms. Python with Data Sets

Reference Books:

1. Think Python 2nd Edition - How to Think Like a Computer Scientist, Allen B Downey, O‘Reilly publication
2. Learn Python 3 the Hard Way, Zed A. Shaw, Pearson publication
3. Head First Programming: A Learner‘s Guide to Programming using the Python Language, Paul Barry
4. David Griffiths Barry Griffiths, O‘Reilly publication
5. Dive into Python 3, Mark Pilgrim, Apress publication
6.

Introduction to 'Python' Programming Lab

CSP DC 102 **0-0-2=1**

List of experiments:

1 Write a program to add two numbers.
2 Write a program to calculate grade of a student.
3 Write a program to print following pattern.
*
**
***
4 Write a program to print table of a number.
5. Write a program to print following pattern:
0
01

012

6. Write a program to add and multiply numbers using user define functions.
7. Write a program to concatenate strings in Python.
8. Give at least five examples of inbuilt functions of Python.
9. Give at least five examples of inbuilt Math functions of Python.
10. Write a program to calculate factorial of a number using recursion.
11. Write a program to make a List in Python and perform following operations on List:
    a) Length using len() function
    b) Print element at index 0
    c) Adding an element to the list using + operator
    d) Appending an element to the list
    e) Negative indexing in list
    f) Remove the first occurrence of element a from list
    g) Reverse the list
    h) Sort list

12 Write a program to demonstrate use of Dictionary in Python with their inbuilt functions.
13 Write a program to demonstrate use of Set in Python with their inbuilt functions.
14 Write a program to demonstrate use of Tuple in Python with their inbuilt functions.
15 Write a program to calculate Median using List.
16. Write a program to calculate Mode using List.
17 Write a program to calculate Mean using List.
18 Write a program to inherit properties of a person to a student using inheritance in Python.
19 Write a program to calculate Coefficients of given numbers.
20 Write a program to calculate Covariance of given numbers.
21 Write a program to plot a graph using python library.
22 Write a program to make a class Vehicle and their properties.
23 Write a program to make a game Rock-Paper-Scissor.
24 Write a program to make classes for bird and animal with their properties and simulate a zoo like environment.
25 Write a program to make a GUI to take input from user and display.

Shri Mata Vaishno Devi University

(Approved Under Section 2(f) and 12(B) of UGC act of 1956)

School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

MEL xxxx			Engineering Graphics				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
1	0	3	2.5	1 Hours	3 Hours	10	20	20	50	100

Introduction of Engineering Graphics: Drawing instruments and their uses,

Orthographic Projections: Planes of projection – Projection of points in different quadrants. Projection of Straight Line parallel to one plane and inclined to the other plane and inclined to both the planes – True Length and inclination of lines with reference planes – Traces of line – Projection of Planes. (3)

Projection of Solids: Types of Projection- Orthographic, Isometric, Oblique and Perspective Projections, exercises on Isometric drawings. (2)

Now onwards all sheets on AutoCAD:

Section of Solids: Classification of Solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to other plane. (2)

Intersection of Surfaces: two prisms, two cylinders, and cone and a cylinder (2)

Development of Surfaces: Principle, Engineering applications and Methods of development of solids. Cylinder, Cones, sectional solids and intersecting solids (2)

Reference Books:

1. Narayana, K.L. and Kannaiah, P. - Engineering Graphics, Tata Mc Graw Hill, New Delhi.
2. Gill, P.S- Engineering Drawing, S.K. Kataria & Sons, New Delhi.
3. Bhat, N.D. and Panchal, V. M. - Engineering Drawing, Charotar Publishers, Anand.

Semester 3rd

CSL DC 201			Data Structure				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Select appropriate data structure as applied to specified problem definition.
2. Understand basic data structures such as arrays, linked lists, stacks and queues.
3. Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data.
4. Demonstrate a thorough understanding of how data structures impact the performance of algorithms.

Course Contents:

Unit-1: INTRODUCTION (5 Contact Periods)

Introduction to programming methodologies and design of algorithms, Structured programming concepts, Study and implementation of basic data structures like: Arrays, multidimensional arrays and their organization, introduction to sparse arrays

Unit-2: LINKED LIST (6 Contact Periods)

Linked list (singly, doubly and circular),Concept of linked list, Difference of link list & array, Single linked list, Representation, Operations, Traversing, Insertion(first node, last node, at a position, after a node value), Deletion(first node, last node, at a position, after a node value), Double linked list, Representation , Operations, traversing, Insertion (first node, last node, at a

position, after a node value), Deletion (first node, last node, at a position, after a node value), Circular link list & header link list example

Unit-3: STACKS & QUEUES (8 Contact Periods)

Stacks, Queues, Operations on Stack, Array & Linked Representation, Programs on stack, Push & Pop operations, traversing. Operations on Queue, Array & Linked Representation, Programs on stack, Insert & Delete operations, Circular queue, representation, Deque, Priority Queue, Application of queue

Unit-4: SORTING AND SEARCHING (8 Contact Periods)

Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Heap sort, Radix sort

Unit-5: TREES AND GRAPHS (9 Contact Periods)

Tree terminology, Binary tree, Complete Binary Tree, Binary search tree, Tree Traversals, Creation of Binary Tree from traversal methods, Expression Tree & expression, Manipulation, Binary Search Tree, Insertion & deletion in BST(Program), AVL Tree, M-way Search Tree, B+ tree, Insertion & deletion, Graph:, Graph terminology, Representation of graphs, Path matrix, Graph Traversal, BFS (breadth first search), DFS (depth first search), Minimum spanning Tree, Kruskal's Algorithm & Prim's Algorithm, Warshall's algorithm (shortest path, algorithm)., Introduction to trees and graphs and traversal methods.

Reference Books:

1. Data structures, Lipshutiz, Shaum series
2. Data structures & program design, R Kurse, PHI
3. Data structures: A pseudo code approach with C, R F Gilbarg, Thomson
4. An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill.
5. Data Structures using C & C++ -By Ten Baum Publisher – Prenctice-Hall International.
6. Fundamentals of Computer Algorithms by Horowitz, Sahni,Galgotia Pub. 2001 ed. Fundamentals of Data Structures in C++-By SartajSahani.
7. Data Structures: A Pseudo-code approach with C -By Gilberg&Forouzan Publisher Thomson Learning.

Data Structures Lab

CSP DC 201 **0 – 0– 2 = 1**

List of Experiments:

1. Design, Develop and Implement a menu driven Program in C for the following Array operations
2. Creating an Array of N Integer Elements
3. Display of Array Elements with Suitable Headings
4. Inserting an Element (ELEM) at a given valid Position (POS)
5. Deleting an Element at a given valid Position (POS)
6. Exit.

7. Support the program with functions for each of the above operations.
8. Design, Develop and Implement a Program in C for the following operations on Strings
9. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP)
10. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR. Support the program with functions for each of the above operations. Don't use Built-in functions.
11. Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)
12. Push an Element on to Stack
13. Pop an Element from Stack
14. Demonstrate how Stack can be used to check Palindrome
15. Demonstrate Overflow and Underflow situations on Stack
16. Display the status of Stack
17. Exit
18. Support the program with appropriate functions for each of the above operations
19. Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix
20. Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^ (Power) and alphanumeric operands.
21. Design, Develop and Implement a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks.
22. Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX)
23. Insert an Element on to Circular QUEUE
24. Delete an Element from Circular QUEUE
25. Demonstrate Overflow and Underflow situations on Circular QUEUE
26. Display the status of Circular QUEUE
27. Exit
28. Support the program with appropriate functions for each of the above operations.
29. Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, PhNo
30. Create a SLL of N Students Data by using front insertion.
31. Display the status of SLL and count the number of nodes in it

32. Perform Insertion and Deletion at End of SLL
33. Perform Insertion and Deletion at Front of SLL
34. Demonstrate how this SLL can be used as STACK and QUEUE
35. Exit
36. Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo
37. Create a DLL of N Employees Data by using end insertion.
38. Display the status of DLL and count the number of nodes in it
39. Perform Insertion and Deletion at End of DLL
40. Perform Insertion and Deletion at Front of DLL
41. Demonstrate how this DLL can be used as Double Ended Queue
42. Exit
43. Design, Develop and Implement a Program in C for the following operations on Singly Circular
44. Linked List (SCLL) with header nodes
45. Represent and Evaluate a Polynomial P(x,y,z) = 6x2y2z-4yz5+3x3yz+2xy5z-2xyz3
46. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z)
47. Support the program with appropriate functions for each of the above operations
48. Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers
49. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2
50. Traverse the BST in In order, Preorder and Post Order
51. Search the BST for a given element (KEY) and report the appropriate message
52. Delete an element (ELEM) from BST
53. Exit
54. Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities
55. Create a Graph of N cities using Adjacency Matrix.
56. Print all the nodes reachable from a given starting node in a digraph using BFS method
57. Check whether a given graph is connected or not using DFS method.
58. Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H: K ®L as H(K)=K mod m (remainder method), and implement hashing

technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

MTL DC 201			Discrete Mathematics				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Know the counting principles concerning set relations and functions
2. Understand Mathematical logic and solve problems on recurrence relations, generating functions.
3. Understand the concepts of graph theory.
4. Apply combinatorial and graph theoretic techniques to solve relevant problems of engineering.

Course Contents:

Section A

Basic counting Techniques: Unary & Binary relation, equivalence relation. Functions, Injective, Surjective & Bijective mappings. Partial orders, Lattice & Boolean Algebra, Pigeon-hole principle, Binomial and multinomial coefficients, Mathematical Induction, Inclusion-exclusion principle.

Section B

Recurrence relations, Generating functions, Discrete numeric functions, Asymptotics (Big-O, Little-O, asymptotic dominance, growth of functions)

Mathematical Logic: Truth tables, Logical equivalence, rules of inferences, argument and its validity, Methods of proof, Predicate Calculus- Symbolizing everyday language.

Section C

Introduction to Graph, Euler graph, Hamiltonian paths and circuits; Trees, Fundamental Circuits, Distance and Centre, Spanning Tree, Cut-sets and Cut-vertices, Connectivity and Separability, Planar graph, Geometric dual, Combinatorial dual, Matrix representation of graph, Colouring, Chromatic number, Chromatic Polynomial; Covering and Partitioning, Chromatic partitioning, Matching, Covering, Network flows

Suggested Books:

1. K. H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph.
2. Theory (English) Macgraw Hill Education, 7th Edition
3. R.R Stoll., Set Theory and Logic, Dover Publications, New ed., 2012.
4. Graph Theory – with application to Engineering and Computer Science, Narshing Deo, PHI
5. Algorithm Graph Theory, Gibbons, Cambridge University Press

MTL DC 203			Integral Transforms & complex analysis				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcome:

After successful completion of this course, students will be able to;

1. Solve the problems based on Fourier analysis.
2. Understand and apply the concepts of Laplace Transforms.
3. Solve problems based on Complex Analysis.
4. Apply concepts of Integral transforms and complex analysis to solve relevant problems of engineering.

Course Contents:

Section A

Fourier Analysis: Periodic functions, trigonometric series, fourier series for functions with period 2Π, complex form of the series, functions with arbitrary period, even and odd functions, half range series, approximation by trigonometric polynomials, square error, Bessel's inequality, Parseval's identity, Fourier integral.

Section B

Laplace Transforms: Function of bounded variation, laplace transform of 1, tn, eat, sin(at), cos(at), sinh(at), cosh(at), erf(t), shifting properties, expressions with proofs for:
1. L{tn f(t)} 2. L{f(t)/t} 3. L{∫f(u) du} Unit step functions, Heaviside function, direct functions and their Laplace transformation, Laplace transform of periodic function. Evaluation of inverse Laplace transform, partial fraction method, Heaviside development, convolution theorem. Application to solve initial and boundary value problems involving the ordinary differential equation with one dependent variable

Section C

Complex Analysis: Curves and regions in complex plane, complex functions, analytic functions, Cauchy-Riemann equations, Laplace equations. Rational, exponential, trigonometric, hyperbolic functions, derivatives of analytic functions, Power series, Taylor series, Laurent series, zero and singularity behaviour of f(z) at infinity.

Recommended Books:

1. Bali and Iyengar, Engineering Mathematics, Luxmi Publications(P), 2004.
2. S.C. Malik & S. Arrora , Mathematical Analysis, New Age International, 1992.
3. M.R.Spiegel, Complex Analysis, Schuam's outline Series, New edition.

MTL DC 205				Probability and Statistics			Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

COURSE OUTCOMES:

After successful completion of this course, students shall be able to:

1. Understand Measures of Central tendency, Dispersion, Skewness and Kurtosis.
2. Understand the Probability distributions and evaluation of statistical parameters.
3. Understand and apply method of least squares.
4. Understand and apply test of goodness of fit and independence of attributes.

Section A

Measures of Central tendency, Dispersion, Skewness and Kurtosis. Review of probability. Bayes' rule. Distribution function, Marginal and joint probability distribution. Mathematical expectation of sum and product of random variables, Probability distributions: Binomial, Poisson and Normal- evaluation of statistical parameters for these distributions.

Section B

Correlation and Regression, Karl Pearson and Spearman Rank Correlation coefficient. Curve fitting by the method of least squares. Fitting of straight lines, second degree parabolas and more general curves.

Section C

Test of significance for single mean, difference of means, correlation coefficient, single proportion, difference of proportions and variance. Chi-square test for goodness of fit and independence of attributes.

Recommended Books:

1. Ervin Kreyzig. Advanced Engineering Mathematics. 2. S. Ross, A First Course in Probability.
2. 2V Feller. An introduction to Probability Theory and its applications 4. S.P. Gupta. Statistical Methods, Sultan Chand and sons.
3. SCGupta, V.K. Kapoor, Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
4. 6B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition. 2000.

MTL DC 207			Modern Algebra				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students shall be able to;

1. Know the concepts of Group Theory.
2. Know the concepts of Ring Theory
3. Know the concepts of Field Theory
4. Apply the above concepts (construction of Galois Fields).

Course Contents:

Section A

Introduction to Groups, Groups of transformations, General and special linear groups, Dihedral groups, examples of groups from Codes, Subgroups, Cyclic Groups, Normal Subgroups, Quotient Groups, Homomorphism, Fundamental Theorem of Group Homomorphism. Permutation Group, The alternating groups A_n, Lagrange's.

Section B

Introduction to Rings, Subrings, Integral Domains, Ideals, Prime and Maximal Ideals, Euclidean domains, Fields, Fields of Fractions and Quotient Rings, Fundamental Theorems of Ring Homomorphism. Characteristic of a ring, Boolean rings, Polynomial ring.

Section C

Prime fields, Polynomial ring over a field, introduction to (field extension, finite extension, algebraic extension), Galois field, construction of Galois fields GF(2^n).

Recommended Books:

1. D. Dummit and R. Foote, Abstract Algebra, 3rd edition, Wiley, 2003
2. Thomas W. Hungerford, Abstract Algebra: An Introduction, Third Edition, 2014
3. Thomas Judson's Abstract Algebra: Theory and Applications, 2013 edition
4. Rajendra Kumar Sharma, SudeshKumari Shah and AshaGauri Shankar, Alegebra I: A Basic Course in Algebra, Pearson Education, 2011
5. I.N. Herstein, Topics in Algebra, 2nd Edition, 1975

Semester IV

CSL DC 202			Algorithm Design & Analysis				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Analyze the run time complexity of algorithms when developed using different approaches like Greedy, Dynamic Programming, Divide and Conquer etc.
2. Identify an appropriate data structure and approach while designing an algorithm for a specific problem.
3. Analytically examine the correctness of algorithms on the basis of recurrence relations, inductive proofs etc.
4. Analyze the Best, Worst and Average Case running time of algorithms and how it is affected by the nature of input variables.
5. Analyze various graph algorithms and deploy these algorithms to model engineering problems.

Course Contents:

Introduction: Definition of algorithm, algorithm specification, performance analysis: Time and space analysis, Asymptotic, recurrence relations.

Design of Efficient algorithms: Graphs, trees, recursion, divide and conquer, balancing, dynamic programming.

Sorting: Merge sort, Heaps and maintaining the heap properties, building a heap, Heap sort, Quicksort: algorithm, performance and anlaysis, Sorting without comparison: Radix sort, counting sort, bucket sort.

Some data structures: Hash tables, hash functions, Open addressing, Binary search trees-insertion and deletion, Balanced trees: AVL trees, m-way trees, B Trees, 2-3 Trees, Binomial heaps: Binomial trees and operations on binomial heaps.

Advanced design and analysis Techniques: Dynamic programming: Definition, Matrix-chain multiplication, optimal binary search trees, longest common subsequence, 0-1 knapsack problem.

Greedy algorithms: Definition, Fractional knapsack problem, Huffman coding, Task-scheduling problem.

Divide and conquer algorithm: Definition, Strassen's matrix multiplication, finding minimum and maximum from an array.

Backtracking: Definition, n-queens problem, sum of subset problem.

Graph algorithm: Elementary graph algorithms, Breadth-first and Depth-first search, Minimum spanning trees: Prim's and Krushkal's algorithm, Single source shortest path problem, Bellman-Ford algorithm, Floyd-Warshall algorithm, Johnson's algorithm.Integer and Polynomial arithmetic: Polynomial addition and multiplication.

Reference Books:

1. Introduction to Algorithm, TH Corman, Charles E, PHI
2. The design and anal. Of Comp. Algorithms Aho, Hopcroft, Ullman Addition Wesley
3. Computer Algorithms, Galgotia., Horowitz, Sahni and Rajsekaran

MTL DC 202			Real Analysis				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students shall be able to;

1. Know the Real Number system and countability.
2. Know the concepts of sequences of real numbers and their convergence.
3. Understand the concepts of metric spaces and their formulations.
4. Apply concepts of sequences and metrics to solve relevant problems of engineering

Course Contents:

Section-A

The systems of Real Numbers: Real Numbers R, Peano's Postulate/Axiom,: Real valued functions, Image and Inverse Image, Composition of Functions, countable and uncountable sets, concepts of bounds, least upper bound & greatest lower bound, order and completeness properties of R, Archimedean Property of Real Numbers.

Section-B

Real Sequences: Definition, range of Sequence, Equality of Sequence, Constant Sequence, Subsequence, sub-sequence, Bounded Sequence, Convergence of the Sequence (Limit of

Sequence), Monotonic Sequence, non-increasing, non-decreasing, strictly increasing, strictly decreasing sequences, Monotone sequences and their Convergence, Operations on convergent and divergent sequences, Bolzano-weierstrass Theorem, Cauchy Sequence, Cauchy's general principle for convergence

Section-C

Metric Spaces: Definition and examples, Euclidean space Rn, Limits in metric spaces, Continuous functions on a metric space, open balls and open sets, closed sets. Convergent sequences in metric space, Cauchy Sequence, continuity and inverse images of open or closed sets, Continuity of the inverse function.

Recommended Books:

1. Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH publishing Co. Pvt. Ltd, 1970.
2. Bartle, R.G. and Sherbert, D.R., Introduction to real analysis (2nd edition), John Wiley & Sons, Inc., New York, 2000.
3. Mathematical Analysis, Apostol, Narosa pub. House (2nd Edi.).2002
4. Mathematical Analysis, S.C. Malik and Savita Arora (4th Edi.) New age international publishers 2010.

CSL DC 204			Theory of Computation				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

1. Design the FSM and its variants for the given problem.
2. Able to convert RE to FA, differentiate between Regular and Non-regular languages, argue about diff. properties of Regular Languages.
3. Define and construct CFG along with corresponding machines, classify the languages into different Normal Forms.
4. Define and construct various type of TM, argue about decidability/undecidability of the problems.

Course Contents:

Unit - I: Introduction

Basic Concepts: Symbols, Strings, Language, Formal Language, Natural Language. Basic Machine and Finite State Machine. Finite Automata: Definition and Construction – Deterministic Finite Automata, Non-Deterministic Finite Automat, NFA with Epsilon-Moves, Equivalence of

NFA and DFA, Minimization of Finite Automata, Concept of Generalized non-deterministic finite automata.

Unit - II: Regular Expressions, Regular Grammar and Languages

Definition and Identities of Regular Expressions, Regular Grammar and Finite Automata: FA to RG and RG to FA, Left Linear and Right Linear Grammar and Inter-conversion between them. Closure Properties of Regular Languages, Non-regular languages and Pumping Lemma.

Unit - III: Context Free Grammar and Languages

Definition and Construction of CFG, Definition, Parse tree, derivation, ambiguity, Ambiguous Grammar and Removal of Ambiguity. Simplification of Grammar. Normal Forms of Grammar: Chomsky normal form and GNF. Non-Context Free Languages, pumping lemma.

Unit - IV: Pushdown Automata

Definition and Construction of Deterministic pushdown automata (DPDA) and Non-Deterministic pushdown automata (NPDA). Pushdown Automata - Examples and Relation with CFGs, Equivalence of PDAs and CFGs, Closure Properties of CFLs.

Unit - V: Turing Machines & Decidability

Definition and Construction of Turing Machines. Languages of TM.Types of TM. Time Complexity of TM, Halting Problem, Decidability/ undecidability

Reference Books:

1. Hopcroft Ulman, “Introduction to Automata Theory, Languages and Computations”, Pearson Education Asia, 2nd Edition.
2. K.L.P Mishra, N. Chandrasekaran, “Theory of Computer Science (Automata, Languages and Computation)”, Prentice Hall India, 2nd Edition.
3. John C. martin, “Introduction to Language and Theory of Computation”, TMH, Third Edition. 978-0-07-066048-9.
4. Michel Sipser “Introduction to Theory of Computation” Thomson Course Technology, Second Edition 0-534-95097-3.
5. Peter Linz, “An introduction to formal languages and Automata”, Narosa Publication.

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School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

CSL DC 206			Computer Organization & Architecture				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Learn basic micro-operations and organization of a basic digital computer.
2. Learn Overall organization of CPU, pipelining and vector processing.
3. Understand various arithmetic algorithms and communication techniques with Input/output devices.
4. Understand the organization and operation of various memory.

Course Contents:

Unit-I: Introduction

Overview of Digital Fundamentals

Unit-II: Register Transfer and Micro operation

Register Transfer Language, Register Transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations and Shift, Micro operations.

Unit-III: Basic Computer Organization and Design

Instruction Codes, Computer Registers, Computer Instructions, Timing & Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupts, Design of Basic Computer, Design of Accumulator Logic.

Unit-IV Micro-programmed Control Unit

Control Memory, Address Sequencing. Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes.

Unit-V Computer Arithmetic

Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating Point Arithmetic Operation, Decimal Arithmetic Unit, Decimal Arithmetic Operations.

Unit-VI Input–Output Organization

Peripheral devices, Input – Output interface, Asynchronous Data Transfer, Modes of Data Transfer, Priority Interrupt, Direct Memory Access, Input – Output Processor.

Unit-VII Memory Organization

Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Unit-VIII Multiple Process Organization

Flynn's classification of parallel processing systems, pipelining concepts.

Reference Books:

1. Computer System and Architecture, Mano, M, PHI
2. Computer Organization & Design, Pal Chaudhuri, P., PHI
3. Digital Computer Electronics: An Introduction to Microcomputers, Malvino
4. Digital Principles and Applications, 4/e, Malvino, M G Hill
5. Computer Architecture and Organization, Hayes. J.P, M G Hill
6. Computer Organization & Architecture, Stallings, W, PHI

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School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

MTL DC 204			Linear Algebra and Applications				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcome:

After completion of the course the student shall be able to;

1. Understand the fundamental concepts of Vector Spaces.
2. Learn and apply the notions of linear transformations.
3. Solve vector space problems by using matrix representation of linear mapping.
4. Apply the concepts of vector spaces and linear transformation to solve problems of Engineering.

Course Contents:

Section A

Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Dimensions, Quotient space and its dimension, Homomorphism and isomorphism of vector spaces.

Section B

Linear transformations, Vector space of all the linear transformations, Null Space, Range space of a linear transformation, Kernel and image of a Linear Transformation, Rank and Nullity Theorem, Algebra of Linear Transformation, Minimal Polynomial of a linear transformation, Singular and non-singular linear transformations.

Section C

Matrix representation of a linear Transformation, Change of basis, Non-singular transformations, Inverse of LT, Similarity, Inner product spaces, Cauchy-Schwarz inequality, Orthogonality, Orthogonal complements, Orthogonal sets and Basis, Gram-Schmidt, Orthogonalization process, Characteristic polynomial, Cayley Hamilton Theorem, Diagonalization, Eigen values and Eigen vectors of linear transformations.

Recommended Books:

1. S. Axler, Linear Algebra Done Right, 2nd Edition, John-Wiley, 1999.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice- Hall of India, 2005
3. S. Lang, Linear Algebra, Springer UTM, 1997.
4. S. Kumaresan, Linear Algebra: A Geometric Approach, Prentice-Hall of India, 2004

CSL DC 301			Operating System				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Learn different types of operating systems along with of history of operating systems and basic functions of operating systems.
2. Students will have knowledge of Process management, process synchronization and deadlock handling algorithms, inter-process communication and CPU scheduling algorithms used in operating system. Memory management and virtual memory concepts, I/o Devices management, file management.
3. Students will be able to analyze and implement various algorithms used for management, process scheduling, memory allocation and process communication in operating system.
4. Analyze the structure of OS and basic architectural components involved in OS design.

Course Contents:

Introduction to OS: Processor management, memory management, file system management, system calls.

Process management: Scheduling levels, quantities to be optimized, preemptive/non preemptive, interrupting clock, FIFO, shortest job first, shortest remaining job first, round robin, priority, multilevel queues, multilevel feedback queues.

Concurrent processes: Mutual exclusion and Bernstein's conditions, Fork/Join construct, PARBEGIN/PAREND construct; semaphores: use of semaphores to complement PARBEGIN/PAREND; critical section problem; 2 process critical section problem and solution, both H/W and S/W; monitors; message passing; case studies: dining philosophers problem, reader writer problem and disk head scheduler problem.

Memory management: Single user contiguous: protection; fixed partition multiprogramming; protection, fragmentation, relocation; variable partition multiprogramming: compaction, storage placement strategies; multiprogramming with storage swapping; paging: segmentation; paging and segmentation together; virtual memory: page replacement and strategies, locality, working sets, page fault frequency, demand paging, optimization technique.

Dead locks: Resource concepts, necessary conditions, resource allocation graph, deadlock prevention: three strategies of Havender, deadlock avoidance: Bankers algorithm, deadlock detection: reduction of resource allocation graph, deadlock recovery.

File systems: directory organization, functions, data hierarchy, blocking and buffering, file organization, free space management, allocation techniques: contiguous, noncontiguous; sector oriented linked; block: block chaining, index block chaining, block oriented file mapping;

Device management: types: block, character; PIO, DMA, I/O channels, virtual devices.

Disk scheduling: operations of disks, quantities to be optimized, seek optimization: FCFS, SSTF, SCAN, C-SCAN, M-STEP SCAN, Eschenbach; rotation optimization, system consideration, disk caching and other optimizations.

Reference Books:

1. Operating system concepts: Silberschatz, Addison Wesley Longman
2. Modern Operating Systems: Tanenbaum, PH(I)
3. Operating systems: H.M.Deitel, Addison Wesley Longman
4. Operating systems: Madnick and Donovan, McGraw-Hill I.E.

Operating System Lab

CSP DC 301 0 – 0 – 2 = 1

List of Experiments:

1) Write a shell script to ask your name, program name and enrolment number and print it on the screen.
2) Write a shell script to find the sum, the average and the product of the four integers entered
3) Write a shell program to exchange the values of two variables
4) Find the lines containing a number in a file
5) Write a shell script to display the digits which are in odd position in a given 5-digit number

6) Write a shell program to reverse the digits of five-digit integer
7) Write a shell script to find the largest among the 3 given numbers
8) Write a shell program to search for a given number from the list of numbers provided using binary search method
9) Write a shell program to concatenate two strings and find the length of the resultant string
10) Write a shell program to find the position of substring in a given string
11) Write a shell program to display the alternate digits in a given 7-digit number starting from the first digit
12) Write a shell program to find the gcd for the 2 given numbers
13) Write a shell program to check whether a given string is palindrome or not.
14) Write a shell program to find the sum of the series sum=1+1/2+…+1/n
15) Write a shell script to find the smallest of four numbers
16) Write a shell program to add, subtract and multiply the 2 given numbers passed as command line arguments
17) Write a shell program to convert all the contents into the uppercase in a particular file
18) Write a shell program to count the characters, count the lines and the words in a particular file
19) Write a shell program to concatenate the contents of 2 files
20) Write a shell program to find factorial of given number
21) WAP that accepts user name and reports if user logged in.
22. WAP that takes a filename as input and checks if it is executable, if not make it executable.
23. WAP which displays the following menu and executes the option selected by user:
1. ls
2. pwd
3. ls –l
4. ps -fe
24) Write a shell script to find the average of the numbers entered in command line
25) Write a shell script to sort the given numbers in descending order using Bubble sort
26) Write a shell program to find the sum of all the digits in a given 5-digit number
27) Shell script to find occurrence of particular digit in inputted number
28) Write a shell script to print following pattern.
*
* *
* * *
* * * *
29) Write a shell script to print following pattern.
1
2 3

4 5 6

30) Create a data file called employee in the format given below:

a. EmpCode Character
b. EmpName Character
c. Grade Character
d. Years of experience Numeric
e. Basic Pay Numeric

Sort the file on EmpCode.
Sort the file on EmpName.
Sort the file on
(i) Decreasing order of basic pay
(ii) Increasing order of years of experience.
(iii) Display all records with 'smith' as a part of employee name.

MTL DC 301			Number Theory				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcome:

After completion of the course the student shall be able to;

1. Understand the concepts of divisibility of numbers and congruences.
2. Learn and apply the notions of number theoretic functions and their properties.
3. Solve problems related to prime numbers and quadratic reciprocity.
4. Apply the concepts of number theory to solve problems of Engineering.

Course Contents:

Section-A

Divisibility and factorization: Division algorithm, greatest common divisor, Euclid's algorithm, linear equations and its theorem, fundamental theorem of arithmetic.

Congruences: Linear congruence theorem, solution of linear congruence, simultaneous linear congruences, Chinese Remainder theorem, Wilson's theorem, Fermat's theorem, Euler's theorem.

Section-B

Functions: Arithmetic function, multiplicative functions Moebius function, Moebius inversion formula, Euler phi function, Euler's formula, number- of -divisors, sum -of -divisors functions, perfect numbers, characterization of even perfect numbers.

Section-C

Prime numbers and Quadratic reciprocity: Prime number, Euclid's theorem, infinitely many prime theorem, Fermat primes, Mersenne primes, Dirichlet's theorem on primes, estimates for pi(x), Legendre and Jacobi symbols, Euler's criterion, Gauss's lemma, law of quadratic reciprocity

Reference Books:

1. Joseph H. Silverman: A friendly Introductory Number Theory,3rd edition, Pearson.
2. K.H. Rosen: Elementary Number Theory, and its application,5ht edition, McGraw Hill ISBN 0-21-87073-8.
3. G.A. Jones and J.M. Jones: Elementary Number Theory,Springer.
4. I Niven, H. Zuckerman, and H. Montgomery: An Introductionto the Number Theory, 5th edition, Wiley ESBN: 0-471625469.
5. G.E. Andrews: Number Theory, Dover Publications.

MTL DC 303			Stochastic Process				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students shall be able to;

1. Know the fundamental of time series and stochastic models.
2. Understand the Markov process and their applications to ergodic systems.
3. Understand some stochastic process and renewable theory.
4. Apply concepts of stochastic process and renewable theory to solve relevant problems of engineering

Course Contents:

Section – A

Stochastic processes: Introduction, Classification and examples of stochastic processes, Bernoulli process, Poisson process, Gaussian process, Renewal process, Stationary process, Brownian motion. **Random Walk:** Introduction and examples, simple random with unrestricted, two absorbing barriers, one absorbing barrier, two reflecting barriers and one reflecting barrier.

Section – B

Discrete time Markov chain: Definition, n-step transition probability, States classification, Limiting probabilities, Distribution of times between states, Irreducible finite chains with aperiodic states, Reducible chains (Finite Markov chains with absorbing

states). **Continuous time Markov chain:** Definition, Chapman Kolmogorov equation, Birth-Death process, Special cases of Birth-Death process, Markov chains with absorbing states.

Section - C

Renewal process: Definition, Examples, Renewal equation, Renewal theorems, Application of renewal process. **Queuing Models:** Introduction to queueing models, M/M/1; M/M/c and Erlang loss models. Steady state solutions. State dependent parameters.

Recommended Books:

1. P.G. Hoel, S.C. Port, C.J. Stone, Introduction to stochastic processes, Universal Book Store, New Delhi.
2. S.K. Srinivasan, K.M. Mehata, Stochastic Processes, Tata McGraw-Hill Publishing Company limited, New Delhi.
3. J. Medhi, Stochastic Processes.
4. G.E.P. Box and G.M. Jenkins, Time series Analysis: Forecasting and control.
5. 5.C. Chatfield, The Analysis of Time Series: Theory and Practice

Semester VI

CSL DC 302			Data Base Management System				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Define the terminology, features, classifications, and characteristics embodied in database systems.
2. Convert any information model into a relational database schema and implement the same using SQL.
3. Formulate the data requirement in terms of Relational algebra operation and query languages operations.
4. Apply the normalization theory to normalize the given Database schema.
5. Understand the requirement of ACID properties & their implementation.

Course Contents:

Introductory Database Concepts: Introduction to data processing, overview of files and file systems, drawbacks of files systems, concept of a database, data abstraction and data independence, data models, database language, database users and administrators, transaction management, database system structure.

Entity Relationship Model: Basic concepts, constraints, design issues, entity relationship diagram, week entity sets, extended ER features, design of ER database schema, reduction of ER schema to tables.

Relational Model: Concept of a relation, primary and secondary keys, foreign keys, structure of relational databases, the relational algebra and extended relational algebra operations, formulation of queries, modification of the database, views.

SQL: Background, basic structure, set operations, aggregate functions, null values, nested queries, views, complex queries, database modification, DDL, embedded SQL, stored procedures and functions, dynamic SQL, other SQL features.

Integrity & Security: Domain constraints, referential integrity, assertions, triggers, triggers and assertions in SQL, security in authorization in SQL.

Relational Database Design: First normal form, pitfalls in relational database design, functional dependencies, decomposition, desirable properties of decomposition, boycecodd normal form, third and fourth normal forms, other normal forms.

Transactions: Transaction concept, transaction state, implementation of atomicity and durability, concurrent executions, serializability, recoverability, implementation of isolation, transaction definition in SQL.

Concurrency Control: Lock based protocols, timestamp-based protocols, validation-based protocols, multiple granularities, multi version schemes, deadlock handling, inset and delete operations.

Recovery Systems: Failure classification, storage structure, recovery and atomicity, log-based recovery, shadow paging, recovery with concurrent transitions, buffer management.

Reference Books:

1. Principles of Database System, Ullman, Galgotia.
2. Database System Concepts, Silberschatz, Korth & Sudarshan, McGraw Hill.
3. Database Management Systems, Raghu Ramakrishnan, McGraw Hill.
4. Fundamentals of Database Systems, Elmasri & Navathe Addison Wesley

Database Management System Lab

CSP DC 302 0– 0 – 2 = 1

List of experiments

Creation of a database and writing SQL queries to retrieve information from the database.

1.1 Data Definition Language (DDL).

a. CREATE d. TRUNCATE
b. ALTER e. RENAME
c. DROP f. COMMENT

1.2 Data Manipulation Language (DML)

INSERT

UPDATE
DELETE
SELECT
Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.
Creation of Views, Synonyms, Sequence, Indexes, Save
3.1. Implementation of Views.
3.2. Implementation of Synonyms
3.3. Implementation of Sequence
3.4. Implementation of Indexes
3.5. Implementation of Save point.
Creating an Employee database to set various constraints.

(a). Primary key, (e).Null, (i). Disable Constraints

(b).Foreign Key,` (f). Not null, (j). Drop Constraints

(c). Check, (g) . Default,

(d). Unique, (h). Enable Constraints,

5. Creating relationship between the databases.
5.1 Implementation of set operations
5.2. Implementation of Nested Queries / Sub queries
5.2. Implementation the Join Operations
6. Creation and use of Triggers
7. Creation of functions using PL/SQL.

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School of Mathematics

Faculty of Science, SMVDU

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CSL DC 304			Machine Learning				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Know the basics and mathematics behind various Machine Learning algorithms.
2. Think analytically and suggest possible solutions to problems using Machine Learning.
3. Know various programming tools to apply Machine Learning techniques into action.

Course Contents:

Unit 1:

Brief Introduction to Machine Learning, Supervised Learning, Unsupervised Learning, Reinforcement Learning.

Unit 2:

Probability Basics, Linear Algebra, Statistical Decision Theory – Regression & Classification, Bias – Variance, Linear Regression, Multivariate Regression

Unit 3:

Dimensionality Reduction, Subset Selection, Shrinkage Methods, Principle Components Regression, Linear Classification, Logistic Regression, Linear Discriminant Analysis, Optimization, Classification-Separating Hyperplanes Classification.

Unit 4:

Artificial Neural Networks (Early models, Back Propagation, Initialization, Training & Validation), Parameter Estimation (Maximum Likelihood Estimation, Bayesian Parameter

Estimation), Decision Trees, Evaluation Measures, Hypothesis Testing, Ensemble Methods, Graphical Models

Unit 5:

Clustering, Gaussian Mixture Models, Spectral Clustering, Ensemble Methods, Learning Theory, Reinforcement Learning.

Reference Books:

1. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008.
2. Christopher Bishop. Pattern Recognition and Machine Learning. 2e.

Machine Learning Lab

CSP DC 304 0– 0 – 2= 1

List of experiments

NOTE: Use any of this programming language: Python/Octave/MATLAB/R)

1. Explore the Weka tool and practice various pre-coded ML algorithms for regression, classification, clustering algorithms on the sample WEKA-datasets/UCI datasets.
2. Compute cost function for linear regression
3. Implement gradient descent for univariate linear regression
4. Compute cost function for multivariate linear regression
5. Implement gradient descent for multivariate linear regression
6. Given a UCI-Iris dataset (or any other dataset) code the classifier/clustering algorithm to:
7. Predict the type (Iris-Setosa /Iris-Versicolor / Iris-Verginica) when given an input combination of: (sepal length, sepal width, petal length, petal width)
8. Cluster and visualize the data given in the Iris.xls based on Sepal Length.
9. Cluster and visualize the data given in the Iris.xls based on Sepal Width.
10. Cluster and visualize the data given in the Iris.xls based on Petal Length.
11. Cluster and visualize the data given in the Iris.xls based on petal Width.
12. Cluster and visualize the data based on Iris (types: Iris-Setosa /Iris-Versicolor / Iris-Verginica)

Semester VII

CSL DC 403			Cryptography & Network Security				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Identify factors driving the need for network security.
2. Identify and classify particular examples of attacks.
3. Define the terms vulnerability, threat and attack.
4. Identify physical points of vulnerability in simple networks.
5. Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and the characteristics of hybrid systems.

Course Contents:

UNIT 1

Introduction to cryptography and network security, Networks OSI Model of networking layers, Importance of Security in networks, types on internetwork, attacks, security services pervasive security mechanism.

UNIT 2

Foundation of Modern Cryptography, private key cryptography, DES, TDEA, Block Ciphers, linear cryptanalysis, differential cryptanalysis, AES public key Cryptography, DH algorithm, Algorithms for discrete algorithms birth day paradox, pollard's p algorithm for discrete algorithm, EI Gomel public key, RSA, Elliptic curve cryptography, stream chippers

UNIT 3

Hashing Authentication & Signature Schemes Hashing schemes SHA- Family, MAC, Digital Signature RSA EI Gamel, DSS DSA Authentication Protocols, applications Kereberos X.509 Directory Services, E-mail security, Email architecture SSL PGP, MIME, S/MIME Internet Protocol Security (IPSec) IPSec architecture, IPSec verses other layers security, Mobile IPsec VPN Web Security, SSl, TLS, SETetc

UNIT 4

System Security Intruders, Types of Attacks, protecting against Intruders, Honeypots, Scanning and analysis tools, Viruses and Worms, Types of Viruses, Protection, Firewall architecture

implementing firewalls, XML firewalls, Trusted systems, Trusted system security implementation, wireless security.

Reference Books:

1. Cryptography and Network Security: Behrouz A. Forauzan 2/e
2. Cryptography and Network Security: William Stallings 4/e
3. Cryptography and Network Security: AtulKahate 2/e

MTL DC 403			Mathematical Modelling & Simulation				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students shall be able to;

1. Understand the concepts of the modelling & simulation.
2. Understand the concepts of Queuing models and its applications.
3. Understand the concepts of network scheduling.
4. Apply the concept of modelling & simulation to solve relevant problems of engineering

Section-A

Modelling: Definition of a SYSTEM, System concepts, and types of system, continuous & discrete systems, modelling process, verification & validation.

Simulation: Introduction, classification of simulation models, advantages and disadvantages of simulation, Discrete system simulation: Monte Carlo method, Random Number Generation.

Section-B

Queuing Theory: Introduction, Notation and assumption, Queuing model with poisson input, exponential service and arbitrary service times. Simulation of queuing system, Simulation of a single-server queue, Simulation of two-server queue.

Inventory Control: Elements of inventory theory, more complex inventory models, finite and infinite delivery rate model with and without back ordering. Simulation of inventory systems.

Section-C

Evaluation of simulation, length of simulation runs, variance reduction technique.

Project management: PERT/CPM techniques, simulation of PERT networks. Model as components of information systems, modelling for decision support.

Virtual reality: the ultimate interactive model.

Recommended Books:

1. Gorden, G., System Simulation, Prentice Hall of India.
2. Narsing Deo, System Simulation, Mcgraw Hill.

3. Payne, J.A., Introduction to Simulation, Mc-Graw Hill 1982

School Elective Courses

MTL DE 301			Operations Research				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students shall be able to;

1. Know the meaning and nature of OR and its formulation.
2. Learn different methods of linear optimization problems.
3. Solve the transportation, assignment and game theoretic problems.
4. Apply optimization techniques to solve relevant problems of engineering.

Section-A

Meaning and nature of Operations Research (OR). History and development of OR. Applications of OR. Models in OR and Methodology of OR. Linear Programming Problem (LPP): Introduction, General Formulation of LPP, Assumptions, Limitations and Applications of LPP, Graphical Solution to LP problems, Special cases in graphical method.

Section-B

Computational procedure of Simplex Method; Artificial Variables, Big-M method; Special cases in Simplex procedure; Degeneracy in LPP.

Transportation Problem: Initial Basic Feasible Solution by North West Corner Rule, Least Cost Method and Vogel's Approximation method. u v – Method.

Section-C

Assignment problem, Hungarian Algorithm; Applications of transportation and assignment problems. Introduction to Game Theory, Maximin-Minimax principle, Saddle point, Games with and without saddle point, Applications of game theory.

References:

1. Swarup, K, Gupta, M. and Manmohan, Operations Research, Sultan chand and sons, 15th Edition (1998).
2. Sharma, S. D., Operations Research, Kedar Nath Ram Nath, 10th Edition (2013).

3. Taha, H A., Operations Research, Pearson Education, 9th Edition (2014).
4. Hadley, G., Linear Programming, Narosa Publishing House, 8th Edition (1994).

CSL DE 301			Object Oriented programming				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:
After successful completion of this course, students will be able to;

1. Knowledge and understanding of OOP using C++ that are new to programmers of traditional structured language like C.
2. Ability to write simple programs in C++ language by using basic control structures in addition to C, function overloading, constructor and destructor, run time memory allocation using new and delete etc.
3. Implementing the concept of OOP with C++ using classes and objects, operator overloading, Inheritance, polymorphism, template generic programming, exception handling, writing of large programs code with files and implement the various operations on them.
4. Ability to design and develop application model for on various software requirement of large databases.

Course Contents:
Object-Oriented Programming Concepts: Introduction, comparison between procedural programming paradigm and object-oriented programming paradigm, basic concepts of object-oriented programming.
concepts of an object and a class, interface and implementation of a class, operations on objects, relationship among objects, abstraction, encapsulation, data hiding, inheritance, overloading, polymorphism, messaging.
Constructors and Destructors: Need for constructors and destructors, copy constructor, dynamic constructors, explicit constructors, destructors, constructors and destructors with static members, initializer lists. Classes and Objects: Specifying a class, creating class objects, accessing class members, access specifiers, static members, use of const keyword, friends of a class, empty classes, nested classes, local classes, abstract classes, container classes, bit fields and classes.

Inheritance: Introduction, defining derived classes, forms of inheritance, ambiguity in multiple and multipath inheritance, virtual base class, object slicing, overriding member functions, object composition and delegation, order of execution of constructors and destructors. Virtual functions & Polymorphism: Concept of binding - early binding and late binding, virtual functions, pure virtual functions, abstract classes, virtual destructors

Standard Input/output: Concept of streams, hierarchy of console stream classes, input/output using overloaded operators >> and << and member functions of i/o stream classes, formatting output, formatting using ios class functions and flags, formatting using manipulators.

Pointers and Dynamic Memory Management: Declaring and initializing pointers, accessing data through pointers, pointer arithmetic, memory allocation (static and dynamic), dynamic memory management using new and delete operators, pointer to an object, this pointer, pointer related problems - dangling/wild pointers, null pointer assignment, memory leak and allocation failures.

Operator Overloading and Type Conversion: Overloading operators, rules for overloading operators, overloading of various operators, type conversion - basic type to class type, class type to basic type, class type to another class type.

Exception Handling: Review of traditional error handling, basics of exception handling, exception handling mechanism, throwing mechanism, catching mechanism, rethrowing an exception, specifying exceptions.

Templates and Generic Programming: Template concepts, Function templates, class templates, illustrative examples.

Files: File streams, hierarchy of file stream classes, error handling during file operations, reading/writing of files, accessing records randomly, updating files.

Introduction to STL: Different types of Containers, Algorithms, Iterators and their implementations.

Reference Books:

1. Lafore R., Object Oriented Programming in C++, Waite Group.
2. E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.
3. R. S. Salaria, Mastering Object-Oriented Programming with C++, Salaria Publishing House.
4. Bjarne Stroustrup, The C++ Programming Language, Addison Wesley.
5. Herbert Schildt, The Complete Reference to C++ Language, McGraw Hill-Osborne

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School of Mathematics

Faculty of Science, SMVDU

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MTL DE 422			Modern Applied Algebra				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students shall be able to;

1. Explain the fundamentals of Modern Algebra (Group, Rings and Fields)
2. Apply these techniques in coding by using matrix technique and polynomial technique.
3. Compare the process of coding and decoding by above mentioned techniques.
4. Explain some useful codes like Hamming codes and BCH-codes and their applications.

Course Contents:

Section A

Binary Group Codes, Communication system and its problems, Binary Symmetric Channel, Encoding and Decoding, Error detecting and correcting codes, Block codes, Distance between words, Matrix Encoding Technique, Groups codes, Construction of Decoding Table, Hamming codes.

Section B

Polynomial Rings, Polynomial Rings over field, Polynomial codes, Shift Register and its use in polynomial multiplication, Unique Factorization Theorem for polynomials, Complex Roots of unity, Formal Derivatives.

Section C

Extension of fields, Simple Extensions, Computation in R[x]/[m(x)], Existence Theorem, Finite fields, Computation in GF (2n). Root fields of Polynomials, BCH Codes.

Suggested Books

1. G. Birkhoff., Barte, Thomas C., Modern Applied Algebra, CBS Publication
2. I.N. Herstein, Topics in Algebra, John Wiley & sons publisher, 2nd edition (1975)
3. Gill, Arthar, Applied Algebra for computer science, Prentice Hall of India.
4. Dornhoff, Larry L., Applied Modern Algebra, MacMillan & Co. & Franz E.
5. V. K. Bhat, Modern Algebra and its Applications, Narosa,

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School of Mathematics

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MTL DE 303			Complex Analysis				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students shall be able to;

1. Understand the concepts of the theories for functions of a complex variable and continuity of functions.
2. Analyze various properties of analytic functions.
3. Solve contour integral and residues
4. Apply the concept of complex functions to solve relevant problems of engineering.

Course Contents:

Section A

Analytic (Holomorphic) functions, Cauchy-Riemann equations, Polar form of Cauchy-Rieman equations, Harmonic functions, Exponential and Trigonometric functions, conformal transformation, Bilinear transformation.

Section B

Integral along a path, Cauchy's Theorem, Cauchy Integral Formula, Taylor's and Laurent's expansions, Cauchy inequalities, Liouville's Theorem' Fundamental Theorem of Algebra, Morera's Theorem, Maximum modulus and minimum modulus Theorems, Argument Principle, Rouche's Theorem, Schwarz Lemma.

Section C

Singularities, Different Types of singularities, Residue at a singularity, Cauchy's Residue theorem. Residue and Contour integration, Analytic continuation, Uniqueness of analytic continuation.

Suggested Books:

1. John H. Mathews and Russell W. Howell, Complex analysis, Narosa Publication, 2006.
2. S. Lang, Complex Analysis Springer; 4th ed. 1999.
3. J.B. Conway, Functions of one Complex Variable, Springer; 2nd ed. 1978. Corr. 7th printing 1995 4. Ahlfors, Complex Analysis McGraw Hill Education India Private Limited; Third edition, 2013
5. J.C. Chaturvedi& S.S. Seth, Functions of a Complex Variable McGraw-Hill, 1987

6. Walter Rudin, Real and Complex Analysis, McGraw-Hill, 1976.

Scientific Computing

MTL DC 302 **L-T-P: 3-0-0**

(Credits=5)

UNIT-I

Differences: Error in interpolation, Detection of error by use of difference tables, Differences of a Polynomial, Newton's formula for Forward and Backward interpolation, Gauss Central difference Interpolation formula, Striling's formula, Bessel's formula, Interpolation with unequal intervals; Lagrange's formula, Divided differences and their properties, Newton's general Interpolation formula, Inverse interpolation.

UNIT-II

Errors in Numerical Calculations, Number and their accuracy, Errors and their analysis errors in a series approximation, Numerical solutions of algebraic and transcedental equations: Bisection Method, Iterative Method, Method of false-position, Newton-Raphson method, Secant method, curve fitting and approximation; fitting of a straight line. Approximation of functions, Chebyshev polynomials. Taylor's series approximation. Solution of linear systems of equations: Direct method, Elimination method, Gauss-seidel method, Jacobi method.

UNIT-III

Numerical Differentiation: Maximum and minimum value of a tabulted function, Numerical Integration: Trapezoidal Rule. Simpon's 1/3 and 3/8 Rule. Newton-cotes integration formula. Gaussian quardrature formula. Numerical evaluation of singular integrals. Numerical solution of ordinary differential equations: Solution by Taylor's series. Euler's method, Picard's method. Runge Kutta method. Predictor Corrector Method: Miline's method and Adams-Moulton's method.

Reference Books:

1. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice-Hall of India.
2. Gerald, C.F, and Wheatley, P.O, Applied Numerical Analysis, Sixth Edition, Pearson Education Asia, New Delhi, 2002.
3. E. Balagurusamy, Numerical Methods, Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999.

4. Burden, R.L and Faires, T.D., Numerical Analysis, Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.
5. Conte S.D. & Boor C.D., Elementary Numerical Analysis, An algorithmic approach, Mc Graw Hill.

CSL DE 302			Computer Networks				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:
After successful completion of this course, students will be able to;

1. Understand computer networking and data communications.
2. Understand the standard networking models along with their layers and associated applications.
3. Be familiar with the different concepts of network protocols.
4. Analyze the features and operations of various protocols.

Course Contents:
Introduction: Uses of Computer Networks, Network Architecture, Reference Model (ISO-OSI, TCP/IP-Overview, IP Address Classes, Subnetting), Domain Name Registration & Registrars
The Physical Layer: Theoretical basis for data communication, transmission media-Magnetic Media, Twisted Pair, Baseband Coaxial Cable, Broadband Coaxial Cable, Fibre Cable, Structured Cabling, Cable Mounting, Cable Testing, Wireless transmission, the telephone system, narrowband ISDN, broadband ISDN and ATM.

The Data Link Layer: Data link layer design issues, error detection and correction, data link protocols, sliding window protocols, Examples of Data Link Protocols.
The Medium Access Sublayer: The channel allocation problem, multiple access protocols, IEEE standard 802 for LANS and MANS, high-speed LANs, satellite networks, Network devices-repeaters, hubs, switches and bridges.
The Network Layer: Network layer design issues, routing algorithms, congestion control algorithm, internetworking, the network layer in the internet, the network layer in ATM networks.
The Transport Layer: A simple transport protocol, internet transport protocols, UDP, introduction to TCP, service model, TCP connection establishment, transmission policy, congestion control, timer management, wireless TCP and UDP, transactional TCP.
The Application Layer: HTTP, electronic mail, SNMP, SMTP, DNS.

Reference Books:

1. Computer Networks, 3rd Ed, Tananbaum A.S, PHI
2. Computer Networks-Protocols, Standards and Interfaces, Black U. PHI
3. Computer Communication Networks, Stallings W. PHI
4. Data communication and networking, B. F. Ferouzan, TMH

CSL DE 304			Software Engineering				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understanding the basics of Software Development Life Cycle and appreciating the complex process of Engineering an Industry Standard Software.
2. Appreciating the importance of a software process by understanding the already existing software process models.
3. Understanding the Software metrics, Project Planning, ISO & CMM standards.
4. Inculcating the ability to write a good quality SRS document, Design document. Ability to model the problem, designing solution through Data Flow Diagrams, Object Oriented Modeling, Use-cases etc.
5. Ability to Code & Test following industry standards for documentation and other best practices.
6. Usage of Industry standard tools like IBM Rational Software Architect during the entire life cycle of software building.

Course Contents:

Unit I: Introduction

The role of Software, Software Characteristics, Industrial strength software, Classification of software products, Legacy Software, Software Engineering Challenges, Software Development Life Cycle.

Unit II: Software Process

Software Development Process Models: Waterfall, Prototyping, Iterative, Spiral. Comparison of Models, Project Management Process, Inspection Process, Software Configuration management Process, Requirements Change management Process, Agile Process.

Unit III: Feasibility Study, Requirements Engineering & Analysis Modeling

Feasibility study: Technical, Economic & Behavioral; Data Gathering: Sources of Data, Observation, Interviewing, Questioners, On-site Observation, Software Process & Characteristics, Software Requirements, Problem Analysis: Data Flow Modeling, Object

Oriented Modeling, Prototyping, Cost Benefit Analysis, SRS, Developing Use Cases. Validation & Metrics

Unit IV: Planning Software Projects

Effort Estimation: Constructive Cost Model (COCOMO), Project Scheduling, SCM planning, Quality Planning, Risk Management, Project Monitoring Planning

Unit V: Design Engineering

Design Concepts & Principles, Cohesion, Coupling, Design Methodology, Introduction to Unified Modeling Language (UML), Verification, Metrics

Unit VI: Coding & Testing

Programming principles, Coding Conventions, Coding process, Refactoring, Verification, Coding Metrics, Test Cases, Test Plan, White box & Black box testing, Unit Testing, Integration Testing, Validation Testing: Alpha & Beta Testing, System Testing, Debugging, Testing Metrics

Unit VII: Reliability, Quality & Maintenance

Software Reliability & Metrics, ISO 9000 Standard, Capability Maturity Model, CASE Tools, User Training, Software Maintenance.

Reference Books:

1. Software Engineering: A practitioner's Approach, Pressman,6th Ed., McGraw Hill
2. System Analysis & Design, Elias M Awad
3. Fundamentals of Software Engineering, Ghezzi, C, PHI
4. Managing the Software Process,W S Humphrey Addison–Wesley
5. Ed. Encyclopedia of Software Engineering, Vols 1&2, J JMarciniak, John Wiley
6. Software Engineering, 5th Edition, Sommerville Ian Addison Wesley.
7. Software Engineering, Manmdrioli, Dino
8. Software Engineering: A programming Approach,3rd Edition, Bell, Douglas
9. An integrated Approach to Software Engineering, Jalote, P, Narosa Pub House.

CSL DE 306			Artificial Intelligence.				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understand the basics of Artificial Intelligence, Intelligent Agents and its structure.
2. Understand the problem solving by various searching techniques.
3. Understand the concept of informed search and Exploration.
4. Understand the concept of constraint satisfaction Problems and Adversarial Search.
5. Understand what is reasoning and Knowledge Representation.
6. Understand the concept of Reasoning with Uncertainty & Probabilistic Reasoning.
7. Understand the basic forms of Machine Learning, decision trees and statistical Learning setting.

Course Contents:

Unit I: Introduction

AI History and applications. Overview of AI application areas: game playing, automated reasoning and theorem proving, expert systems, natural language understanding, planning and robotics, machine learning and Alan Turing Test.

Unit II: The Propositional and Predicate Logic

Symbol and sentences, the semantics of the Propositional Calculus & Predicate Calculus. Inference Rules and Theorem Proving. Axioms, Literals, Horn clause & Clausal forms.

Unit III: Reasoning

Inductive, Deductive, Abductive and Default reasoning. More examples on Resolution proof.

Unit IV: Problem Solving as Search

Structures and strategies for state space search. Algorithms for Heuristic search, Heuristic evaluation functions.

Unit V: Knowledge Representation

Knowledge representation Techniques; conceptual graphs; structured representations; frames, scripts; issues in knowledge representation: hierarchies, inheritance, exceptions.

Unit VI: Knowledge Elicitation and Knowledge Acquisition

An overview of the induction methods, types and tools. Stages in Knowledge acquisition with examples. Analyzing, coding, documenting and diagramming. Scope of knowledge.

Unit VII: Expert Systems

Overview of expert system technology; rule-based expert systems; Construction of ES. Components of an ES, The explanation facility, Rule-based formation and forward and backward chaining techniques for problem solving.

Unit VIII: Natural Language Processing

Introduction. Vocabulary and issues, How NLP programs work, Natural Language application, NL Interfaces.

Reference Books:

1. Artificial Intelligence - A New Synthesis by Nils J. Nilsson, Morgan Kaufmann Publishers.
2. Artificial Intelligence: Strategies and techniques for complex problems solving by George Luger, Addison-Wesley, 2003.
3. Artificial Intelligence - A Modern Approach by Stuart Russell & Peter Norvig, Prentice

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CSL DE 308			Computer Graphics				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understand the basics of computer graphics, different graphics systems and applications of computer graphics.
2. Discuss various algorithms for scan conversion and filling of basic objects and their comparative analysis.
3. Use of geometric transformations on graphics objects and their application in composite form.
4. Explore projections and visible surface detection techniques for display of 3D scene on 2D screen.

Course Contents:

Computer Graphics and output primitives: Concepts and applications, Random and Raster scan devices, Refresh Cathode ray tubes, LCD monitors, Laser, Printers, Keyboards, Mouse, Scanners, Graphics Software output primitives: Line drawing algorithm : DDA along with Bresenhan's.

Circle generating algorithm, Midpoint algorithms: ellipse and other curves. Attributes of output primitive, Anti-aliasing, Area

filling: Filled area primitive: Scan-line Polygon fill Algorithm, boundary fill algorithm, flood fill algorithm.

2-D-Transformation, Viewing, Clipping Two-dimensional Transformations: Translation, scaling, rotation, reflection, shear, matrix representation of all homogeneous coordinates, composite transformation. 2D-projections– parallel and perspective projection. Two-dimensional viewing, Viewing pipeline Window-to-view port transformation. Clipping operations. Line Clipping: Cohen Sutherland, Nicholl-lee- Nichol land Liang-barsky, Polygon Clipping.

3-D Transformation and Visible surface detection

Three-dimensional object representations: Polygon Surface, Tables, Plane Equation. Curved lines and Surfaces: Spline representation, Interpolating and approximation curves, continuity conditions Cubic Splines, Bezier curves B-Spline curves: characteristics and generation, 3-D Transformation. Visible Surface detection Algorithm: Object based and image-based methods,

depth comparison, A-Buffer, Back face removal, Scan-line method, Depth Sorting Method Area subdivision method.

Overview of multimedia

Overview of multimedia, Classification, basic concept of sound/audio MIDI: devices, messages, software. Speech, Video and Animation: Basic concept, computer-based animation, methods of controlling animation, display of animation, and transmission of animation.

Data Compression

Storage space, coding requirements. Source, entropy and hybrid coding some basic compression technique: run length code, Huffman code. JPEG: Image preparation, Lossy sequential DCT – based mode, expanded lossy DCT based mode, Lossless mode, Hierarchical mode. MPEG, Huffman Encoding, LZW compression.

Text Books: -

1. Computer Graphics by Donand Hearn & M. Pauline Baker PHI.
2. Multimedia Computing Communication & Applications “By Ralf Steimnety & Kerla Neshtudt.” Prince Hall.

Reference Books:

1. Principles of Interactive Compo Graphics; W.M. Newman & Robert F Sproull.
2. Computer Graphics by Rogers TMH.
3. Introduction to Computer Graphics Anirban Mukhopadhyay & Arup Chattopadhyay.
4. Schaum’s outlines – Computer Graphics Mc Graw Hill International Edition.5
5. Principles of Multimedia by Ranjan Parekh TMH.
6. “Multimedia Systems Design”, P.K. Andleigh & K. Thakrar, Prentice Hall Pvt. Ltd.

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CSL DE 310			Web Technology				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Explain the history of the internet and related internet concepts that are vital in understanding web development.
2. Discuss the insights of internet programming and implement complete application over the web.
3. Demonstrate the important HTML tags for designing static pages and separate design from content using Cascading Style sheet.

Course Contents:

UNIT 1: Introduction to HTML5

Base HTML tags, Paragraph tags, Break tags, Header tags, Bold, Italic tags, Ordered Lists, Unordered List, hyperlinks, table, iFrame, Form, Text fields, Text areas, Radio Buttons, Comments in code, Data Input, Meta tags, Images, Anchor elements, Introduction to hosting Websites

UNIT 2: CSS3 & Front-end development Frameworks :

CSS selectors, properties, attributes, ID, Class, Element, Internal Style sheet, External Style Sheet, Inline Styles, Box model, CSS colors, fonts, background images, Styling Links and ID, Introduction to Front-end frameworks and Libraries: React, Angular, Vue.js, Bootstrap

UNIT 3: JavaScript

Introduction to JavaScript: data types, variables, alerts, naming conventions, Strings, Arithmetic, modulo operator, comparison operators, increment and decrement, functions, control statements, switch statements, Arrays, Introduction to Document Object Model, Adding JavaScript to websites, Selecting HTML elements with JavaScript, Manipulating and changing styles of HTML elements with JavaScript, JavaScript objects, event handling and responding to events

UNIT 4: Back-end development, APIs, DBMS, Deployment, Security

Introduction to server-side programming languages: Node.js, Express.js, Django. Handling Requests, and Responses: the GET Request, responding to requests, POST requests, JSON parsing, AJAX basics, Rendering Website, Version control using Git/GitHub, CRUD operations on the database MySQL/Mongo, deploying web app, API paths, parameters, Introduction to creating RESTful APIs and Web Services, Security considerations in web development: Authentication, Authorization, Introduction to Continuous Integration and Continuous Deployment tools.

Reference Books:

1. Ramesh Bangia, “Internet and Web Design”, New Age International
2. Ivan Bayross,” HTML, DHTML, Java Script, Perl & CGI”, BPB Publication
3. Deitel, “Java for programmers”, Pearson Education
4. Chris Bates, “Web Programing Building Internet Applications”, 2nd Edition, WILEY, Dreamtech
5. Joel Sklar, “Principal of web Design” Vikash and Thomas Learning
6. Horstmann, “CoreJava”, Addison Wesley

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CSL DE 312			Cluster & Grid Computing				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understand the cluster and grid computers.
2. Understand task scheduling and resource allocation in cluster and grid environment.
3. Understand middleware architecture in Cluster and Grid Environment.
4. Understand the cluster and grid computing platform as an alternative to traditional supercomputers.

Course Contents:

Unit 1.

Introduction: High Performance Computing (HPC), Grand Challenge Problems Computational and communication intensive, Parallel Architectures Classifications SMP, MPP, NUMA, Clusters and Components of a Parallel Machine, Conventional Supercomputers and its limitations.

Unit 2:

Multi-processor and Multi Computer based Distributed Systems. Cluster and Grids: Cluster Components Processor/machine

Unit 3:

High Speed Interconnections goals, topology, latency, bandwidth, Example Interconnect: Myrinet, Inifiniband, QsNet, Fast Ethernet, Gigabit Ethernet, Light weight Messaging system/Light weight communication Protocols.

Unit 4:

Cluster Middleware Job/Resource Management System, Load balancing, Scheduling of parallel processes, Enforcing policies, GUI.

Unit 5:

Introduction to programming tools such as PVM, MPI, Cluster Operating Systems Examples: Linux, MOSIX, CONDOR, Characteristics of Grid, Computational services, Computational Grids, Data grids/Storage grids, management and applications, Different components of Grid Grid fabric, Grid middleware.

Unit 6:

Grid applications and portal, Globus toolkit Ver.2.4, web services, MDS, GRAM, Grid Security –Cryptography, Authentication, Integrity, Digital Signature, Digital Certificates, Certificate Authority, MD 5, RSA, GSI, GSSAPI, Directory Service, LDAP, GRID FTP, GASS Fault Tolerance: Fault detection and diagnosis of Clusters and Grids. Recent advances in cluster and grid computing.

Reference Books:

1. R. K. Buyya, High Performance Cluster Computing: Programming and Applications, PHI, 2021
2. D. Janakiram, Grid Computing, Tata Mcgraw Hill, 2005.

CSL DE 314			Big Data Analytics				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Be exposed to big data.
2. Understand the methods of data collections.
3. Learn the different ways of Data Analysis.
4. Be familiar with the visualization of data.

Course Contents:

Unit I Introduction to Big Data

Introduction to Big Data Platform – Challenges of conventional systems – Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs. reporting – Modern data analytic tools, Statistical concepts: Sampling distributions, resampling, statistical inference, prediction error.

Unit II Data Analysis

Regression modelling, Multivariate analysis, Bayesian modelling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics – Rule induction – Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.

Unit III Mining Data Streams

Introduction to Streams Concepts – Stream data model and architecture – Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments -Counting oneness in a window – Decaying window – Realtime Analytics Platform (RTAP) applications – case studies – real time sentiment analysis, stock market predictions.

Unit IV Frequent Itemsets And Clustering

Mining Frequent itemsets – Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques - Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

Unit V Frameworks And Visualization

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques, interaction techniques; Systems and applications:

Reference Books:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
4. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007
5. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
6. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.

Optimization Techniques

MTL DC 401 **L-T-P: 3-1-0(Credits=4)**

UNIT-I

Introduction to Operations Research. Linear Programming: Principles of simplex Method, Simplex method in tabular form, Duality and Dual simplex Method, Degeneracy and cycling. Transportation and Assignment problems.

UNIT-II

Matrix games, Fundamental theorem of matrix games, Games with mixed strategies. Matrix game and its relation with linear programming. Network Scheduling: Networks and basic components, Rules for Network Construction, CPM and PERT.

UNIT-III

Queuing theory: Objectives, Different characteristics of a queuing system, Measures of Performance, Poisson process, Birth-death process, Steady-state behavior of Markovian and Erlangian queuing models (MM/1, MM/c, and $M/E_K/1$).

Recommended Books:

1. V.K. Kapoor, Operations Research, Sultan Chand and Sons, 9th Edition, 2014.
2. Taha, Operations Research, Pearson India, 9th Edition, 2014.
3. Kanti Swaroop, Operations Research, Sultan Chand, 2014.

4. S.D. Sharma, Operations Research, Kedar Nath Ram Nath and Co., 2013.
5. B.E. Gillet, Introduction of Operations research, Tata Mc-Graw Hill, 32nd Edition, 2008.
6. G.K. Murthy, Linear Programming, John Wiley & Sons Ltd. 1st Edition, 1983.
7. D. Gross and C.M. Harris, Fundamentals of Queuing Theory, Wiley India Private Limited; 4th Edition, 2012.

CSL DE 401			Data Warehousing & Data Mining				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understand data warehouse concepts, architecture, business analysis and tools.
2. Understand data pre-processing and data visualization techniques.
3. Study algorithms for finding hidden and interesting patterns in data.
4. Understand and apply various classification and clustering techniques using tools.

Course Contents:

Module - I

Data Mining: Introduction, Relational Databases, Data Warehouses, Transactional databases, Advanced database Systems and Application, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining.

Module - II

Data Warehouse: Introduction, A Multidimensional data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology, From Data warehousing to Data Mining.

Module - III

Data Processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept Hierarchy Generation. Data Mining Primitives, Languages and System Architecture: Data Mining Primities, DMQL, Architectures of Data Mining Systems.

Module – IV

Concept Description: Data Generalization & Summarization – Based Characterization, Analytical Characterization, Mining class Comparisons, Mining Descriptive Statistical Measures in Large Databases.

Module - V

Mining Association Rules in Large Databases: Association Rule Mining, Single – Dimensional Boolean Association Rules, Multilevel Association Rules from Transaction

Databases, Multi-Dimensional Association Rules from Relational Databases, From Association Mining to Correlation Analysis, Constraint – Based Association Mining.

Module - VI

Classification and Prediction: Classification & Prediction, Issues Regarding Classification & Prediction, Classification by decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification based on concepts & Association Rule, Other Classification, Prediction, Classification Accuracy.

Module - VII

Cluster Analysis: Types of Data in Cluster Analysis, Partitioning methods, Hierarchical methods, Density – Based Methods, Grid – Based Methods, Model – Based Clustering Methods, Outlier Analysis. Mining Complex Types of Data.

Reference Books:

1. Jiawei Han & Micheline Kamber - Data Mining Concepts & Techniques Publisher Harcourt India. Private Limited.
2. G.K. Gupta – Introduction to Data Mining with case Studies, PHI, New Delhi – 2006.
3. Berson & S.J. Smith – Data Warehousing Data Mining, COLAP, TMH, New Delhi – 2004
4. H.M. Dunham & S. Sridhar – Data Mining, Pearson Education, New Delhi, 2006.

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School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

CSL DE 403			Compiler Design				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understand the different phases of compiler in detail.
2. Analyze the requirement of NFA and DFA in compiler design.
3. Case studies of tools available for lexical analysis, parsing like LEX, YACC.
4. Understanding and develop code optimization techniques.
5. Analyzing and Designing time and space efficient compiler.

Course Contents:

Unit I: Introduction

Issues related to programming Language Design, Issues related to Finite-State Machines, Phases of Compiler Design, Lexical Analysis, Error Detection and Recovery.

Unit II: Basic Parsing Techniques

Parsers, Shift-Reduced Parsers, Operator-Precedence Parsing, Predictive Parsers.

Unit III: Top-Down Parsing, Bottom-up Parsing

LL (1) Grammars, Recursive Descent Parsers, LR Grammars – Concepts and Terminology, LR(O) Parsers, SLR (1) Parsers, Canonical LR (1) Parsers, LALR (1) Parsers, using ambiguous grammar. Attributed Translation Grammar, L-Attributed Translation Grammar.

Unit IV: Syntax-Directed Translation (SDT)

SDT Schemes, Implementation of SDTs, Intermediate Code, Parse Trees and Syntax Trees. Three Address Code, Quadruples and Triples. Translation schemes for Declarations, Assignment statements, Boolean Expressions, Flow of control statements, Array references in Arithmetic Expressions, Procedure Calls, Case Statements, and |Structures.

Unit V: Semantic Analysis & Type Checking

Introduction, Implicit-Stacking in Recursive Descent Compilation, Semantic Stacks in Bottom-up Compilation, Action-Symbols in Top-Down Compilation, Type Expressions, Overloaded Functions, Polymorphic Functions.

Unit VI: Symbol Table Handling Techniques

When to construct and Interact with the symbol Table, Symbol-Table Contents, Operations on symbol Table. Symbol Table organizations for Block – Structured Languages.

Unit VII: Run-Time Storage Organization and Management

Static Storage Allocation, Dynamic Storage Allocation, Heap Storage Allocation, Garbage Collection and Compaction.

Unit VIII: Code Optimization

Principal sources of Optimization, Loop Optimization, Loop-Invariant Computation, Induction variable elimination, Other Loop Optimizations, The DAG representation of Basic Blocks. Global Data – Flow Analysis.

Unit IX: Code Generation

Object programs, Problems Code Generation, A simple Code Generator. Register Allocation and Optimization, Code Generation from DAG, PEECP hole optimization.

Reference Books:

1. Principles of Compiler Design; A. V. Aho& J. D. Ullman Narosa
2. The Theory and Practice of Compiler Writing, J Tremblay and Paul G. S.

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School of Mathematics

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CSL DE 405			Wireless & Mobile Computing				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understand the basis of Mobile and Pervasive Computing and its enabling technologies.
2. Understand the Scientific and engineering principles related to the enabling technologies.
3. Understand the Distributed computer systems architecture and organization.
4. Understand the Networking and communication systems theory and practice (inc. important issues such as security).

Course Contents:

Unit 1: Introduction

Introduction to mobile computing, Adaptability in mobile computing, mechanism for adaption, support to build adaptive applications, applications of mobile computing.

Unit 2: Mobility Management

Registration area, location management principles and techniques, Mobile IP and their classification,

Unit 3: Data Dissemination

Challenges, data dissemination, Mobile data caching, cache consistency, performance and architectural issues, Mobile Cache management techniques, broadcasting invalidation report, handing disconnection, energy and bandwidth efficiency algorithms.

Unit 4: Adhoc Networks

Introduction to Adhoc networks, routing issues, Body, Personal, and Local Ad Hoc Wireless Networks, Multicasting Techniques in Mobile Ad Hoc Networks, Quality of Service in Mobile Ad Hoc Networks, Power-Conservative Designs in Ad Hoc Wireless Networks, Energy efficient algorithms for routing in Adhoc networks, clustering techniques, Coding for the Wireless Channel, Unicast Routing Techniques for Mobile Ad Hoc Networks, Position-Based Routing in Ad Hoc Wireless Networks.

Unit 5: Sensor Networks

Introduction to sensor networks, Data aggregation and data dissemination techniques in sensor networks, localization in sensor networks, Energy saving issues for Wireless Sensor, Broadcast Authentication and Key Management for Secure Sensor Networks, Embedded Operating Systems for Wireless Microsensor Nodes, Time Synchronization and Calibration in Wireless Sensor Networks, The Wireless Sensor Network MAC, Topology Construction and Maintenance in Wireless Sensor Networks.

Unit 6: Security in Adhoc and Sensor Networks

Basic concepts of cryptography, Key generation and management techniques, D-H algorithm, DES, Algorithms for key generation and distribution, overhead issues in key management w.r.t. mobile clients, Hashing techniques.

Unit 7: Mobile Middleware

Introduction to mobile middleware, adaption, agents, and service discovery.

Reference Books:

1. Sandeep K Gupta, Frank Adelstein, Golden G. Richard, Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing: TMH

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CSL DE 407			Multimedia System				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Graduate will demonstrate an ability to do research by designing and conducting experiments, analyze and interpret multimedia data individually as well as part of multidisciplinary teams.
2. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications of the customers and society needs.
3. Graduates will demonstrate an ability to prepare short films and documentaries to showcase their knowledge of multimedia tools.

Course Contents:

UNIT 1 Multimedia preliminaries and applications

Multimedia preliminaries and applications: Development and use of multimedia packages; introduction to virtual reality and modeling languages. CD-ROM and the Multimedia Highway, Introduction to making multimedia - The Stages of project, the requirements to make good multimedia, Multimedia skills and training, Training opportunities in Multimedia. Motivation for multimedia usage, Frequency domain analysis, Application Domain & ODA etc. Multimedia-Hardware and Software: Multimedia Hardware – Macintosh and Window production Platforms, Hardware peripherals – Connections, Memory and storage devices, Media software – Basic tools, making instant multimedia, Multimedia software and Authoring tools, Production Standards.

UNIT 2 Multimedia building blocks

Multimedia – making it work – multimedia building blocks – Text, Sound, Images, Animation and Video, Digitization of Audio and Video objects, Data Compression: Different algorithms concern to text, audio, video and images etc., Working Exposure on Tools like Dream Weaver, 3D Effects, Flash Etc.

UNIT 3 Multimedia and the Internet

Multimedia and the Internet: History, Internet working, Connections, Internet Services, The World Wide Web, Tools for the WWW – Web Servers, Web Browsers, Web page makers and editors, Plug-Ins and Delivery Vehicles, HTML, designing for the WWW – Working on the web, Multimedia Applications – Media Communication, Media Consumption, Media Entertainment, Media games.

UNIT 4 Multimedia-looking towards Future

Multimedia-looking towards Future: Digital Communication and New Media, Interactive Television, Digital Broadcasting, Digital Radio, Multimedia Conferencing, Assembling and delivering a project-planning and costing, Designing and Producing, content and talent, Delivering, CD-ROM technology.

Reference Books:

1. Steve Heath, 'Multimedia and Communication Systems' Focal Press, UK.
2. Tay Vaughan, 'Multimedia: Making it Work', TMH
3. Keyes, 'Multimedia Handbook', TMH

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School of Mathematics

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MTL DE 404			Partial Differential Equations				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students shall be able to:

1. Understand fundamental concepts of partial differential equations of first order, second order etc.
2. Learn various methods to solve linear and nonlinear partial differential equations.
3. Understand to solve various real-life problems by formulating them into a partial differential equations.
4. Apply partial differential equations to solve relevant problems of engineering.

Section A

Introduction to partial differential equations of first order, Linear partial differential equations with constant coefficients, Homogeneous equations, Non homogeneous equation.

Section B

Partial differential equation of 2^{nd} and higher order, classification examples of partial differential equations, partial differential equations relevant to industrial problems, solution of elliptic, hyperbolic and parabolic equations.

Section C

Partial Differential equations of second order with variable coefficients, Monge's Methods, Separation of variables, Canonical forms, Cauchy's problem, Legendre polynomials- Solution of Legendre's Equation, Generation function, Rodrigue's formula, orthogonal Properties. Integrals involving Legnedre polynmials, Fourier-Legendre expansion, Recurrence relations, Legendre's function of second kind $Q_n(x)$, Christoffel's summation formula.

Reference Books:

1. F. John, Partial Differential equations, Narosa Publication
2. I. N. Sneddon, Elements of Partial Differential Equations, Mc-Graw Hill
3. H.F. Weinberger, A First Course in Partial Differential equations, John Willey & Sons,
4. W.E. William, Partial Differential equations, Clarendan Press, Oxford.

T. Amarnath, PDE,

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MTL DE 408				**Topology**			Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

COURSE OUTCOMES

After successful completion of this course, students shall be able to;

1. Understand the basic terminology of countable, uncountable sets and topological spaces.
2. Understand the various concepts such as (local) connectedness, (local) compactness of a topological space.
3. Understand the concept of separation axioms and their characterizations.
4. Know the notions of compactification and metrization.

COURSE CONTENT

Section A

Infinite sets, Countable & Uncountable sets, Statements of axiom of choice, Well ordering principle, Zorn's Lemma, Principle of transfinite induction, Housdorff's maximal principle, Topological spaces, open sets, closed sets, neighbourhoods, Bases for a Topology, order Topology, Product Topology, Subspace Topology, limit points, closures, interiors, closed sets, Continuous function. Homeomorphism. Metric Topology, quotient Topology (Introduction only).

Section B

Connectedness and Compactness: Connectedness, Local Connectedness, path connectedness, Compact spaces, locally compact spaces and Limit point Compact spaces.

Section C

Separation Axioms: Hausdorff spaces, Regularity, Normality, Urysohn's lemma, Tietze extension Theorem, Urysohn'sMetrization Theorem. Tychnoff Theorem, Completely regular spaces, One-point Compactification and Stone-Cech compactification (Statement only).

SUGGESTED BOOKS

1. J. R. Munkers, Topology- A First Course: Prentice Hall of India, 2 ed, 2002.
2. K. D. Joshi, General Topology, New age international, 2014.
3. M. G. Murdeshwar, General Topology, New Age International Pvt Ltd Publishers, 2008.
4. G. F. Simmons, Introduction to Topology & Modern Analysis, Tata McGraw-Hill Education, 2004.
5. J. L. Kelley, General Topology, Springer-Verlag, Berlin-Heidelberg-New York, 1975.
6. S. Willard, General Topology, Addison-Wesley Publishing company, Dover, 2012.

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MTL DE 410			**Functional Analysis**				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hours	3 Hours	10	20	20	50	100

COURSE OUTCOMES

After successful completion of this course, students shall be able to;

1. Understand the foundations of functional analysis in the context of normed linear spaces The Big Theorems (Hahn-Banach, Baire Category, Uniform Boundedness, Open Mapping and Closed Graph) and several applications.
2. Understand the important notion of duality in Banach and Hilbert spaces.
3. Define continuity of linear operators. Determine whether an operator is continuous/ discontinuous.
4. Apply his or her knowledge of functional analysis to solve mathematical problems.

Course Content:

Section A

Normed spaces, Banach spaces, further properties of Normed spaces, Subspaces, Linear operators, linear functionals, Bounded and continuous linear operators, Normed spaces of operators, Dual spaces.

Section B

Hahn-Banach theorem (Extension of linear functional) for nomed spaces, Application to bounded linear functional on C [a,b], Adjoint operator, reflexive spaces, uniform boundedness theorem, Convergence of sequence of operators and functionals, Open mapping theorem, Closed linear operator, Closed graph theorem.

Section C

Inner product spaces, Hilbert spaces, Further properties of inner product spaces, Orthogonal complements and direct sums, Orthonormal sets and sequences, Total orthonormal sets and sequences, Representation of functionals on Hilbert spaces, Hilbert adjoint operators, Self adjoint, Unitary and normal operators.

SUGGESTED BOOKS

1. A. Mukherjea and K. Pothoven, Real and Functional Analysis, Springer-Verlag New York Inc.
2. E. Kreyszig, Introductory functional Analysis with application, John Willey and Sons, 1978.
3. Bachman and Naricel, Functional Analysis, Dover Publication, 2nd edition, 2003.
4. G.F. Simmons, Introduction to Topology and Modern Analysis ,TMH, 2003.

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MTL DE 412			Information Theory & Coding				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understands the fundamentals of coding theory.
2. Understands concept of source coding.
3. Understands channel coding theorem.

Course Contents:

Section A

UNIT 1 Mathematical Background and Introduction

Introduction to algebraic structures, Field extensions, Quadratic Residues, Krawtchouk Polynomials, Combinatorial Theory, Probability Theory, Shannon's Theorem, Coding Gain, Problems.

Section B

UNIT 2 Linear and Good Codes

Block Codes, Linear codes, Hamming codes, Majority Logic decoding, Weight enumerators, The Lee Metric, Hadamard codes and generalizations, Binary Golay code, The Ternary Golay code, Constructing codes from other codes, Reed-Muller codes, Kerdock codes

Section C

UNIT 3 Bounds on Codes and Cyclic Codes

Gilbert bound, Asymptotic Plotkin bound, Griesmer bound, The Linear Programming bound, Cyclic codes, Zeros of a Cyclic codes, The Idmpotent of a cyclic codes, Other representations of a Cyclic codes.

Reference Books:

1. Introduction to Coding Theory, J. H. Van Lint

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MTL DE 416			Game Theory				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understand the fundamentals of strategic interactions through the analysis of strategic form games.
2. Identify and analyse dominant strategy equilibria, pure strategy Nash equilibrium, and mixed strategy Nash equilibrium.
3. Gain insights into the existence of Nash equilibrium and methods for computing equilibrium strategies.
4. Understand matrix games and the minimax theorem, providing a foundation for decision-making in zero-sum games.

Course Contents:

Section A

Introduction: Rationality, intelligence, common knowledge, von Neumann - Morgenstern utilities; Noncooperative Game Theory: strategic form games, dominant strategy equilibria, pure strategy nash equilibrium, mixed strategy Nash equilibrium, existence of Nash equilibrium, computation of Nash equilibrium, matrix games, minimax theorem, extensive form games, subgame perfect equilibrium, games with incomplete information, Bayesian games.

Section B

Mechanism Design: Social choice functions and properties, incentive compatibility, revelation theorem, Gibbard-Satterthwaite Theorem, Arrow's impossibility theorem, Vickrey-Clarke-Groves mechanisms, dAGVA mechanisms, Revenue equivalence theorem, optimal auctions.

Section C

Cooperative Game Theory: Correlated equilibrium, two person bargaining problem, coalitional games, The core, The Shapley value, other solution concepts in cooperative game theory

Reference Books:

1. Roger B. Myerson, Game Theory: Analysis of Conflict, Harvard University Press, September 1997.
2. Martin J. Osborne, An Introduction to Game Theory, Oxford University Press, 2003

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MTL DE 418			**Differential Geometry**				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

COURSE OUTCOMES

After successful completion of this course, students shall be able to;

1. Understand fundamental concepts of geometry like parametric curves, surfaces, manifold etc.
2. Based on above concepts they are able to understand fundamental theorems like Frenet-Serret theorem, Fundamental form of Surfaces, Weingartem theorem etc.
3. They are able to understand the Intrinisic and Extrinsic properties of surfaces
4. They are able to solve numerical analysis problems and applications based on above structures.

COURSE CONTENTS

Section A

Parameterized differential curve, regular curve, arc length, plane curves, Euler's theorem, curvature, fundamental theorem for plane curves, involutes and evolutes, Frenet-Serret theorem, torsion, helix, Fundamental theorem for curves in R3.

Section B

Regular surfaces. Inverse function theorem, Implicit function theorem, Change of Co-ordinates, tangent plane, Orientable surface, Tangential maps, First fundamental of a surface, Metric on a regular surface, Curvature for Surfaces, Euler's theorem, Gauss map, Meusnier theorem

Section C

Metric equivalence of surfaces, local isometry, Intrinisic and Extrinsic properties of surfaces, Christoffel Symbols of the first Kind and second kind, Gauss theorem, Fundamental theorem for regular surfaces in R3, Geodesic curves.

SUGGESTED BOOKS

1. T.J. Will More, Introduction to differential Geometry, Oxford University press, 2012
2. John Mccleary, Geometry from a differential view point, Cambridge University press, 2013
3. Barrett O'Neill, Elementary Differential Geometry, Academic press, 2006

4. W. Klingenberg, A course in differential geometry, springer- Verlag, 1978

MTL DE 420			Fuzzy set & Fuzzy logic				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:

After successful completion of this course, students will be able to;

1. Understand the basic ideas of fuzzy sets, operations and properties of fuzzy sets and also about fuzzy relations.
2. Understand the basic features of membership functions, fuzzification process and defuzzification process.
3. Design fuzzy rule-based system.
4. Gain the knowledge about fuzzy C-Means clustering.

Course Contents:

UNIT I Classical sets: Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets. Classical and Fuzzy relations: Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation.

UNIT II λ Fuzzification and Defuzzification: Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, other forms of the implication operation.

UNIT III Fuzzy Systems: Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories.

UNIT IV Fuzzy decision making: Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi objective decision making, Fuzzy Bayesian, Decision method, Decision making under Fuzzy states and fuzzy actions.

UNIT V Fuzzy Classification: Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy **C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition.**

Reference Books:

1. Timothy J. Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley,2010.

2. George J. KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995.
3. S. Rajasekaran, G. A. Vijayalakshmi - Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications, PHI, New Delhi,2003.

MTL DE 424			Tensor Calculus				Pre Requisites			
							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Course Outcomes:
After successful completion of this course, students shall be able to;

1. Understand the algebra of tensor analysis.
2. Understand various properties of tensor analysis.
3. Solve numerical based problem using tensor calculus.
4. Apply the concept of tensor analysis to solve relevant problems of engineering.

Course Contents:

Section A

Contravariant vector, covariant vector, transformation of contravariant and covariant vector, definition of a tensor, tensor field, addition and subtraction of tensors, multiplication of tensors.

Section B

Inner product of tensors, contraction on tensors, symmetric tensors, anti-symmetric tensors, properties of tensors, Invariant of tensors.

Section C

Differential manifolds, Lie –brackets, properties of Lie- bracket, connexions, properties of connexions, covariant derivatives

Recommended Books:

1.Prasun Kumar, Nayak, Textbook of Tensor Calculus and Differential Geometry, PHI learning,2012
2.R.S. Mishra, A course in Tensors with applications to Riemannian Geometry, Pothishala private limited,1973
3. J.L. Synge, Tensor Calculus, Dover publications, 2012
4.Shalini Singh, Tensor Calculus, Ivy publishing house, 2009

Infrastructure/Faculty/Staff Required

To run the newly inducted course B.Tech. in Mathematics & Computing in School of Mathematics smoothly, there is requirement of the following postulates from time to time.

1. Need of four rooms having capacity of 60 students with desk.
   a. One room with 60 desks for 1st year.
   b. One room with 60 desks for 2nd year.
   c. One room with 60 desks for 3rd year.
   d. One room with 60 desks for 4th year.
2. Two Labs having seating capacity of 30 students with appropriate systems.
3. Faculty required for B.Tech. programme in Mathematics & Computing
   a. Professors (01)
   b. Associate Professor (01)
   c. Assistant Professor (08)
4. Staff Required
   a. Technical Assistant (02)
   b. Helper for Lab/Office (01)

Infrastructure Requirement

S No.	B tech Program	Intake	Requirement	Expenditure for Furniture and Lab Equipment
1.	First Year	60	1. One class room 2. One lab with 30 Computer Systems, furniture and fixture. 3. 30 Desks (Two Seated)	₹ 65,00,000
2.	Second Year	60+60	1. One class room 2. 30 Desks (Two Seated)	₹ 5,00,000
3.	Third Year	60+60 +60	1. One class room 2. One lab with 30 Computer Systems, furniture and fixture. 3. 30 Desks (Two Seated)	₹ 65,00,000
4.	Fourth Year	60+60 +60+60	1. One class room 2. 30 Desks (Two Seated)	₹ 5,00,000

विज्ञानं ब्रह्म

Shri Mata Vaishno Devi University

(Approved Under Section 2(f) and 12(B) of UGC act of 1956)

School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

Revenue/Expenditure

S No.	B tech Program	Expenditure on Salary Faculty/Staff		Expenditure on Salary
1.	First Year	Assistant Professor (03) = ₹ 45,00,000 Helper (01) = ₹ 1,20,000		₹ 45,00,000 + ₹ 1,20,000 = ₹ 46,20,000
2.	Second Year	**Existing Staff**	**New appointment during this year**	₹ 46,20,000 + ₹ 45,00,000 + ₹ 6,00,000 = ₹ 97,20,000
		Assistant Professor (03) = ₹ 45,00,000 Helper (01) = ₹ 1,20,000 Total = ₹ 46,20,000	Assistant Professor (03) = ₹ 45,00,000 Technical Assistant (01) = ₹ 6,00,000	
3.	Third Year	**Existing Staff**	**New appointment during this year**	₹ 97,20,000+ ₹ 30,00,000+ ₹ 15,00,000 + ₹ 6,00,000 = ₹ 1,48,20,000
		Assistant Professor (06) = ₹ 90,00,000 Helper (01) = ₹ 1,20,000 Technical Assistant (01) = ₹ 6,00,000 Total = ₹ 97,20,000	Professor(01) = ₹ 30,00,000 Assistant Professor (01) = ₹ 15,00,000 Technical Assistant (01) = ₹ 6,00,000	
4.	Fourth Year	**Existing Staff**	**New appointment during this year**	
		Professor(01) = ₹ 30,00,000 Assistant Professor (07) = ₹ 1,05,00,000 Technical Assistant (02) = ₹ 12,00,000 Helper (01) = ₹ 1,20,000 Total = ₹ 1,48,20,000	Associate Professor(01) = ₹ 24,00,000 Assistant Professor (01) = ₹ 15,00,000	₹ 1,48,20,000+ ₹ 24,00,000 + ₹ 15,00,000 + = ₹ 1,87,20,000

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School of Mathematics

Faculty of Science, SMVDU

Kakryal, Katra 182320

Revenue (Generation and Expenditure)

S No.	B tech Program	Intake	Revenue	Expenditure
1.	First Year	60	₹ 1,41,000 X 60 = ₹ 84,60,000	₹ 46,20,000
2.	Second Year	60+60	₹ 1,41,000 X 120 = ₹ 1,69,20,000	₹ 97,20,000
3.	Third Year	60+60 +60	₹ 1,41,000 X 180 = ₹ 2,53,80,000	₹ 1,48,20,000
4.	Fourth Year	60+60 +60+60	₹ 1,41,000 X 240 = ₹ 3,38,40,000	₹ 1,87,20,000

Integrated B.Sc./M.Sc. Course Structure (Mathematics)

FYUG COURSE STRUCTURE AS PER NEP 2020 (2024 onwards)

COURSE STRUCTURE AS PER NEP 2020

Integrated programs Batch 2022 and 2023

&

FYUG Programs (Four years) from 2024 onwards

Semester-I

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD101	Differential Calculus	4-0-0	4
Minor	XXX MI XXX	**Choose one from the pool of Courses from allied schools**	4-0-0	4
Multidisciplinary	XXX MU XXX		3-0-0	3
Ability Enhancement Course	XXX AE XXX		3-0-0	3
Skill Enhancement course	XXX SE XXX		2-0-0/ 1-0-2	2
Value added course-1	XXX VA XXX		2-0-0	2
Value added course-2	XXX VA XXX		2-0-0	2
		Total Credits	**20-0-0/ 19-0-1**	**20**

Minor

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Minor	MTL MI101	Differential Calculus	4-0-0	4

Multidisciplinary Courses from Mathematics for other Departments/Disciplines:

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Multidisciplinary	MTL MU101	Fundamentals of Calculus and applications	3-0-0	3

Semester-II

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD102	Integral Calculus	4-0-0	4
Minor	XXX MI XXX	**Choose one from the pool of Courses from allied schools**	4-0-0	4
Multidisciplinary	XXX MU XXX	**Choose one from the pool of Courses from other schools**	3-0-0	3
Ability Enhancement Course	XXX AE XXX	**Choose one from the pool of Courses from other schools**	3-0-0/ 2-1-0	3
Skill Enhancement course	XXX SE XXX	**Choose one from the pool of Courses from other schools**	2-0-0/ 1-0-2	2
Value added course-3	XXX VA XXX	**Choose one from the pool of Courses from other schools**	2-0-0	2
Value added course-4	XXX VA XXX	**Choose one from the pool of Courses from other schools**	2-0-0	2
		Total Credits	**20-0-0/ 18-1-1**	**20**

Minor

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Minor	MTL MI102	Integral Calculus	4-0-0	4

Multidisciplinary Courses from Mathematics for other Departments/Disciplines:

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Multidisciplinary	MTL MU102	Probability & Statistics with Applications	3-0-0	3

Semester-III

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD201	Fundamentals of Algebra	4-0-0	4
Major	MTL MD203	**Analytical Geometry**	4-0-0	4
Minor/ DSE-1				
Multidisciplinary	XXX MU XXX	**Choose one from the pool of Courses from other schools**	3-0-0	3
Ability Enhancement Course	XXX AE XXX	**Choose one from the pool of Courses from other schools**	3-0-0	3
Skill Enhancement course	XXX SE XXX	**Choose one from the pool of Courses from other schools**	2-0-0/ 1-0-2	2
		Total Credits	**20-0-0/ 19-0-1**	**20**

	Minor/ DSE-I		
Course Code	**Course Name**	**L-T-P ****	**Credits**
MTL MI201	Computer Programming	3-0-0	3
MTM MI201	Computer Programming Lab	0-0-2	1
MTL MI203	Theory of Reliability	4-0-0	4

Multidisciplinary Courses from Mathematics for other Departments/Disciplines:

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Multidisciplinary	MTL MU201	Discrete Structures with Applications	3-0-0	3

Semester-IV

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD202	Multivariable Calculus	4-0-0	4
Major	MTL MD204 MTM MD204	Probability and Statistics Probability and Statistics Lab	3-0-0 0-0-2	3 1
Major	MTL MD206	Vector Calculus	4-0-0	4
Major	MTL MD208	Real Analysis-I	4-0-0	4
Minor/ DSE-2				
		Total Credits	**19-0-2**	**20**

	Minor/ DSE-2		
MTL MI202	Set Theory	4-0-0	**4**
MTL MI204	Information Theory	4-0-0	4
MTL MI206	Biomathematics	4-0-0	4

Semester-V

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD301	Real Analysis-II	4-0-0	4
Major	MTL MD303	Linear Algebra	4-0-0	4
Major	MTL MD305	Fuzzy Logic and Applications Fuzzy Logic and Applications Lab	3-0-0 0-0-2	3 1
Minor/ DSE-3				
IAPC		**Choose one from the pool of Courses from other schools**		2
Skill Enhancement course	XXX SE XXX	**Choose one from the pool of Courses from other schools**	2-0-0/1-0-2	2

		Total Credits		**20**

	Minor/ DSE-3		
MTL MI301	Integral Transforms	4-0-0	4
MTL MI303	Decision Theory	4-0-0	4
MTL MI305	Econometrics	4-0-0	4

Semester-VI

Broad Category of Course	**Course Code**	**Course Title**	**L-T-P**	**Credits**
Major	MTL MD302	Ordinary Differential Equation	4-0-0	4
Major	MTL MD304	Number Theory	4-0-0	4
Major	MTL MD306	Complex Trigonometry and Theory of Equations	4-0-0	4
Major	MTL MD308	Metric Spaces	4-0-0	4
Minor/ DSE-4				
		Total Credits	**20-0-0**	**20**

	Minor/ DSE-4		
MTL MI302	Linear Programming and Game Theory	4-0-0	4
MTL MI304	Queuing Theory	4-0-0	4
MTL MI306	Financial Mathematics	4-0-0	4

Semester-VII

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD407	Research Methodology	4-0-0	4
Major	MTL MD401	Abstract Algebra	4-0-0	4
Major	MTL MD403	Advanced Real Analysis	4-0-0	4
Major	MTL MD405	Partial Differential Equations	4-0-0	4
Minor/ DSE-5				
		Total Credits	**20-0-0**	**20**

	Minor/ DSE-5		
MTL MI401	Coding Theory	4-0-0	4
MTL MI403	Numerical Methods	4-0-0	4

Semester-VIII

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD402	Complex Analysis	4-0-0	4
Major	MTL MD404	Advanced Linear Algebra	4-0-0	4
Major	MTL MD406	Differential and Integral Equations	4-0-0	4
Major	MTL MD408	Measure Theory	4-0-0	4
Minor/ DSE-6				
		Total Credits	**20-0-0**	**20**

OR

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD402	Complex Analysis	4-0-0	4
Minor/ DSE-6				
Research Project/Dissertation	MTD MD402		12-0-0	12
		Total Credits	**20-0-0**	**20**

	Minor/ DSE-6		
MTL MI402	Numerical Solution of Ordinary and Partial Differential Equations	4-0-0	4
MTL MI404	Commutative Algebra	4-0-0	4

Semester-IX

Broad Category of Course	**Course Code**	**Course Title**	**L-T-P**	**Credits**
Major	MTL MD501	Topology	4-0-0	4
Major	MTL MD503	Calculus of Variations and Mechanics	4-0-0	4
Minor/ DSE-7				
Minor/ DSE-8				
Research Project/Dissertation	MTD MD501		12-0-0	12
		Total Credits	**28-0-0**	**28**

	Minor/ DSE-7		
MTL MI501	Optimization Techniques	4-0-0	4
MTL MI503	Survey Sampling	4-0-0	4
MTL MI505	Algebraic Number Theory	4-0-0	4
	Minor/ DSE-8		
MTL MI507	Advanced topics in Algebra	4-0-0	4
MTL MI509	Stochastic Process	4-0-0	4

Semester-X

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD502	Differential Geometry	4-0-0	4
Major	MTL MD504	Functional Analysis	4-0-0	4
Minor/ DSE-9				
Minor/ DSE-10				
Research Project/Dissertation	MTD MD502		12-0-0	12
		Total Credits	**28-0-0**	**28**

	Minor/ DSE-9		
MTL MI502	Applied Algebra	4-0-0	4
MTL MI504	Fluid Mechanics	4-0-0	4
	Minor/ DSE-10		
MTL MI506	Graph Theory	4-0-0	4
MTL MI508	Advanced Topics in Topology	4-0-0	4

LIST OF MINOR/ DSEC OURSES:

	Minor/ DSE-**I**		
Course Code	**Course Name**	**L-T-P ****	**Credits**
MTL MI201	Computer Programming	4-0-0	4
MTM MI201	Computer Programming Lab	0-0-2	1
MTL MI203	Theory of Reliability	4-0-0	4
	Minor/ DSE-2		
MTL MI202	Set Theory	4-0-0	**4**
MTL MI204	Information Theory	4-0-0	4
MTL MI206	Biomathematics	4-0-0	4
	Minor/ DSE-3		
MTL MI301	Integral Transforms	4-0-0	4
MTL MI303	Decision Theory	4-0-0	4

MTL MI305	Econometrics	4-0-0	4
	Minor/ DSE-4		
MTL MI302	Operation Research	4-0-0	4
MTL MI304	Queuing Theory	4-0-0	4
MTL MI306	Financial Mathematics	4-0-0	4
	Minor/ DSE-**5**		
MTL MI401	Advanced Calculus and Special Functions	4-0-0	4
MTL MI403	Numerical Methods	4-0-0	4
	Minor/ DSE-6		
MTL MI402	Advanced Numerical Methods	4-0-0	4
MTL MI404	Commutative Algebra	4-0-0	4
	Minor/ DSE-7		
MTL MI501	Optimization Techniques	4-0-0	4
MTL MI503	Survey Sampling	4-0-0	4
	Minor/ DSE-8		
MTL MI505	Advanced topics in Algebra	4-0-0	4
MTL MI507	Stochastic Process	4-0-0	4
	Minor/ DSE-9		
MTL MI502	Modern Applied Algebra	4-0-0	4
MTL MI504	Fluid Mechanics	4-0-0	4
	Minor/ DSE-10		
MTL MI506	Measure Theory	4-0-0	4
MTL MI508	Advanced Topics in Topology	4-0-0	4

Differential Calculus

MTL- MD 101 **L-T-P:4-0-0**

(Credits=4)

UNIT-I

Limit and continuity (ε and δ definition), properties of limit and classification of discontinuities, Successive differentiation, Leibnitz's theorem and applications. Partial and total derivative of implicit and composite functions. Euler's theorem for homogenous functions.

UNIT-II

Tangent and Normal(Polar co-ordinates only), Curvature, Asymptotes, Singular points, Double point, inflection point, Concavity and Convexity, Envelopes and Evolutes, Tracing of curves. Parametric representation of curves and tracing of parametric curves, tracing of curves in polar coordinates.

UNIT-III

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of some standard functions, Indeterminate forms, Maxima and Minima for functions of two variables, Lagrange's multipliers.

Recommended Books:

1. Shanti Narayan, Differential Calculus, S Chand; 30th revised edition, 2005.
2. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.
3. Courant and John, Introduction to Calculus and Analysis, Vol I, Springer
4. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
5. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.

Fundamentals of Calculus and Applications

MTL- MU101 **L-T-P:3-0-0(Credits=3)**

UNIT-I

Geometrical representation of real numbers, limit and continuity (ε and δ definition), Differentiability of functions, partial and total derivative of implicit and composite functions, successive differentiation, Leibnitz's theorem, Euler's theorem on homogeneous functions.Taylor and Maclaurin's series expansions.

UNIT-II

Tangent and Normal, Curvature, Asymptotes, Singular points, Double point, Rolle's theorem, Mean Value theorems, Applications based on Rolle's theorem and Mean Value theorems.

UNIT-III

Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Maxima and Minima for functions of two variables, Lagranges multipliers, Indeterminate forms, Applications (Heat Equation, wave equation, CR equations etc.)

Recommended Books:

1. Shanti Narayan, Differential Calculus, S Chand; 30th revised edition, 2005.
2. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.
3. Courant and John, Introduction to Calculus and Analysis, Vol I, Springer
4. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
5. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.

Integral Calculus

MTL-MD102 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Reduction formula and derivation of different types of reduction formulas. Differentiation under integral sign by Leibnitz rule, Beta and Gamma functions and their properties, Differentiation under the integral sign, Leibnitz rule.

UNIT-II

Improper Integrals: Improper integrals of Type-I and Type–II, convergence and divergence of improper integrals. Double and triple integrals, Evaluation of integrals using change of order of integration, Jacobian transformations.

UNIT-III

Definite Integrals and their properties, length of a curve and rectification, quadrature and area between curves, change of order of integration, surface and volumes integrals of solids of revolution.

Recommended Books:

1. Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas' Calculus, Pearson, 14th Ed. 2018.
2. Hughes – Hallett et al., Calculus – Single and Multivariable, John-Wiley and Sons.
3. Robert T. Smith & Ronald B. Minton, Calculus, , McGraw-Hill, 4th Ed. 2011.
4. Shanti Narayan and P.K. Mittal, Integral Calculus, S. Chand & Company, Revised Edition.
5. R. K. Ghosh and K.C. Maiti, Integral Calculus, New Central Book Agency-Kolkata.
6. Joseph Edwards, Integral Calculus for Beginners, Arihant Publications; First edition (2016).

Probability & Statistics with applications

MTL-MU102 **L-T-P: 3-0-0**

(Credits=3)

UNIT-I

Measures of central tendency (A.M., G.M., H.M.), Median and mode, their merits and demerits. Measures of Dispersion: Range. Inter Quartile range, Mean Deviation, Standard Deviation, Variance & Coefficient of Variation. Skewness and Kurtosis meaning and measures.

UNIT-II

Review of Probability- Random Variable and Distribution function, Marginal and Joint probability distribution, Mathematical expectation of sum and product of random variables.Moments, Moment generating function.

UNIT-III

Bivariate data: Correlation and Regression, Karl Pearson and Spearman Rank Correlation coefficient. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Suggested Books:

1. R. D. Yates and D. J. Goodman, Probability and Stochastic Processes, Wiley, 1999.
2. Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, Third Edition, Prentice-Hall, 2008.
3. P. Z. Peebles, Probability, Random Variable and Random Signal Processing, Fourth Edition, McGraw-Hill, 2001.
4. S. Ross, First Course in Probability, Sixth Edition, Prentice-Hall, 2002.
5. R. E. Ziemer, Elements of Engineering Probability and Statistics, Prentice Hall, 1997.
6. M. B. Pursley, Random Processes in Linear Systems, Prentice-Hall, 2002.
7. H. Stark and J W. Woods, Probability and Random Processes with Applications to Signal Processing, Third Edition, Prentice-Hall, 2002.
8. R. Gallager, Stochastic Processes: Theory for Applications, Cambridge, 2014.

Fundamentals of Algebra

MTL MD201 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Divisibility, Primes, GCDs, and the Euclidean Algorithm, Congruence, Division Modulo n and Linear Congruence Equations, Fermat's and Euler's theorems, Introduction to Groups, Groups of transformations, General and special linear groups, Dihedral groups, Subgroups, Cyclic Groups

UNIT-II

Permutation Groups, The alternating groups A_n, Normal Subgroups, Quotient Groups. Homomorphisms and Isomorphism. Fundamental Theorem of Group Homomorphism, Coset decomposition, Lagrange's theorem and its consequences, Cayley's theorem.

UNIT-III

Introduction to Rings, Subrings, Integral Domains, Ideals, Prime and Maximal Ideals, Fields, Fields of Fractions and Quotient Rings, Fundamental Theorems of Ring Homomorphism, Finite Fields.

Recommended Books:

1. I.N. Herstein, Topics in Algebra, 2nd Edition, 1975
2. D. Dummit and R. Foote, Abstract Algebra, 3rd edition, Wiley, 2003
3. Thomas W. Hungerford, Abstract Algebra: An Introduction, Third Edition, 2014
4. Thomas Judson's Abstract Algebra: Theory and Applications, 2013 edition
5. Rajendra Kumar Sharma, SudeshKumari Shah and AshaGauri Shankar, Alegebra I: A Basic Course in Algebra, Pearson Education, 2011.

Analytical Geometry

MTL-MD203 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Review of concepts in two-dimensional geometry including important results on lines, circles, parabola, ellipse and hyperbola. Polar Coordinates and conic sections in polar coordinates. Recapitulation of elements of three-dimensional geometry, Directpion Cosine and direction Ratios, Different forms of equations of plane, Determination of planes satisfying given conditions, angle between planes,Bisector planes.

UNIT-II

Equation of line (symmetrical and general form), Angle between a line and a plane, Coplanarity of two lines, Shortest distance between two lines. Various forms of equation of the sphere, Plane section of a sphere, Tangent plane to a sphere, Intersection of two spheres, Angle of intersection of two spheres, orthogonality of spheres, Sphere through a given circle, Intersection of a sphere and a line, Power of a point, Plane of contact, Polar plane,, Radical plane, Coaxial system of spheres.

UNIT-III

Definition of cone, Enveloping cone of a sphere, Various equations of cone, Intersection of a line and a quadratic cone, Tangent lines and tangent plane at a point of cone, Condition that a plane may touch a cone, Reciprocal cones, Intersection of two cones with a common vertex, Right circular cone. Definition of cylinder, cylinder whose generators intersect a given conic and are parallel to a given line, Equation of the right circular cylinder, cylinder with a given axis and radius.

Recommended Books:

1. Loney, S. L., The Elements of Co-ordinate Geometry, MacMillan & Co., 1895.
2. Narayan, Shanti, Analytical Solid Geometry, S. Chand & Co., 12th Edition.
3. Chatterjee, Dipak, Analytical Solid Geometry, PHI Pvt. Ltd.
4. Balasubrahmanyam, P., Venkataraman, G. R., Coordinate Geometry of two and three dimension.
5. Puri, M. R., Solid Geometry, Kapoor Publications.
6. Puri, M. R., Coordinate Geometry of Conics, Kapoor Publications.

Computer Programming

MTL MI201 **L-T-P:4-0-0**

(Credits=4)

UNIT-I

Introduction to C Language: Introduction, Basic block diagram and functions of various components of computer, Compiler and Interpreter. Basic Difference between Procedure Oriented Language and Object-Oriented Language, Data Types, Variables, Constants, Input / Output, Operators (Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associatively, Expression Evaluation, Type conversions.

UNIT-II

Fundamentals and Control Structures of 'C': Features of C language, structure of C program, comments, Selection Statements (Decision making decisions)–if and switch statements, Repetition statements (loops)-while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Simple C Program examples.

UNIT-III

Array and Functions: Basic concept of array, 1-D and 2-D arrays, declarations & Initializations of 1-D and 2-D array, String, String Input / Output functions, string manipulation functions, string /data conversion. Concept of user defined functions, prototype, definition of function, parameters, parameter passing, calling a function, call by value, call by reference, Pointers–Introduction, Arrays and Pointers, Pointer Arithmetic, pointers to void, pointers to functions, Introduction to structures and unions.

Text Books:

1. C: The Complete Reference, Herbert Schildt, McGrawHill
2. Programming in ANSI C, Forth Edition, E Balagurusamy, TMH
3. Let us C, YashwantKanitkar
4. Computer fundamentals and Programming in C, Pradipdey and ManasGhosh, Oxford

Theory of Reliability

MTL MI203 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Basics of Reliability, Classes of life Distributions.Series, Parallel, stand by configuration, (k, n) systems, Bridge structure. Reliability Models of maintained and non– maintained systems. Availability Theory and its Modeling for various configurations.

UNIT-II

Reliability Allocation problems.Discrete Replacement Policies Age, Block, Preventive and Corrective Maintenance policies, concept of minimal repair, notions of aging.

UNIT-III

Renewal theory and its applications, Solution of Renewal type equations, Algorithms by Min Xie. Optimisation problems with respect to systems Reliability. Overhaul and repair decision and other related problems. Introduction to Software Reliability.

Recommended Books:

1. Barlow, R.E. and Proschan, F., Mathematical theory of Reliability, John Wiley and Sons, New York 1965.
2. Cox., D.R., Renewal Theory, Matheun London, 1962
3. Jardine, A.K.S., Maintenance, Replacement and Reliability, Pitman
4. Morse, P.M., Queues, Inventories and Maintenance, John Wiley and Sons,
6. Rau, John, G., Optimization and Probability in systems engineering, Van Nostrand Reinhold Company, 1970.
7. Roy, Billinton and Ronald, W. Allan, Reliability Evaluation of Engineering Systems, Pitman Publication, 1983.
8. Tillman, F.A. Hwang, Optimisation of systems Reliability Marcel Dekker inc.
9. 8. Musa, J.D. Jannino Antony, Software Reliability Measurement, Prediction and Applications, McGraw Hill, 1987.
10. Lewis, E.E., Introduction to Reliability Engineering, 2nd edition, John Wiley & Sons, 1994.
11. Villemeur, A., Reliability, Availability, Maintainability and Safety Assessment, John Wiley,

Discrete Structures with Applications

MTL MU201 **L-T-P: 3-0-0**

(Credits=3)

UNIT-I

Review of Sets and relations, types of relations. Unary and Binary operations, partial order relation, chains and anti-chains, Structure theorem, Basics of Lattice Theory.

UNIT-II

Boolean algebra, order relation in Boolean algebra, Boolean polynomials, Block diagrams for gating network, Connections with logic. Boolean subalgebra, Application of Boolean Algebra to switching circuit.

UNIT-III

Basic concepts of graph theory: vertices, edges, degree, paths, circuits, cycles, complete graphs and trees. Multi-graphs, weighted graphs and directed graphs, Adjacency matrix of a graph, Connected and disconnected graphs, K-connected and K-edge connected graphs. Shortest path in weighted graphs, Eulerian path and circuits, Hamiltonian path and circuits, Planar graphs, chromatic number, colouring of graphs. Four colouring problem(statement only).

Recommended Books:

1. C.L. Liu, Elements of Discrete Mathematics, McGraw Hill International editions, 2006.
2. J.P Tremblay & R. Manohar, Discrete Mathematical Structures with applications to Computer Science, Tata McGraw Hill Book Co. 1988
3. N. Iyengar, Discrete Mathematics, Vikas Publishing House Pvt Ltd, 2003.
4. Richard Johnson Baugh, Discrete Mathematics, 7th ed., pearsons, 2009.
5. NarsinghDeo, Graph Theory, Prentice Hall of India, 2004.
6. K.D. Joshi, Foundations of Discrete Mathematics, Wiely Eastern Ltd., 1989

Multivariable Calculus

MTL MD202 **L-T-P: 4-1-0 (Credits=5)**

UNIT-I

Concept of neighbourhood of a point in R^n ($n > 1$), interior point, limit point, open and closed sets in R^n ($n > 1$). Functions of several variables, limit and continuity of functions of two variables. Partial differentiation and total differentiation, sufficient condition for differentiability. Chain rule, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

UNIT-II

Extrema of functions of two variables, method of Lagrange multipliers, Concavity and Convexity, Definition of vector field, divergence and curl, Double integration over rectangular region, double integration over nonrectangular region, Double integrals in polar co-ordinates.

UNIT-III

Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates. Change of variables in double integrals and triple integrals, Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem for line integrals, conservative vector fields**.**

Recommended Books:

1. M. J,.Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. S C Mallik and S Arora: Mathematical Analysis, New Age International Publications
3. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
4. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus,Springer(SIE). Indian reprint, 2005.

Probability and Statistics

MTL MD-204 **L-T-P: 3-0-0**

(Credits=3)

UNIT-I

Review of probability- Random variable and Distribution function, Marginal and joint probability distribution Mathematical expectation of sum and product of random variables. Moments, Cumulates and their interrelationship, Moment generating function and cumulate generating function, Binomial, Normal and Poisson with their properties.

UNIT-II

Correlation and Regression, Karl Pearson and Spearman's rank correlation coefficient, Regression coefficient and lines of regression. Partial and multiple correlation, Sampling distribution, Standard error, Simple random sampling and stratified random sampling with their role.

UNIT-III

Test of significance for mean, variance, proportion and correlation coefficient, Test of goodness of fit and Independence of attributes, Analysis of variance for one way and two way classified data.

Recommended Books:

1. Erwin Kreyzig, Advanced Engineering Mathematics.
2. S. Ross, A First Course in Probability,
3. W. Feller, An introduction to Probability Theory and its applications
4. S.P. Gupta, Statistical Methods, Sultan Chand and sons.
5. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
6. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

Probability & Statistics Lab

MTM MD 208 **L-T-P:0-0-2**

(Credit=1)

List of Experiments:

1. Fitting of binomial distributions for given n and p.
2. Fitting of binomial distributions after computing mean and variance
3. Fitting of Poisson distributions after computing mean
4. Application Problems based on area property of normal distribution
5. To find the ordinate for a given area for normal distribution
6. Fitting of normal distribution when parameters are given
7. Fitting of normal distribution when parameters are not given
8. To compute the multiple and partial correlation coefficients
9. To compute ranks and find rank correlation coefficient
10. To fit simple and multiple linear regression to the given data
11. To apply chi-square test for distribution fitting
12. To apply t-test for comparing two population means
13. To use F-test for testing the difference between several means

SUGGESTED BOOKS

1. A.M. Goon, M.K. Gupta and B. Das Gupta, Fundamental of Statistics, Vol. I & Vol. II, World Press, 1988.
2. A.M. Goon, M.K. Gupta, B.Das Gupta, A Dublin of Statistical Theory-Vol. I & II, World Press, 1983.
3. S.C. Gupta , V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2005.
4. An Introduction to probability theory and mathematical statistics: V.K. Rohatgi (Wiley Eastern Publisher Ltd., New Delhi), 1988.
5. S.P.Gupta, Statistical Methods, Sultan Chand and Sons, 2012.

Vector Calculus

MTL MD206 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Scalar and vector product of three vectors, product of four vectors, Reciprocal vectors. Vector differentiation, Scalar Valued point functions, vector valued point functions, derivative along a curve, directional derivatives, Gradient of a scalar point function, geometrical interpretation of grad, Divergence and curl of vector point function, characters of Divergence and Curl of a vector point functions, Gradient, divergence and curl related vector identities.

UNIT-II

Curvilinear coordinates, Orthogonal curvilinear coordinates. Conditions for orthogonality fundamental triad of mutually orthogonal unit vectors. Gradient, Divergence, Curl and Laplacian operators in terms of orthogonal curvilinear coordinates, Cylindrical co-ordinates and Spherical coordinates.

UNIT-III

Vector integration, Line integral, Surface integral, Volume integral.Theorems of Green, Gauss & Stokes and problems based on these theorems.

Recommended Books:

1. Murrary R. Spiegal : Theory and Problems of Advanced Calculus, Schaum Publishing Company, New York.
2. Murrary R. Spiegal : Vector Analysis, SchaumPublisghing Company, New York.
3. N. Saran and S.N. NIgam. Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
4. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Real Analysis-I

MTL MD208 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Countable and uncountable sets. Order Properties of R and Q. Bounded sets and their properties, sup and inf of sets. The least upper bound(l.u.b) and greatest lower bound(g.l.b) properties and equivalent conditions including the nested interval property, Archimedean property of R.

UNIT-II

Sequences, Bounded, unbounded and oscillatory sequences, monotone sequences and their convergence, lim-sup and lim-inf and convergence criterion using them, subsequences, Cauchy sequences and their convergence criterion, Sandwich rule. Nested interval theorems, Cauchy's first and second limit theorems.

UNIT-III

Infinite Series: Convergence and divergence of infinite series of real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence of positive term series: Integral test, Basic comparison test, Limit comparison test, D'Alembert's ratio test,

Cauchy's nth root test; Raabe's test, Gauss test. Alternating series, Leibniz test, Absolute and conditional convergence.

Recommended Books:

1. T. Apostol, Mathematical Analysis.
2. R. Courant and F. John, Introduction to Calculus and Analysis, Volume I.
3. Goldberg, Methods of Real Analysis.
4. Rudin, Principles of Mathematical Analysis.
5. Bartle, Robert G., & Sherbert, Donald R. (2015). Introduction to Real Analysis (4th ed.). Wiley India Edition. New Delhi.
6. Denlinger, Charles G. (2011). Elements of Real Analysis. Jones and Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.

Set Theory

MTL MI202 **L-T-P: 4-0-0 (Credits=4)**

UNIT-I

Partition of sets and equivalence relations, Fundamental theorem on equivalence relations, Partial order, partially and totally ordered sets. Functions and its types, composition of functions,.

UNIT-II

Cartesian products of family of sets, Axioms of choice and its results, maximal and minimal elements, Zorn's Lemma, Hausdroffmaximality theorem, Well ordering principle, Principle of transfinite induction, equipotent sets and its relations.

UNIT-III

Denumerable, non-denumerable sets and their results, Cardinal numbers, its operations and properties.Cantor's theorem, Schroeder Berstein theorem, Continuum hypothesis, Ordinal numbers and its properties, Lexico graphical ordering.

Books Recommended:

1. R.P.Grimaldi, Discrete Mathematicsand Combinatorial Mathematics, Pearson Education, 5th edition, 2006.

2. P. R. Halmos, Native Set Theory, Springer, 2019.

3. E. Kamke, Theory of Sets, Dover Publishers, 2010.

4. H. B. Enderton, Elements of Set Theory, Elsevier, 2006.

Information Theory

MTL MI204 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Measure of Information – Axioms for a measure of uncertainty, The Shannon entropy and its properties. Joint and conditional entropies, Transformation and its properties, Noiseless coding - Ingredients of noiseless coding problem, Uniquely decipherable codes, Necessary and sufficient condition for the existence of instantaneous codes, Construction of optimal codes.

UNIT-II

Discrete Memoryless Channel - Classification of channels, Information processed by a channel, Calculation of channel capacity, Decoding schemes, The ideal observer, The fundamental theorem of Information Theory and its strong and weak converses, Continuous Channels-The time-discrete Gaussian channel, Uncertainty of an absolutely continuous random variable, The converse to the coding theorem for time-discrete Gaussian channel, The time-continuous Gaussian channel, Band-limited channels.

UNIT-III

Some intuitive properties of a measure of entropy –Symmetry, normalization, expansibility, boundedness, recursivity, maximality, stability, additivity, subadditivity, nonnegativity, continuity, branching, etc. and interconnections among them, Axiomatic characterization of the Shannon entropy due to Shannon and Fadeev, Information functions, The fundamental equation of information.

Recommended Books:

1. Ash, R., Information Theory, Inderscience Publishers, New York, 1965.
2. Reza, F.M., An Introduction to Information Theory, MacGraw-Hill Book Company Inc., 1961.
3. Aczela, J. and Daroczy, Z., On Measures of Information and their Characterizations, Academic Press, New York

Biomathematics/Mathematical Modelling

MTL MI206 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Dynamic Modeling with Difference equations: The Malthusian Model, Non-linear models, Analyzing non-linear models, Variations on the Logistic Model. Linear Models of Structured Populations: Linear models and Matrix algebra, Projection matrices for structured models, Eigenvectors and Eigenvalues. Curve Fitting and Biological Modeling: Fitting curves to data, The method of least squares, Polynomial curve fitting.

UNIT-II

Modeling Molecular Evolution: Background on DNA, An introduction to Probability, Conditional Probabilities, Matrix Models of Base Substitution. Genetics: Mendelian Genetics, Probability distributions in genetics, Linkage, Gene frequency in populations. Applications of stochastic

processes in biology, Markov processes, Markov chains, Chapman-Kolmogorov Equations, Limiting distribution of Markov chain.

UNIT-II

Introduction of a Field K and an Algebra A over K, Examples, Types of Algebras, Basis and Dimensions of an Algebra, Gametic Algebra for Simple Mendalian Inheritance, Zygotic Algebra, Communicative Duplication of Algebras. Non associativity of Inheritance. Baric Algebra and Weight Function, Idempotents and Train Algebras, Genetic Algebra, Application of the Genetic Algebra in theory to genetics (Self-fertilization, autopolyploid and Sex-linked Inheritance).

Recommended Books:

1. Allman, Elizabeth S. and Rhodes, John A., Mathematical Models in Biology, Cambridge University Press (2004).
2. Keshet, E. L., Mathematical models in biology, McGraw-Hill, New York (1988).
3. Rubinow, S. I., Introduction to Mathematical Biology, John Wiley, New York (1975)

REAL ANALYSIS-II

MTL MD301 **L-T-P: 4-0-0 (Credits=4)**

UNIT-I

Interior points and limit points, open, closed and perfect sets, Compact sets, Limit and continuity, Basic properties of continuous functions, sequential criterion for continuity & discontinuity, Algebra of continuous functions, Properties of continuous functions on closed and bounded intervals; Uniform continuity, Non-uniform continuity criteria, Uniform continuity theorem.

UNIT-II

Definition of Riemann integration, Inequalities for upper and lower Darboux sums, Necessary and sufficient conditions for the Riemann integrability, Definition of Riemann integration by Riemann sum and equivalence of the two definitions, Riemann integrability of monotone functions and continuous functions, Properties of Riemann integrable functions, Definitions of piecewise continuous and piecewise monotone functions and their Riemann integrability, intermediate value theorem for integrals, Fundamental theorems (I and II) of calculus, and the integration by parts.

UNIT-III

Integration of unbounded functions with finite limits of integration, Comparison tests for convergence, Convergence of Beta functions, Cauchy's test for convergence of improper integral, absolute convergence of improper integral, Convergence at ∞ and $-\infty$, Comparison tests for convergence at ∞, Convergence of Gamma functions, Abel's test and Dirichlet's test for convergence.

Recommended Books:

1. T. Apostol, Mathematical Analysis.
2. R. Courant and F. John, Introduction to Calculus and Analysis, Volume I.
3. Goldberg, Methods of Real Analysis.

4. Rudin, Principles of Mathematical Analysis.
5. Bartle, Robert G., & Sherbert, Donald R. (2015). Introduction to Real Analysis (4th ed.). Wiley India Edition. New Delhi.

Linear Algebra

MTL MD303 **L-T-P: 4-0-0 (Credits=4)**

UNIT-I

Matrices: Symmetric, Skew- Symmetric, Hermitian, Skew- Hermitian, Unitary and Orthogonal. Rank of a matrix, characteristic polynomial of a matrix, eigen values, eigen vectors. Cayley – Hamilton theorem and its applications, Determinant and its properties.

UNIT–II

Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vector space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension, Homomorphism and isomorphism of vector spaces, Linear transformations, Vector space of all the linear transformations.

UNIT–III

Linear transformation on vector space and their examples, algebra of linear transformation on a vector space, Null space and range of linear transformation, Rank - Nullity theorem. Inverse of a linear transformation on finite dimensional vector space. Matrix representation of linear transformation, Bilinear forms.

Recommended Books:

1. I. K. Rana, An Introduction to Linear Algebra, Ane Books Pvt. Ltd., 2010
2. Shanti Narayan, P.K. Mittal, A Textbook of Matrices, S. Chand Publishing, 2010
3. S.Axler, Linear Algebra Done Right, 2nd Edition, John-Wiley, 1999.
4. S.Kumaresan, Linear Algebra:A Geometric Approach, Prentice-Hall of India, 2004
5. Hoffman & Kunze, Linear Algebra, Prentice Hall PTR,3rd revised ed., 1999

Fuzzy Logic and Applications

MTL MD305 **L-T-P: 4-0-0 (Credits=4)**

UNIT-I

Fuzzy Sets: Basic definitions, α-cuts, strong α-cuts, level and support of a fuzzy set, core and height, normal and subnormal, convex fuzzy sets, cutworthy and strong cutworthy property, standard fuzzy set operations, equilibrium points, fuzzy set inclusion, cardinality of a fuzzy set, the degree of subsethood, Representation of fuzzy sets, three basic decomposition theorems of fuzzy sets, Extension principle for fuzzy sets, the Zadeh's extension principle, Images and inverse images of fuzzy sets, Fuzzy numbers, relation between fuzzy number and a convex fuzzy set.

UNIT-II

Operators on fuzzy sets: fuzzy complements, equilibrium of a fuzzy complement, equilibrium of a continuous fuzzy complement, first and second characterization theorems of fuzzy complements, fuzzy intersections (t-norms), standard fuzzy intersection as the only idempotent t-norm, standard intersection, algebraic product, bounded difference and drastic intersection as examples of t-norms, decreasing generator, the Pseudo-inverse of a decreasing generator, increasing generators and their Pseudo inverses, conversion of decreasing generators and increasing generators, characterization theorem of t-norms, Fuzzy unions, standard union, algebraic sum, bounded sum and drastic union as examples of t-conorms, characterization theorem of t-conorms.

UNIT-III

Fuzzy Relations: Crisp and fuzzy relations, projections and cylindrical extensions, binary fuzzy relations, domain, range and height of a fuzzy relation, membership matrices, sagittal diagram, inverse of a fuzzy relation, composition of fuzzy relations, standard composition, max-min composition. Decision–making in Fuzzy environment: Individual decision-making, fuzzy decision, simple examples, idea of weighting coefficients, Fuzzy group decision, Pattern recognition, Clustering, Fuzzy optimization Models.

Recommended Books:

1. G.J.Klir and B.Yuan: Fuzzy Sets and Fuzzy Logic; Theory and Applications, Sixth Indian Reprint, Prentice Hall of India, New Delhi, 2002.
2. H.J. Zimmerman, Fuzzy Set Theory and it Application, Second revised edition, Springer Science+Business Media, Newyork, 1990.

Fuzzy Logic and Applications Lab

MTP MD305 **L-T-P: 0-0-2**

(Credits=01)

Practical: (Fuzzy Logic and Applications)

1. 2D and 3D plots in MATLAB
2. Write programs to draw Triangular and Trapezoidal Membership functions
3. Write programs to draw Gaussian and Sigmoid Membership functions
4. Write programs/Simulate fuzzy operations
5. Simulate the Fuzzy Inference System (Washing Machine)
6. Write programs to model a fuzzy decision-making problem
7. Write programs to model a fuzzy clustering analysis problem
8. Simulate Fuzzy Control

Recommended Books:

1. Fuzzy Logic Toolbox User's Guide, The Mathworks, Inc., 2020
2. S. N. Sivanandan, S. Sumathi, S. N. Deepa, Introduction to Fuzzy Logic using MATLAB, Springer, 2007

3. Ismail H. Altaş, Fuzzy Logic Control in Energy Systems, with design applications in MatLab/Simulink, The Institution of Engineering and Technology, United Kingdom, 2017

Integral Transforms

MTL-MI301 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Laplace Transforms: Function of bounded variation, Laplace transform of 1, t^n, e^{at}, sin(at), cos(at), sinh(at), cosh(at), erf(t), shifting properties, expressions with proofs for: 1. L{t^n f(t)} 2. L{f(t)/t} 3. L{$\int$f(u) du}. Unit step functions, Heaviside function, direct functions and their Laplace transformation, Laplace transform of periodic function. Evaluation of inverse Laplace transform, partial fraction method, Heaviside development, convolution theorem. Application to solve initial and boundary value problems involving the ordinary differential equation with one dependent variable.

UNIT-II

Fourier Analysis: Periodic functions, trigonometric series, Fourier series for functions with period 2Π, complex form of the series, functions with arbitrary period, even and odd functions, half range series, approximation by trigonometric polynomials, square error, Bessel's inequality, Parseval's identity, Fourier integral.

UNIT-III

Fourier transforms: Properties of Fourier transform, Fourier cosine and sine transforms of elementary functions, Properties of Fourier Transform: Linearity, Shifting, change of scale, Modulation, Fourier Transform of Derivatives and Integrals, Convolution Theorem (statement only), Inverse of Fourier Transform and its examples. Z-transforms: Properties of Z-transform, and inverse Z-transforms and applications, region of convergence of Z-transforms.

Recommended Books:

1. S.C. Malik & S. Arrora , Mathematical Analysis, New Age International, 1992.
2. T. Veerarajan, Engineering Mathematics, Tata McGraw Hill
3. Jordan, Mathematical Techniques, Oxford Press
4. Potter, Advance Engineering Mathematics, Oxford Press
5. Irvin Kreyszig, Advanced Engineering Mathematics, Wiley

Decision Theory

MTL MI303 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Concepts of process, Bayesian Procedure, Decision Functions, Different Decision Criterion for Decision Problems under risk and Uncertainty. Regret versus Loss Function, Expected Value of perfect Information, Utility and its Application in Decision Problems.

UNIT-II

Multilevel (Multi-Stage) Decision problem, Principles of Diagramming and Locating of Optimal Strategy.Decision Analysis with Continuous Distribution for the Events.

Decision Process with Sampling Information: Simple Sampling and Binomial Sampling and with Updating the Prior Distribution of the Events (Use of Posterior Distribution). Decision Process and Normal Distribution of Event.

UNIT-III

Basic Concepts of the Sampling time Markov Decision process Examples, Stationary Policies, Average Cost Criterion, Policy- Iteration Algorithm, Linear Programming Formulation Procedure and Comparison of Linear Programming Formulation Procedure and Policy Iteration Algorithm for Solving an Infinite Stage Markov Decision Problem. Simple Concept of Semi Markov Decision Process. Application of Markov Decision Process to Inventory Management, Maintenance, Manufacturing Process, Telecommunication and Queuing theory.

Recommended Books:

1. Baird, Bruce F., Managerial decision under uncertainty – An introduction to the analysis of ecision making (chapters- 7,8,10,12), John Wiley, 1989.
2. Buchanan, J. T., Discrete and dynamic decision analysis, 1982.
3. Bunn, D. W., Applied decision analysis, McGraw Hill book co., 1986.
4. Mogran Johns, Introduction to decision theory.
5. Tijms, H. C., Stochastic model – An algorithmic approach, John Wiley

Econometrics

MTL MI305 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Two-variable linear model: Linear model and underlying assumptions, ordinary least squares estimators, linear hypothesis, Testing a single coefficient, Testing the significance of the complete regression, Testing the significance of a subset of coefficients confidence estimation, R^2 and adjusted R^2, Use of extraneous information in terms of exact and stochastic linear restrictions, restricted restrictions, Prediction in the least squares model, point and interval predictors.

UNIT-II

Tests for structural change, use of dummy variables, problem of multicollinearity and its remedies, estimation of parameters by generalised least squares in models with non spherical disturbances, heterosceldasticity of disturbances, estimation under autocorrelated disturbances.

UNIT-III

Bayesian analysis of linear models, Simultaneous equation model, concept of structural and reduced forms, problem of identification, rank and order conditions of identifiability, indirect least squares, Two stage least square and limited information maximum, likelihood estimation.

Recommended Books:

1. J. Johnston, Econometric methods
2. Judge, Griffiths, Hill, Hitkepohl, The theory and practice of econometrics.
3. D.N. Gujrati, Basic Econometrics (McGraw-Hill).

Ordinary Differential Equation

MTL MD302 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Linear differential equations, equations reducible to linear form, exact differential equations, equations reducible to exact differential forms, First order higher degree equations solvable for *x, y, p*. Clairaut's form and singular solutions. Orthogonal trajectories.

UNIT-II

Linear differential equations of higher order, Operator D, Rules to find the complementary solutions of the differential equations, Rules to find the particular solutions of the differential equations, Method of Variation of Parameters technique, Cauchy's Homogenous linear equations, Method of variation of parameters. Ordinary simultaneous differential equations.

UNIT-III

Series solutions of differential equations, Series solution of second order linear differential equations, Power series method, and regular singular point of the differential equations, Methods of Frobenius to solve differential equations. Exact and non-exact linear differential equations. Legendre and Bessel's functions.

Recommended Books:

1. N.P.Bali, Manish Goyal, A Text Book of Engineering Mathematics, PLI
2. Ross, Wiley, Differential Equations
3. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc.,9th edition, 2011.
4. Simons, George, Differential equations with applications

Number Theory

MTL MD304 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Principle of Mathematical induction (Strong version), Greatest integer function, Divisibility, Greatest common divisor, Euclidean Algorithm, Least common multiple, Special divisibility tests, The Fundamental Theorem of arithmetic, Sieve of Eratosthenes, Properties of congruences, Residues classes.

UNIT-II

Solutions of linear congruences, Diophantine equations, Chinese remainder Theorem, Fermat's little theorem, Wilson's theorem. Arithmetic functions such as sigma, tau, Euler's phi function etc., Dirichlet product and Dirichlet inverse , Euler's Theorem, Mersenne primes and Fermat numbers.

UNIT-III

Primitive Roots and indices, Existence of primitive roots, Quadratic Reciprocity, Quadratic Residues, The Legendre Symbol and its properties, Lemma of Gauss, The Gaussian Reciprocity Law, The Jacobi symbol.

Reference Books:

1. Burton, D.M., Elementary Number Theory, 7 th Edition. McGraw-Hill Education, 2010.
2. Robbins, N., Beginning Number Theory, 2nd Edition. Narosa Publishing House.
3. Hardy, G. H. and Wright, E. M., An introduction to the Theory of Numbers, 4 th Edition. Oxford University Press, 1975.

4. H. Davenport, The Higher Arithmetic, Cambridge University Press, 2008.
5. Niven, I., and Zuckerman, H. S., An introduction of the Theory of Numbers, John Wiley & Sons, 1991.

Complex trigonometry and Theory of equations

MTL MD306 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Basics of complex numbers, De-Moivre's Theorem, Applications of De-Moivre's Theorem, expressing sines and cosines in terms of sines and cosines of multiples of angle and vice-versa.

UNIT-II

Function of complex variable: Exponential Functions, Logarithmic Functions, Circular and Hyperbolic Functions, Inverse Circular Functions, relation between them and their properties.

UNIT-III

General properties of Equations, synthetic Division, Fundamental Theorem of Algebra, relation between roots & coefficient, Transformation of an equation. Cardon's solution of cubic. Solution of bi-quadratic equations by Descarte's and Farrare's method.

Recommended Books:

1. Brown, J. W. and *Churchill, R. V., Complex variables and applications,* 9th Edition,McGraw-HillHigher Education, 2014.
2. Gamelin, T.*Complex Analysis,* Springer.
3. Duraipandian, P., and Pachaiyappa, K., Complex Analysis, S. Chand 2021.
4. Kishan, H., Theory of Equations, Atlantic Publications and Distribution, 2022.
5. Burnside, W. S., and Panton, A. W., Theory of Equations.

Metric Spaces

MTL MD308 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Definition and examples of metric spaces, sequences in metric spaces, Cauchy sequences, completion of a metric space, Cantor Intersection theorem, Baire's category Theorem and its applications

UNIT-II

Compact metric spaces, Compact sets and their criterion, properties of compact sets, Relation between compactness, completeness and closedness, finite intersection property, sequential compactness, totally bounded spaces.

UNIT-III

Continuous functions between two metric spaces, characterization of continuous functions, continuous functions on compact spaces, Uniform continuous functions, Homeomorphism and Isometry, equicontinuity and Ascoli-Arzela Theorem, fixed point, Banach contraction theorem.

Reference Books:

1. S. Shirali and H. L. Vasudeva, Metric Spaces, Springer, 2nd edition, 2011.
2. S. Kumaresan, Topology of Metric spaces, Alpha Science, 2005.
3. P. K. Jain and Khalid Ahmad, Metric Spaces, Alpha Science, 2004.

Operations Research

MTL MI 302 **L-T-P: 4-1-0**

(Credits=5)

UNIT-I

Meaning and nature of Operations Research (OR), Historical and development of OR, Applications of OR, OR models, OR methodology. Linear Programming Problem (LPP): Introduction, Mathematical Formulation of LPP, Graphical Solution to Linear programming problems, Special cases in graphical method.

UNIT-II

General Formulation of LPP, Slack and Surplus Variables, Standard form of LPP, Assumptions, Limitations and Applications of LPP, Computational procedure of Simplex Method, Artificial Variables, Big-M method, Two-Phase method, Special cases in Simplex procedure.

UNIT-III

Mathematical Formulation of Transportation Problem, Initial Basic Feasible Solution by North West Corner Rule, Least Cost Method, Vogel's Approximation method, Assignment problems, Hungarian Algorithm, Applications of transportation and assignment problems. Introduction to Game Theory, Maximin-Minimax principle, Saddle point, Games with saddle point, Applications of game theory.

Recommended Books:

1. Hadley, G., Linear Programming, Narosa Publishing House, 8th edition.
2. Sharma, S. D., Operations Research, KedarNath Ram Nath-Meerut, 10th edition.
3. Swarup, K, Gupta, M. and Manmohan, Operations Research, Sultan Chand and Sons,15th Edition.
4. Taha, H A., Operations Research, Pearson Education, 8th edition.

Queuing Theory

MTL MI304 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Concept of Stochastic Process, Markov Chains with discrete and continuous time parameter.Objectives and different characteristics of a queuing system. Performance measures, Steady-state solution of queuing models: M/M/1, M/M/c, M/E_k/1 and E_k/M/1.

UNIT-II

Transient solution of M/M/1, M/M/c and M/M/∞ queuing models including busy period distribution. Bulk Queues: Steady-state analysis of $M^{[X]}$/M/1 and M/$M^{[Y]}$/1 queuing models.

UNIT-III

Imbedded Markov chain technique and its use to the Queuing models: M/G/1, GI/M/1.Design and control of queuing systems. Queuing Networks: Open and Closed Queuing Networks, Jackson network, Jackson Theorem, Tandem queuing networks. Applications of Queuing networks. Simulation procedures: Data generation and Book- keeping aspects.

Recommended Books:

1.Cooper, R.B., Introduction to Queuing Theory, 2nd Ed, North Holland,
2.Cox, D.R. and Smith W.L., Queues, Mathuen, 1961
3.Gross, D. and Harris C.M., Fundamentals of Queuing Theory, 2nd Ed., John
4.Kleinrock, L., Queuing Systems, Vol. I, John Wiley, 1975.
5.Medhi, J., Stochastic Model in Queuing theory, Academic Press, 1991.
6.Satty, T.L., Elements of Queuing Theory with Applications, Mc-Graw Hill,

Financial Mathematics

MTL MI306 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Role of Financial Management. Financial Analysis and planning. Working Capital Management. Cost of Capital, Capital Structure and Dividend Policies, Short term and Long-term Financial Planning.

UNIT-II

Analytical Approach to Finance. Technique of Goal Programming and its Application to Profit Planning and Financial Budgeting. Capital Expenditure Decision under Risk.

UNIT-III

Financing Decision: Problem of determining optimal capital structure, Leasing, Debt Management, Analysis of commitment of funds and risk of cash insolvency; Receivables and Inventory Management Approaches, Simulation Approach to Working Capital Management.

Recommended Books:

1. Van Horne J.C., Fundamentals of Financial Management, Prentice Hall
2. Brigham E.F., Gapenski L.C., Financial Management: Theory and Practice, The Dryden Press, 9thedi., 1998.
3. Khan M.Y. and Jain P.K., Financial Management, Tata McGraw Hill Pub. Co.,
4. Clark J.J. Hendland T.J. and Pritchard R.E, Capital Budgeting Planning and Control of Capital Expenditures, Prentice Hall, Englewood Cliffs, NJ, 1986.
5. Donaldson G. and Bertrand F., Corporate Debt Capacity: A Study of Corporate Debt Policy and the Determination of Corporate Debt Capacity, Beard Books, 2000.

6. Fogler, R.H. and Ganpathy, S., Financial Econometrics, Prentice Hall,
7. Levy H. and Sarnat M., Capital Investment and Financial Decisions, Prentice Hall, Englewood Cliffs, NJ, 1982.

Mao J.C.T., Quantitative Decision of Financial Decisions, Macmillan, NY

Research Methodology

MTL-MD401 **L-T-P: 4-0-0**

Unit I

Meaning of research – the relation between theory and research – scientific and social research – pure and applied research – special features of social research – different approaches in social research method– interdisciplinary research

Unit II

Formulation of null and alternative hypothesis – research design and methods – exploratory, diagnostic and experimental studies – deductive and inductive method – static and dynamic method – historical and dialectical method – case study

Sampling methods – random, stratified, multistage, systematic, cluster, quota and judgment samples – data analysis techniques – drawing inferences from analysis; report writing procedure

Unit III

Estimation of mean, median and mode – standard deviation and coefficient of variation – presentation ofgraphs – line, sub divided, multiple, pie graphs – estimation of growth rates – estimation of trend equations – estimation of regression equations – introduction to EXCEL, SPSS.

SUGGESTED READINGS

1. Research in education, By J W Best and J V Kahn, Pearson/ Allyn and Bacon.
2. Research Methodology – Methods and Techniques, C K Kothari, New Age International.
3. Design and Analysis of Experiments, D C Montgomery, Wiley.
4. Applied Statistics & Probability for Engineers, D C Montgomery & G C Runger, Wiley.
5. Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education.

Abstract Algebra

MTL MD403 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Review of basic Group Theory and Ring Theory, Symmetric and alternating groups, Simplicity of Alternating group A_n for n>5, Commutators, Conjugates, Centralizer, series of subgroups, Jordan Holder theorem, solvable groups.

UNIT-II

Integral Domains, Fields, Ideals, Residue class Rings, Theorems on Homomorphisms, Division Rings, Prime and Maximal Ideals, Polynomial Rings, Divisibility, Eulclidean and Principal Ideal Domains, Unique Factorization Domains, Gauss Theorem.

UNIT-III

Prime fields, Field Extensions, Finite Extensions, Algebraic element, Algebraic Extensions, relation between finite extensions and algebraic extensions.Separable Extensions.

Recommended Books:

1. Herstein, I. N., Topics in Algebra, Wiley, 2004.
2. Rajendra Kumar Sharma, Sudesh Kumari Shah and AshaGauri Shankar, Alegebra I: A Basic Course in Algebra, Pearson Education, 2011
3. Artin, M. , Algebra, 2 ed, Pearson education, India.
4. Fraleight, J. B., A First Course in Abstract Algebra, 7 ed, Pearson, 2002.
5. Bhattacharya, J. & Nagpal, Abstract Algebra, Cambridge University Press, 2 ed, 1994.
6. Gallian, J. A., Contemporary Abstract Algebra, Cengage India Private Limited.

Advanced Real Analysis

MTL MD405 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Definition and examples of complete Metric Spaces, Euclidean spaces,Bolzano Weierstrass theorem, Lindeloff covering theorem, Heine Borel theorem, Pointwise and Uniform convergences, uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation.

UNIT-II

The Riemann-Stieltjes integral: partitions, definition of Riemann-Stieltjes integral, refinement, existence of the integral, properties of the integral, fundamental theorems of integral calculus, mean value theorems, integration by parts. Functions of bounded variation, total variation, bounded variation functions as difference of monotone functions, continuous functions of bounded variations,

UNIT-III

σalgebra of sets, limits of sequences of sets, Borel-algebra, G and F-sets, Measurable space and measure space, Outer measures, regular outer measures, metric outer measures, construction of outer measures. Construction & properties of Lebesgue measure, Integration of simple functions, Lebesgue integral of non-negative and measurable functions, Properties of Lebesgue integrals.

Recommended Books:

1. Rudin Walter: Real and Complex analysis, McGraw-Hill, 1976.
2. T. M. Apostol: Mathematical Analysis, 2nd Edition, Addison Wesley, 1974.
3. J.Yeh Lectures on Real Analysis, World Scientific 2000.

4. M.E. Munroe, Measure and Integration, 2nd edition Addison Wesley, 1971.
5. G.DeBarra, Measure theory and Integration, Wiley Eastern Ltd.,1987.
6. H.L.Royden, Real Analysis,3rd edition, Macmillan, New York, 1988.

Partial Differential Equations

MTL MD407 **L-T-P: 4-0-0 (Credits=4)**

UNIT-I

Introduction of Partial Differential Equation(PDE), formulation of first order PDE and Derivation of PDE by eliminating method of arbitrary functions, Lagrange's method, Integral surfaces passing through a given curves, Cauchy problem for first order PDE.

UNIT-II

Compatible system of first order PDE, particular forms of non-linear partial differential equations, Charpit's method. Classification of second order PDE, canonical form for elliptic equations, parabolic and hyperbolic equations.

UNIT-III

Laplace equation and its derivation, boundary value problems, harmonic functions, spherical mean, mean value theorem, Maximum-Minimum principle and its applications, Linear partial differential equations with constant coefficients. Homogeneous and Non homogeneous PDEs.

Recommended Books:

1. I. N. Sneddon, Elements of Partial Differential Equations, Mc-Graw Hill
2. K. Sankara Rao, Introduction to Partial Differential Equations, Prentice Hall of India, 2nd Edition, New Delhi 2007.
3. F. John, Partial Differential equations, Narosa Publication
4. F. Watson, Advanced Calculus:An Introduction to Analysis, Wiley, 3 edition, 2016
5. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc.,9th edition, 2011.
6. T. Amarnath, An Elementary Course in Partial Differential Equations, Alpha Science International Ltd.

Coding Theory

MTL MI401 **L-T-P: 4-0-0 (Credits=4)**

UNIT-I

Introduction to Coding Theory: Error detection and Error correction, Maximum likelyhood decoding, Code words, Hamming distance and distance of a code, Nearest-neighbour decoding principle, Brief discussion of Finite Fields and basics of linear algebra.

UNIT-II

Linear codes, Dual of linear codes, Algorithms for finding bases for linear codes and their dual, Generator and parity check matrices for linear codes, Encoding and decoding by linear codes, particularly, decoding by coset leaders and syndrome decoding procedure, Equivalence of linear codes, Bounds for codes particularly, Hamming or sphere packing bounds.

UNIT-III

Perfect Codes, Binary Hamming Codes (BHC), Generalization of BHC, Golay Codes, Maximum distance separable (MDS) code, Construction of linear codes, Introduction to Cyclic codes.

Reference Books:

1. Roman Steven, Coding and Information Theory, Springer Verlag, 1992.
2. Garrett Paul, The Mathematics of Coding Theory, Pearson Education, 2004.
3. Vera P., Introduction to the Theory of Error Correcting Codes, John Wiley and Sons, 1998
4. LING S., XING C., Coding Theory , A First Course, Cambridge University Press, 2004.

Numerical Methods

MTL MI403 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Differences: Error in interpolation, Detection of error by use of difference tables, Differences of a Polynomial, Newton's formula for Forward and Backward interpolation, Gauss Central difference Interpolation formula, Striling's formula, Bessel's formula, Interpolation with unequal intervals; Lagrange's formula, Divided differences and their properties, Newton's general Interpolation formula, Inverse interpolation.

UNIT-II

Errors in Numerical Calculations, Number and their accuracy, Errors and their analysis errors in a series approximation, Numerical solutions of algebraic and transcedental equations: Bisection Method, Iterative Method, Method of false-position, Newton-Raphson method, Secant method, curve fitting and approximation; fitting of a straight line. Approximation of functions, Chebyshev polynomials.Taylor's series approximation. Solution of linear systems of equations: Direct method, Elimination method, Gauss-seidel method, Jacobi method.

UNIT-III

Numerical Differentiation: Maximum and minimum value of a tabulted function, Numerical Integration: Trapezoidal Rule. Simpon's 1/3 and 3/8 Rule.Newton-cotes integration formula.Gaussian quardrature formula.Numerical evaluation of singular integrals. Numerical solution of ordinary differential equations: Solution by Taylor's series. Euler's method, Picard's method.RungeKutta method. Predictor Corrector Method: Miline's method and Adams-Moulton's method.

Reference Books:

1. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice-Hall of India.
2. Gerald, C.F, and Wheatley, P.O, Applied Numerical Analysis, Sixth Edition, Pearson Education Asia, New Delhi, 2002.
3. E. Balagurusamy, Numerical Methods, Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999.
4. Burden, R.L and Faires, T.D., Numerical Analysis, Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.
5. Conte S.D. & Boor C.D., Elementary Numerical Analysis, An algorithmic approach, McGraw Hill.

Complex Analysis

MTL MD402 **L-T-P: 4-0-0 (Credits=4)**

UNIT-I

Limits, Continuity and differentiability of complex functions. Analytic (Holomorphic) functions, Cauchy-Riemann equations, Polar form of Cauchy-Riemann equations, Harmonic functions, conformal transformation, Bilinear transformation.

UNIT-II

Integral along a path, Cauchy's Theorem, Cauchy Integral Formula, Taylor's and Laurent's expansions, Cauchy's inequality, Liouville's Theorem' Fundamental Theorem of Algebra, Morera's Theorem, Maximum modulus and minimum modulus Theorems, Argument Principle, Rouche's Theorem, Schwarz Lemma.

UNIT-III

Singularities, Residue at a singularity, Cauchy's Residue theorem. Residue and Contour integration, Analytic continuation, Uniqueness of analytic continuation.

Reference Books:

1. J.B. Conway, Functions of one Complex Variable, Springer; 2nd ed. 1978. Corr. 7th printing 1995
2. Ahlfors, Complex Analysis McGraw Hill Education India Private Limited;Third edition, 2013
3. John H. Mathews and Russell W. Howell, Complex analysis, Narosa Publication, 2006.
4. J.C. Chaturvedi& S.S. Seth, Functions of a Complex Variable McGraw-Hill, 1987
5. Walter Rudin, Real and Complex Analysis, McGraw-Hill, 1976.
6. S. Ponnusamy, Foundation of Complex Analysis, Narosa (2011).

Advanced Linear Algebra

MTL MD404 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Linear functionals and the dual space, Dual basis, Second dual space, Annihilators, Inner product spaces, Cauchy-Schwarz inequality, orthogonality, orthonormal sets, Gram-Schmidt orthogonalizationprocess,Characteristic and minimum polynomials of linear operators.

UNIT-II

Hermitian, Unitary and Normal Transformations. Similar linear transformations, Invariant subspaces of vector spaces. Reduction of a linear transformation to triangular form. Nilpotent transformations. Index of nilpotency of a nilpotent transformation. Cyclic subspace with respect to a nilpotent transformation. Uniqueness of the invariants of a nilpotent transformation.

UNIT-III

Algebraic multiplicity, Geometric multiplicity, Diagonalizability, Necessary & Sufficient condition of diagonalizability, Spectral Theorem, Canonical forms, Jordan blocks and Jordan canonical forms. Companion matrix of a polynomial f(x). Trace and transpose.

Recommended Books:

1. Hoffman & Kunze, Linear Algebra, Prentice Hall PTR,3rd revised ed., 1999
2. I.N. Herstein,: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975

3. Roman, Steven. Advanced Linear Algebra. 3rd Edition. Springer. 2011
4. S. Lang, Linear Algebra, Springer New York, 1997.

Differential and Integral Equations

MTL MD406 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Linear differential equations of second order with variable coefficients and its solution by using various methods, Total differential equations, its geometrical interpretation and solutions by various methods, Sturm–Liouville problem, Riccati's equation

UNIT-II

An introduction to integral equations and its classification, Conversion of initial value problem into Volterra Equation , Conversion of boundary value problem into Fredholm Integral Equation, Eigen values and Eigen functions, Homogeneous Fredholm integral equation with separable kernel.

UNIT-III

Iterated kernels, Method of successive approximations, Neumann series, Reciprocal functions, Classical Fredholm Theory, Integral Equations with symmetric kernel, Hilbert-Schmidt theorem, Green's function and its application on converting initial and boundary value problems into integral equations.

Recommended Books:

1. E.L. Ince, Ordinary Differential Equations, Dover Publication Inc. 1956.
2. E.A. Coddington, An Introduction to ordinary differential equations, PHI, 1990.
3. M. D. Raisinghania, Ordinary and Partial differential equations, S. Chand & Co., 2016.
4. C., Cordumeanu, Integral Equations and Applications, Cambridge University Press, 1991.
5. M. D. Raisinghanis, Integral Equations & Boundary Value Problems, S. Chand & Co., 2010.

Measure Theory

MTL MD408 **L-T-P: 4-0-0**

(Credits=4)

Unit-I:

Lebsegue integration & its properties.Fatou's Lemma, Lebesgue monotone convergence theorem, Lebesgue dominated convergence theorem, L^p Spaces: Cauchy-Schwartz inequality, Holder inequality, Minkowski inequality, Jensen inequality,

Unit-II:

Signed Measures, Signed Measure Spaces, Integration on a Signed Measure Space, Absolute Continuity of a Measure, The Radon-Nikodym Derivative, Absolute Continuity of a Signed Measure Relative to a Positive Measure, Properties of the Radon-Nikodym Derivative.

Unit-III:

Product Measure Spaces, Existence and Uniqueness of Product Measure Spaces, Integration on Product Measure Space, Fubini's Theorem, Completion of Product Measure Space, Convolution of Functions, Some related Theorems.

Recommended Books:

1. S. Kesavan, Measure and Integration, Jainendra K Jain.

2. J.Yeh Lectures on Real Analysis, World Scientific 2000.
3. M.E. Munroe, Measure and Integration, 2nd edition Addison Wesley, 1971.
4. G.DeBarra, Measure theory and Integration, Wiley Eastern Ltd.,1987.
5. H.L.Royden, Real Analysis,3rd edition, Macmillan, New York, 1988.
6. I. K. Rana, An Introduction to Measure and Integration, 2nd edition, Narosa.

Advanced Numerical Methods

MTL MI402 **L-T-P:4-0-0**

(Credits=4)

UNIT-I

Overview of Numerical Solution of Ordinary Differential Equations, Different types of errors, Truncation errors and consistency, error propagation, Convergence and Stability criteria, Classification, Finite Difference representation of Partial Differential Equation.
Introduction to well posed PDE, Classification, various types of governing conditions, Finite Difference representation of derivatives.

UNIT-II

Parabolic PDE: Explicit and implicit schemes. Compatibility, Stability and Convergence. Parabolic PDE: Solution for one Dimensional equation, explicit and various implicit schemes, Discussion on compatibility, stability and convergence of above schemes, extension to 2d Heat Conduction equation.

UNIT-III

Elliptic PDE: Solution of Laplace/ Poisson PDE, ADI and SOR schemes, Methods for solving diagonal systems, Treatment of irregular boundaries, Hyperbolic equations-wave equation, Finite difference explicit and implicit schemes, stability analysis, Method of characteristics and their significance.

RecommendedBooks:

1. G.D. Smith, "Numerical Solution of Partial Differential Equations: Finite Difference Methods" (Oxford Applied Mathematics & Computing Science Series).
2. R K Jain,"Numerical Methods for Scientific and Engineering Computations": M K Jain, S R K Iyengar.
3. John Wiley, "Finite Difference methods for partial Differential equations": Forsythe G.E. &Wasow, WR.
4. Gerald, C.F.& Wheatley P.O. "Applied Numerical Analysis", Pearson Education Asia.

Commutative Algebra

MTL MI404 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Rings and ideals: review of ideals in quotient rings; prime and maximal ideals, prime ideals under quotient, existence of maximal ideals; operations on ideals (sum, product, quotient and radical); Chinese Remainder theorem; nilradical and Jacobson radical; extension and contraction of ideals under ring homomorphisms; prime avoidance.

UNIT-II

Free modules; Projective Modules; Tensor Product of Modules and Algebras; Flat, Faithfully Flat and Finitely Presented Modules; Shanuels Lemma. Localisation and local rings, universal property of localisation, extended and contracted ideals and prime ideals under localisation, localisation and quotients, exacteness property, Results on prime ideals like theorems of Cohen and Isaac, Nagatas criterion for UFD and applications, equivalence of PID and one-dimensional UFD.

UNIT-III

Modules over local rings, Cayley-Hamilton, NAK lemma and applications, Examples of local-global principles, Projective and locally free modules, Patching up of Localization, Polynomial and Power Series Rings, Noetherian Rings and Modules, Hilberts Basis Theorem, Associated Primes and Primary Decomposition, Artininan Modules, Modules of Finite Length.

Integral Extensions: integral closure, normalization and normal rings, Cohen-Seidenberg Going-Up Theorem, HilbertsNullstellensatz and applications, Valuations, Discrete Valuation Rings, Dedekind domains.

Recommended Books.

1. Introduction to Commutative Algebra, by M.F. Atiyah and I.G. MacDonald
2. Commutative Algebra, Vol.-II, by Oscar Zariski, Pierre Samuel
3. Commutative Algebra, by N.S. Gopalakrishnan.

Topology

MTL MD501 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Topological spaces, open sets, closed sets, neighbourhoods, Bases for a Topology, order Topology, Product Topology, Subspace Topology, limit points, closures, interiors, closed sets, Continuous function. Homeomorphism. Metric Topology, quotient Topology.

UNIT-II

Connectedness and Compactness: Connectedness, Local Connectedness, path connectedness, Compact spaces, locally compact spaces and Limit point Compact spaces.

UNIT-III

Separation Axioms: Hausdorff spaces, Regularity, Normality, Urysohn's lemma, Tietze extension Theorem, Urysohn's Metrization Theorem. Tychnoff Theorem, Completely regular spaces, One-point Compactification and Stone-Cech compactification (Statement only).

Recommended Books:

1. J. R. Munkers, Topology- A First Course: Prentice Hall of India, 2 ed, 2002.
2. K. D. Joshi, General Topology, New age international, 2014.
3. M. G. Murdeshwar, General Topology, New Age International Pvt Ltd Publishers, 2008.
4. G. F. Simmons, Introduction to Topology & Modern Analysis, Tata McGraw-Hill Education, 2004.
5. J. L. Kelley, General Topology, Springer-Verlag, Berlin-Heidelberg-New York, 1975.
6. S. Willard, General Topology, Addison-Wesley Publishing company, Dover, 2012.
7. V. Aithal and S. Kumaresenn, Topology (A Core Course), Techno World.

Calculus of Variations and Mechanics

MTL MD503 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Introduction, problem of brachistochrone, problem of geodesics, isoperimetric problem, Variation and its properties, functions and functionals, Comparison between the notion of extrema of a function and a functional. Variational problems with the fixed boundaries, Euler's equation, the fundamental lemma of the calculus of variations, examples.

UNIT-II

Functionals involving more than one dependent variable and their first derivatives, the system of Euler's equations.Functionals depending on the higher derivatives of the dependent variables, Euler- Poisson equation, examples, Functionals containing several independent variables, Ostrogradsky equation, examples, Variational problems in parametric form, applications to differential equations, examples, Variational problems with moving boundaries, Transversality condition, examples.

UNIT-III

Generalized coordinates, Lagrange's equations, Applications of Lagrange Equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis.

Recommended Books:

1. L.E. Elsgolc, Calculus of Variations, Courier Corporation, 2012.
2. L.A. Pars, An Introduction to the Calculus of Variations, Courier Corporation, 2013.
3. I. M. Gelfand and S. V. Fomin, Calculus of Variations, PHI
4. M.G. Calkin, Lagrangian and Hamiltonian Mechanics, World Scientific Publishers, 1996.
5. SankaraRao, Classical Mechanics, Prentice Hall India, 2005.

Optimization Techniques

MTL MI501 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Introduction to Operations Research. Linear Programming: Principles of simplex Method, Simplex method in tabular form, Duality and Dual simplex Method, Degeneracy and cycling. Transportation and Assignment problems.

UNIT-II

Matrix games, Fundamental theorem of matrix games, Games with mixed strategies. Matrix game and its relation with linear programming.Network Scheduling: Networks and basic components, Rules for Network Construction, CPM and PERT.

UNIT-III

Queuing theory: Objectives, Different characteristics of a queuing system, Measures of Performance, Poisson process, Birth-death process, Steady-state behavior of Markovian and Erlangian queuing models (MM/1, MM/c, and $M/E_K/1$).

Recommended Books:

1. V.K. Kapoor, Operations Research, Sultan Chand and Sons, 9th Edition, 2014.
2. Taha, Operations Research, Pearson India, 9th Edition, 2014.
3. KantiSwaroop, Operations Research, Sultan Chand, 2014.

4. S.D. Sharma, Operations Research, KedarNath Ram Nath and Co., 2013.
5. B.E. Gillet, Introduction of Operations research, Tata Mc-Graw Hill, 32nd Edition, 2008.
6. G.K. Murthy, Linear Programming, John Wiley & Sons Ltd. 1st Edition, 1983.
7. D. Gross and C.M. Harris, Fundamentals of Queuing Theory, Wiley India Private Limited; 4th Edition, 2012.

Survey Sampling

MTL MI503 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Complete enumeration Vs sample enumeration, sampling and non sampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of population mean and variance and their unbiasedness, merits and demerits of SRS.

UNIT-II

Meaning of Stratification, Method of Stratified sampling and its advantages and disadvantages. Mean and Variance of Stratified sampling, Method of allocation: equal allocation, Proportional allocation, optimum allocation/ Neyman allocation, comparison of stratified random sampling with SRS. Systematic sampling Technique, estimates of population mean and total, variances of these estimates (N=nk). Comparison of systemic sampling with SRS and stratified sampling in the presence of linear trend.

UNIT-III

Cluster sampling (equal clusters only) estimation of population mean and its variance, comparison (with and without randomly formed clusters). Relative efficiency of cluster sampling with SRS in terms of intra class correlation. Concept of sub-sampling.

Recommended Books:

1. Choudhary, F. S and Singh, Daroga (2020): Theory and Analysis of sample Survey Designs, New Age International Private Limited
2. Cochran, W.J. (1991) : Sampling Technique. Wiley Series in Probability and Statistics.
3. Sukhatme, P.V. and Sukhatme B.V.(1984): Sampling theory survey with applications. Iowa State University Press; 3rd Revised edition
4. Murty, M.N.(1969): Sampling theory and methods. Statistical Publishing Society,Kolkatta.

5. Chaudhari , A and Pal, S.(2023) : A Comprehensive Textbook on Sample Surveys. Springer Verlag, Singapore; 1st ed.
6. Gupta, S.C and Kapoor, V.K.(2014); Fundamental of applied Statistics. Sultan Chand & Sons; Fourth edition
7. Changbao, Wu and Thompson, Mary E.(2020) : Sampling Theory and Practice Springer Nature Switzerland AG; 1st ed.
8. Panse,V.G. and Sukhatme P.V.(1985): Statistical methods of agricultural workers. Indian Council of Agricultural Research Publication.

Algebraic Number Theory

MTL MI505 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Basics of integral domains, Trivial factorization, Factorization into irreducibles, Examples of non-unique factorization into irreducibles, Prime factorization, Euclidean domains, Noetherian domains, Elements integral over a ring, Integral Extensions, Integrally Closed Rings, Integers in quadratic number fields.

UNIT-II

Norms and Traces, The Discriminant, Cyclotomic Fields and their ring of integers. Integral basis of algebraic number field, Dedekind domains, Prime factorization of ideals, Norm of an ideal.

UNIT-III

Factroing primes in a number field, units in real quadratic fields, Ideal class group, Minkowski's theorems, Dirichlet's unit theorem, valuations of an element of a number field, Units in imaginary and real number rings, Fundamental system of units.

Recommended Books:

1. Pierre Samuel, Algebraic Theory of Numbers, Hermann Publishers, 1970.
2. D. A. Marcus, Number Fields, University text, Springer-Verlag, 1977.
3. G. J. Janusz, Algebraic Number Fields, Graduate Studies in Mathematics 7, American Mathematical Society, 1996.
4. S. Alaca, K. S. Williams, Introductory Algebraic Number Theory, Cambridge University Press, 2004.
5. J. Neukirch, Algebraic Number Theory, Springer-Verlag, 1999.
6. A. Frohlich, M. J. Taylor, Algebraic Number Theory, Cambridge Studies in Advanced Mathematics 27, Cambridge University Press, 1993.

Advanced Topics in Algebra

MTL MI507 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Rings, Matrix rings, Polynomial rings, Skew Polynomial rings, Laurant rings, Boolean rings. Opposite ring, Characteristic of a ring. Direct Products. Ideals, Homomorphism of rings, Endomorphism rings, Field of fractions, Prime fields, PIDS and UFDS.

UNIT-II

Modules Direct product, Direct sum of modules, Free modules, Homomorphism of modules, Maximal submodule, Minimal Submodule, Simple modules, Schurs lemma, Annihilator of a Subset of a module, Modules over PID's, Torsion modules, torsion free modules.

UNIT-III

Chain conditions, Artinian modules, Northerian modules, Composition series, Modules of finite length, Jordan Holder Theorem. Artinian rings, Noetherian rings, Hilbert Basis Theorem, I.S.Cohen's Theorem, Introduction of Nil radical and Jacobson radical.

Recommended Books:

1. C. Musili, Introduction to rings and modules, Narosa, 2003.
2. K.R. Gooderal and R.B. Warfield, Introduction to Non-commutative rings, Cambridge University Press.
3. N. McCoy, Ring Theory, Chelsea Pub Co., 1973

Stochastic Processes

MTL MI509 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Review of probability, random variables and probability distributions, expectations. Stochastic Process and its classification according to state space and parameter space. Discrete and Continuous-time Markov Chains: Transition probability matrix, Chapman-Kolmogorov equations, n-step transition and limiting probabilities, ergodicity, stationary distribution. Applications of Discrete-time Markov Chains. Kolmogorov differential equations for Continuous-time Markov Chains, infinitesimal generator, Poisson and birth-death processes.

UNIT-II

Brownian Motion: Wiener process as a limit of random walk; first -passage time and other problems, applications to finance. Branching Processes: Definition and examples branching processes, probability generating function, mean and variance, Galton-Watson brancing process, probability of extinction.

UNIT-III

Renewal Processes: Renewal function and its properties, renewal theorems, cost/rewards associated with renewals, Markov renewal and regenerative processes, applications.

Stationary Processes: Weakly stationary and strongly stationary processes, moving average and auto regressive processes.

Recommended Books:

1. S.M. Ross, Stochastic Processes, 2nd Edition, Wiley, 1996 (WSE Edition).
2. J. Medhi, Stochastic Processes, 3rd Edition, New Age International, 2009.
3. H.M. Taylor and S. Karlin, An Introduction to Stochastic Modeling, 3rd Edition, Academic Press, New York, 1998.
4. S.K. Srinivasan, K.M. Mehata, Stochastic Processes, Tata McGraw-Hill Publishing Company limited, New Delhi.
5. G. R. Grimmett and D. R.Stirzaker, Probability and Random Processes, 3rd Edition, Oxford University Press, 2001.

Differential Geometry

MTL MD502 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Curves in plane and space: Parameterized curves, Tangent vector, Arc length, Reparametrization, Regular curves, Curvature and torsion of smooth curves, Frenet-Serret formulae, Arbitrary speed curves, Frenet approximation of a space curve, Isometries of $R3$, The Tangent Map of an Isometry, Orientation, Congruence of curves. Surfaces in space: Definition and examples, Smooth surfaces, Smooth maps, Tangents and derivatives.

UNIT-II

Normal and orientability. Examples of surfaces: Level surfaces, generalized cylinder and generalized cone, Ruled surfaces, Surface of revolution, Compact surfaces. First fundamental form, Isometries of surfaces, Conformal mapping of surfaces, Equiareal maps and theorem of Archimedes.

UNIT-III

Second fundamental form, Gauss and Weingarten maps, Normal and geodesic curvatures, Meusnier's theorem, Parallel transport and covariant derivative, Gaussian and mean curvatures, Principal curvatures, Euler's theorem, Surfaces of constant Gaussian curvature, Flat surfaces, Surfaces of constant mean curvature, Gaussian curvature of compact surfaces. Geodesics: Definition and basic properties, Geodesic equations, Geodesics on a surfaces of revolution, Clairaut's theorem, Geodesics as shortest paths, Geodesic coordinates.

Recommended Books:

1. C. Baer, Elementary Differential Geometry, Cambridge University Press, 2001.
2. M. P. Do Carmo, Differential Geometry of Curves and Surfaces, Revised and Updated Second Edition, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 2016.
3. A. Gray, E. Abbena, and S. Salamon, Modern Differential Geometry of Curves and Surfaces with Mathematica, Third edition, CRC Press, 2006.
4. R. S. Millman & G. D. Parkar, Elements of Differential Geometry, Englewood Cliffs, N.J. : Prentice Hall, 1977.
5. B. O' Neill, Elementary Differential Geometry, Revised Second Edition, Academic Press, 2006.
6. A. Pressley, Elementary Differential Geometry, Second Edition, Undergraduate Mathematics Series, Springer-Verlag London Ltd., 2010
7. T. J. Willmore, An Introduction to Differential Geometry, First Edition, Dover Publications, Inc., Mineola, New York, 2012.

Functional Analysis

MTL MD504 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Normed spaces, Banach spaces, Further properties of Normed spaces, Subspaces, Linear operators, Linear functionals, Bounded and continuous linear operators, Normed spaces of operators, Dual spaces.

UNIT-II

Hahn-Banach theorem (Extension of linear functionals) for normed spaces, Application to bounded linear functionals on $C[a,b]$, Adjoint operator, reflexive spaces, uniform boundedness theorem, Convergence of sequence of operators and functionals, Open mapping theorem, Closed linear operator, Closed graph theorem.

UNIT-III

Inner product spaces, Hilbert spaces, Further properties of inner product spaces, Orthogonal complements and direct sums, Orthonormal sets and sequences, Total orthonormal sets and sequences, Representation of functionals on Hilbert spaces, Hilbert adjoint operators, Self adjoint, Unitary and normal operators.

Recommended Books:

1. A. Mukherjea and K. Pothoven, Real and Functional Analysis, Springer-Verlag New York Inc.
2. E. Kreyszig, Introductory functional Analysis with application, John Willey and Sons, 1978.
3. Bachman and Naricel, Functional Analysis, Dover Publication, 2nd edition, 2003.
4. G.F. Simmons, Introduction to Topology and Modern Analysis,TMH, 2003.
5 P.K. Jain, O.P. Ahuja and Khalil Ahmed, Functional Analysis

Applied Algebra

MTL MI502 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Binary Group Codes, Communication system and its problems, Binary Symmetric Channel, Encoding and Decoding, Error detecting and correcting codes, Block codes, Distance between words, Matrix Encoding Technique, Groups codes, Construction of Decoding Table, Hamming codes.

UNIT-II

Polynomial Rings, Polynomial Rings over field,Polynimal codes, Shift Register and its use in polynomial multiplication, Unique Factorization Theorem for polynomials,Complex Roots of unity, Formal Derivatives.

UNIT-III

Extension of fields, Simple Extensions, Computation in R[x]/[m(x)], Existence Theorem, Finite fields, Computation in GF (2^n). Root fields of Polynomials, BCH Codes.

Recommended Books:

1. G.Birkhoff. , Barte, Thomas C., Modern Applied Algebra, CBS Publication
2. I.N. Herstein, Topics in Algebra, John Wiley & sons publisher, 2nd edition (1975)
3. Gill,Arthar, Applied Algebra for computer science, Prentice Hall of India.
4. Dornhoff, Larry L., Applied Modern Algebra , MacMillan & Co. & Franz E.
5. V. K. Bhat, Modern Algebra and its Applications, Narosa

Fluid Mechanics

MTL MI504 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Kinematics - Eulerian and Lagrangian methods. Stream lines, path lines and streak lines. Velocity potential.Irrotational and rotational motions.Vortex lines.Equation of continuity. Boundary surfaces, Acceleration at a point of a fluid. Components of acceleration in cylindrical and spherical polar co-ordiantes.

UNIT-II

Pressure at a point of a moving fluid.Euler's and Lagrange's equations of motion.Bernoulli's equation.Impulsive motion.Stream function, Acyclic and cyclic irrotation motions.Kinetic energy of irrotational flow.Kelvin's minimum energy theorem.Axially symmetric flows.Liquid streaming past a fixed sphere, Motion of a sphere through a liquid at rest at infinity.

UNIT-III

Equation of motion of a sphere.Three-dimensional sources, sinks, doublets and their images.Stoke's stream function, Irrotational motion in two-dimensions. Complex velocity potential. Milne-Thomson circle theorem. Two-dimensional sources, sinks, doublets and their images.Blasius theorem.Two- dimensional irrotation motion produced by motion of circular and coaxial cylinders in an infinite mass of liquid.

Recommended Books:

1. F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985
2. M.E. O'Neill and F. Chorlton, Ideal and Incompressible Fluid Dynamics, Ellis
3. Horwood Limited, 1986.
4. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing
5. Company, New Delhi, 1976.
6. W.H. Besant and A.S. Ramsay, A Treatise on Hydromechanics Part I and II, CBS
7. Publishers, New Delhi.
8. BansiLal, Theoretical Fluid Dynamics, Skylark Pub., New Delhi.

Graph Theory

MTL MI506 **L-T-P: 4-0-0 (Credits=4)**

UNIT-I

Review of basics: Graphs and digraphs, incidence and adjacency matrices, Trees: Equivalent definitions of trees and forests, Cayley's formula, the Matrix-Tree theorem, minimum spanning trees. Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger's theorem; Paths and Cycles: Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, girth, circumference, Network flows.

UNIT-II

Matchings: Matchings: Berge's Theorem, perfect matchings, Hall's theorem, Tutte's theorem, Konig's theorem, Petersen's theorem, algorithms for matching and weighted matching (in both bipartitie and general graphs), factors of graphs (decompositions of the complete graph), Tutte's f-factor theorem.

UNIT-III

Extremal Problems: Extremal problems: Independent sets and covering numbers, Turan's theorem, Ramsey theorems; Colorings: Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem; Graphs on

surfaces: Planar graphs, duality, Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces.

Recommended Books*:*

1. B. West Douglas, Introduction to Graph Theory, Prentice Hall of India,2002.
2. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science. Prentice-Hall,2004.
3. Frank Harary, Graph Theory, Narosa, 2000.
4. R. Ahuja, T. Magnanti, and J. Orlin, Network Flows: Theory, Algorithms, and Applications, Prentice-Hall.
5. BelaBollobas, Modern Graph Theory, Springer.

Advanced Topic in Topology

MTL MI508 **L-T-P: 4-0-0**

(Credits=4)

UNIT-I

Directed sets, nets and subnets, convergence of a net, ultranets, partially ordered sets and filters, convergence of a filter, ultrafilters, basis and subbase of a filter, nets and filters in topology including characterization of compactness in terms of nets and filters.

UNIT-II

Tychonoff theorem, completely regular spaces, local compactness, one-point compactification, Stone-Cechcompactification.Urysohnmetrization theorem. Local finiteness, Nagata-Smirnov metrization theorem, partitions of unity, paracompactness, local metrizability, Smirnov Metrization theorem.

UNIT-III

Complete metric spaces, space-filling curve, compactness in metric spaces, equicontinuity, pointwise and compact convergence, the compact-open topology, Ascoli's theorem, Baire spaces, Baire category theorem, a nowhere differentiable function, An introduction to dimension theory.

Recommended Books:

1. Munkres, J.R., Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
2. Dugundji, J., Topology, Allyn and Bacon, 1966.
3. Simmons, G.F., Introduction to Topology and Modern Analysis, McGraw-Hill, 1963.
4. Kelley, J.L., General Topology, Van Nostrand Reinhold Co., New York, 1995.
5. Hocking, J., Young, G., Topology, Addison-Wesley Reading, 1961.
6. Steen, L., Seebach, J., Counter Examples in Topology, Holt, Reinhart and Winston, New York, 1970.
7. Willard, Stephen, General Topology, Addition-Wesley Publishing Company, 1970.