13. COURSES OF STUDY AND SCHEME OF ASSESSMENT

MSc DATA SCIENCE

(2015 REGULATIONS)
(Minimum No. of Credits to be Earned: 210*)

Course Code	Course Title	Hours/Week			Credits	Maximum marks			CAT
		Lecture	Tutorial	Practical		CA	FE	Total	
I SEMESTER									
15XD11	CALCULUS AND ITS APPLICATIONS	3	2	0	4	50	50	100	BS
15XD12	APPLIED PHYSICS	4	0	0	4	50	50	100	BS
15XD13	DIGITAL ELECTRONICS	4	0	0	4	50	50	100	BS
15XD14	PROBLEM SOLVING &C PROGRAMMING	3	0	0	3	50	50	100	PC
15XD15	ENGLISH FOR PROFESSIONAL SKILLS	3	0	0	3	50	50	100	HS
15XD16	ENGINEERING GRAPHICS AND GEOMETRIC MODELLING	0	0	4	2	100	-	100	ES
15XD17	C PROGRAMMING LAB	0	0	4	2	100	-	100	PC
15XD18	APPLIED PHYSICS AND DIGITAL ELECTRONICS LAB	0	0	4	2	100	-	100	BS
15XD29	PERSONALITY AND CHARACTER DEVELOPMENT	0	0	** Refer Sem 2 and footnote					MC
Total 31 Hrs		**17**	**2**	**12**	**24**	**550**	**250**	**800**	
II SEMESTER									
15XD21	DISCRETE STRUCTURES	3	2	0	4	50	50	100	BS
15XD22	TRANSFORMS AND ITS APPLICATIONS	3	2	0	4	50	50	100	BS
15XD23	DATA STRUCTURES	3	0	0	3	50	50	100	PC
15XD24	OBJECT ORIENTED PROGRAMMING	3	0	0	3	50	50	100	PC
15XD25	THEORY OF PROBABILITY	3	2	0	4	50	50	100	PC
15XD26	OBJECT COMPUTING LAB	0	0	4	2	100	-	100	PC
15XD27	DATA STRUCTURES LAB	0	0	4	2	100	-	100	PC
15XD28	MATHEMATICAL COMPUTING LAB	0	0	2	1	100	-	100	PC
15XD29	PERSONALITY AND CHARACTER DEVELOPMENT	0	0	** Grade - - -					MC
Total 31 Hrs		**15**	**6**	**10**	**23**	**550**	**250**	**800**	

***** Indicated is the minimum number of credits to be earned by a student.
** - Total 40 hrs in semesters I & II put together.
Grade: Completed / Not Completed.

CA – Continuous Assessment ; FE - Final Examination; CAT – Category; BS –Basic Sciences; HS- Humanities & Social Sciences; ES- Engineering Sciences; PC – Professional Core; PE - Professional Elective; OE-Open Elective; EEC – Employability Enhancement Course, MC – Mandatory Course.

MSc DATA SCIENCE **(2015 REGULATIONS)**

Course Code	Course Title	Hours/Week			Credits	Maximum marks			CAT
		Lecture	Tutorial	Practical		CA	FE	Total	
III SEMESTER									
15XD31	APPLIED STATISTICS	3	0	0	3	50	50	100	PC
15XD32	ABSTRACT ALGEBRA	4	0	0	4	50	50	100	BS
15XD33	GRAPH THEORY	3	2	0	4	50	50	100	BS
15XD34	ADVANCED DATA STRUCTURES	3	0	0	3	50	50	100	PC
15XD35	COMPUTER ORGANIZATION AND ASSEMBLY LANGUAGE PROGRAMMING	3	0	0	3	50	50	100	PC
15XD36	APPLIED STATISTICS AND PYTHON PROGRAMMING LAB	0	0	4	2	100	-	100	PC
15XD37	ADVANCED DATA STRUCTURES LAB	0	0	4	2	100	-	100	PC
15XD38	ASSEMBLY LANGUAGE PROGRAMMING LAB	0	0	4	2	100	-	100	PC
Total 30 Hrs		**16**	**2**	**12**	**23**	**550**	**250**	**800**	
IV SEMESTER									
15XD41	LINEAR ALGEBRA	3	2	0	4	50	50	100	BS
15XD42	DATA BASE DESIGN	3	0	0	3	50	50	100	PC
15XD43	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	0	3	50	50	100	PC
15XD44	OPERATING SYSTEMS	3	0	0	3	50	50	100	PC
15XD45	PREDICTIVE ANALYTICS	4	0	0	4	50	50	100	PC
15XD46	UNIX SYSTEMS LAB	0	0	4	2	100	-	100	PC
15XD47	RDBMS LAB	0	0	4	2	100	-	100	PC
15XD48	DESIGN AND ANALYSIS OF ALGORITHMS LAB	0	0	4	2	100	-	100	PC
Total 30 Hrs		**16**	**2**	**12**	**23**	**550**	**250**	**800**	
V SEMESTER									
15XD51	APPLIED NUMERICAL ANALYSIS	4	0	0	4	50	50	100	BS
15XD52	STOCHASTIC MODELS	4	0	0	4	50	50	100	PC
15XD53	COMPUTER NETWORKS	3	0	0	3	50	50	100	PC
15XD54	SUPERVISED AND UNSUPERVISED LEARNING	3	0	0	3	50	50	100	PC
15XD55	PROFESSIONAL ELECTIVE-I	3	2	0	4	50	50	100	PC
15XD56	JAVA PROGRAMMING LAB	0	0	4	2	100	-	100	PC
15XD57	COMPUTER NETWORKS LAB	0	0	4	2	100	-	100	PC
15XD58	SUPERVISED AND UNSUPERVISED LEARNING LAB	0	0	4	2	100	-	100	PC
Total 31 Hrs		**17**	**2**	**12**	**24**	**550**	**250**	**800**	

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MSc DATA SCIENCE **(2015 REGULATIONS)**

Course Code	Course Title	Hours/Week			Credits	Maximum marks			CAT
		Lecture	Tutorial	Practical		CA	FE	Total	
VI SEMESTER									
15XD61	PARALLEL AND DISTRIBUTED COMPUTING	3	0	0	3	50	50	100	PC
15XD62	DATA MINING	3	0	0	3	50	50	100	PC
15XD63	MODERN DATABASE SYSTEMS	3	0	0	3	50	50	100	PC
15XD64	OPTIMIZATION TECHNIQUES	3	2	0	4	50	50	100	PC
15XD65	OPEN ELECTIVE - I	3	2	0	4	50	50	100	OE
15XD66	PARALLEL AND DISTRIBUTED COMPUTING LAB	0	0	4	2	100	-	100	PC
15XD67	MODERN DATABASE SYSTEMS LAB	0	0	4	2	100	-	100	PC
15XD68	SCRIPTING LANGUAGES LAB	0	0	4	2	100	-	100	PC
Total 31 Hrs		**15**	**4**	**12**	**23**	**550**	**250**	**800**	
VII SEMESTER									
15XDP1	PROJECT WORK I	**0**	**0**	**-**	**12**	**50**	**50**	**100**	EEC
VIII SEMESTER									
15XD81	REINFORCEMENT LEARNING	3	0	0	3	50	50	100	PC
15XD82	DATA PRIVACY AND SECURITY	3	0	0	3	50	50	100	PC
15XD83	ADVANCED ANALYTICS	3	0	0	3	50	50	100	PC
15XD84	PROFESSIONAL ELECTIVE-II	3	2	0	4	50	50	100	PE
15XD85	OPEN ELECTIVE-II	3	2	0	4	50	50	100	OE
15XD86	REINFORCEMENT LEARNING LAB	0	0	4	2	100	-	100	PC
15XD87	DATA PRIVACY AND SECURITY LAB	0	0	4	2	100	-	100	PC
15XD88	ADVANCED ANALYTICS LAB	0	0	4	2	100	-	100	PC
Total 31 Hrs		**15**	**4**	**12**	**23**	**550**	**250**	**800**	
IX SEMESTER									
15XD91	WEB ANALYTICS	3	0	0	3	50	50	100	PC
15XD92	NETWORK SCIENCE	3	0	0	3	50	50	100	PC
15XD93	INFORMATION RETRIEVAL	3	0	0	3	50	50	100	PC
15XD94	PROFESSIONAL ELECTIVE – III	3	2	0	4	50	50	100	PE
15XD95	PROFESSIONAL ELECTIVE – IV (SELF STUDY)	3	2	0	4	50	50	100	PE
15XD96	INFORMATION RETRIEVAL LAB	0	0	4	2	100	-	100	PC
15XD97	WEB ANALYTICS LAB	0	0	4	2	100	-	100	PC
15XD98	NETWORK SCIENCE LAB	0	0	4	2	100	-	100	PC
Total 31 Hrs		**15**	**4**	**12**	**23**	**550**	**250**	**800**	
X SEMESTER									
15XDP2	PROJECT WORK II	**0**	**0**	**-**	**12**	**50**	**50**	**100**	EEC

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MSc DATA SCIENCE **(2015 REGULATIONS)**

Course Code	Course Title	Hours/Week			Credits	Maximum marks			CAT
		Lecture	Tutorial	Practical		CA	FE	Total	
PROFESSIONAL ELECTIVE (Four to be opted)									
15XDA1	DATA COMPRESSION	3	2	0	4	50	50	100	PE
15XDA2	MOBILE COMPUTING	3	2	0	4	50	50	100	PE
15XDA3	DIGITAL IMAGE PROCESSING	3	2	0	4	50	50	100	PE
15XDA4	MULTIMEDIA ANALYTICS	3	2	0	4	50	50	100	PE
15XDA5	COMPUTATIONAL NEUROSCIENCE	3	2	0	4	50	50	100	PE
15XDA6	PERVASIVE COMPUTING	3	2	0	4	50	50	100	PE
15XDA7	MARKETING ANALYTICS	3	2	0	4	50	50	100	PE
15XDA8	NATURAL LANGUAGE PROCESSING	3	2	0	4	50	50	100	PE
15XDA9	SOFT COMPUTING	3	2	0	4	50	50	100	PE
15XDAA	COMPUTER GRAPHICS	3	2	0	4	50	50	100	PE
15XDAB	ALGORITHMS FOR BIOINFORMATICS	3	2	0	4	50	50	100	PE
15XDAC	MATHEMATICAL MODELING	3	2	0	4	50	50	100	PE
15XDAD	SOFTWARE ENGINEERING	3	2	0	4	50	50	100	PE
15XDAE	DESIGN PATTERNS	3	2	0	4	50	50	100	PE
15XDAF	APPLIED GRAPH ALGORITHMS	3	2	0	4	50	50	100	PE
15XDAG	GAME THEORY	3	2	0	4	50	50	100	PE
15XDAH	SOCIAL NETWORK DATA ANALYTICS	3	2	0	4	50	50	100	PE
15XDAI	ARTIFICIAL INTELLIGENCE	3	2	0	4	50	50	100	PE
15XDAJ	CLOUD COMPUTING	3	2	0	4	50	50	100	PE
15XDAK	DATA VISUALIZATION	3	2	0	4	50	50	100	PE

Course Code	Course Title	Hours/Week			Credit	Maximum marks			CAT
		Lecture	Tutorial	Practical		CA	FE	Total	
OPEN ELECTIVES (Two to be opted)									
15XDO1	COMPUTATIONAL FINANCE	3	2	0	4	50	50	100	OE
15XDO2	COMPUTATIONAL GEOMETRY	3	2	0	4	50	50	100	OE
15XDO3	RANDOMIZED ALGORITHMS	3	2	0	4	50	50	100	OE
15XDO4	PRINCIPLES OF MANAGEMENT AND BEHAVIOURAL SCIENCES	3	2	0	4	50	50	100	OE
15XDO5	ENTREPRENEURSHIP	3	2	0	4	50	50	100	OE
15XDO6	INFORMATION THEORY AND ERROR CONTROL CODING	3	2	0	4	50	50	100	OE
15XDO7	COMPUTATIONAL COMPLEXITY THEORY	3	2	0	4	50	50	100	OE
15XDO8	ACCOUNTING AND FINANCIAL MANAGEMENT	3	2	0	4	50	50	100	OE
15XDO9	WIRELESS NETWORKS	3	2	0	4	50	50	100	OE

Labeling & Group of Courses

PROFESSIONAL CORE (PC)				
Sl. No.	**Course Code**	**Course Title**	**L:T:P:C**	**Preferred Semester**
1.	15XD15	PROBLEM SOLVING & C PROGRAMMING	3:0:0:3	I
2.	15XD17	C PROGRAMMING LAB	0:0:4:2	I
3.	15XD23	DATA STRUCTURES	3:0:0:3	II
4.	15XD24	OBJECT ORIENTED PROGRAMMING	3:0:0:3	II
5.	15XD25	THEORY OF PROBABILITY	3:2:0:4	II
6.	15XD26	OBJECT COMPUTING LAB	0:0:4:2	II
7.	15XD27	DATA STRUCTURES LAB	0:0:4:2	II
8.	15XD28	MATHEMATICAL COMPUTING LAB	0:0:2:1	II
9.	15XD31	APPLIED STATISTICS	3:0:0:3	III
10.	15XD34	ADVANCED DATA STRUCTURES	3:0:0:3	III
11.	15XD35	COMPUTER ORGANIZATION AND ASSEMBLY LANGUAGE PROGRAMMING	3:0:0:3	III
12.	15XD36	APPLIED STATISTICS AND PYTHON PROGRAMMING LAB	0:0:4:2	III
13.	15XD37	ADVANCED DATA STRUCTURES LAB	0:0:4:2	III
14.	15XD38	ASSEMBLY LANGUAGE PROGRAMMING LAB	0:0:4:2	III
15.	15XD42	DATABASE DESIGN	3:0:0:3	IV
16.	15XD43	DESIGN AND ANALYSIS OF ALGORITHMS	3:0:0:3	IV
17.	15XD44	OPERATING SYSTEMS	3:0:0:3	IV
18.	15XD45	PREDICTIVE ANALYTICS	4:0:0:4	IV
19.	15XD46	UNIX SYSTEMS LAB	0:0:4:2	IV
20.	15XD47	RDBMS LAB	0:0:4:2	IV
21.	15XD48	DESIGN AND ANALYSIS OF ALGORITHMS LAB	0:0:4:2	IV
22.	15XD52	STOCHASTIC MODELS	3:2:0:4	V
23.	15XD53	COMPUTER NETWORKS	3:0:0:3	V
24.	15XD54	SUPERVISED AND UNSUPERVISED LEARNING	3:0:0:3	V
25.	15XD56	JAVA PROGRAMMING LAB	0:0:4:2	V

26.	15XD57	COMPUTER NETWORKS LAB	0:0:4:2	V
27.	15XD58	SUPERVISED AND UNSUPERVISED LEARNING LAB	0:0:4:2	V
28.	15XD61	PARALLEL AND DISTRIBUTED COMPUTING	3:0:0:3	VI
29.	15XD62	DATA MINING	3:0:0:3	VI
30.	15XD63	MODERN DATABASE SYSTEMS	3:0:0:3	VI
31.	15XD64	OPTIMIZATION TECHNIQUES	3:2:0:4	VI
32.	15XD66	PARALLEL AND DISTRIBUTED COMPUTING LAB	0:0:4:2	VI
33.	15XD67	MODERN DATABASE SYSTEMS LAB	0:0:4:2	VI
34.	15XD68	SCRIPTING LANGUAGES LAB	0:0:4:2	VI
35.	15XD81	REINFORCEMENT LEARNING	3:0:0:3	VIII
36.	15XD83	DATA PRIVACY AND SECURITY	3:0:0:3	VIII
37.	15XD84	ADVANCED ANALYTICS	3:0:0:3	VIII
38.	15XD86	REINFORCEMENT LEARNING LAB	0:0:4:2	VIII
39.	15XD87	DATA PRIVACY AND SECURITY LAB	0:0:4:2	VIII
40.	15XD88	ADVANCED ANALYTICS LAB	0:0:4:2	VIII
41.	15XD91	WEB ANALYTICS	3:0:0:3	IX
42.	15XD92	NETWORK SCIENCE	3:0:0:3	IX
43.	15XD93	INFORMATION RETRIEVAL	3:0:0:3	IX
44.	15XD96	INFORMATION RETRIEVAL LAB	0:0:4:2	IX
45.	15XD97	WEB ANALYTICS LAB	0:0:4:2	IX
46.	15XD98	NETWORK SCIENCE LAB	0:0:4:2	IX

PROFESSIONAL ELECTIVES (PE)				
Sl. No.	**Course Code**	**Course Title**	**L:T:P:C**	**Preferred Semester**
1.	15XDA1	DATA COMPRESSION	3:2:0:4	V
2.	15XDA2	MOBILE COMPUTING	3:2:0:4	VI
3.	15XDA3	DIGITAL IMAGE PROCESSING	3:2:0:4	VI
4.	15XDA4	MULTIMEDIA ANALYTICS	3:2:0:4	VI
5	15XDA5	COMPUTATIONAL NEUROSCIENCE	3:2:0:4	VIII
6.	15XDA6	PERVASIVE COMPUTING	3:2:0:4	VIII
7.	15XDA7	MARKETING ANALYTICS	3:2:0:4	VIII
8	15XDA8	NATURAL LANGUAGE PROCESSING	3:2:0:4	VIII
9.	15XDA9	SOFT COMPUTING	3:2:0:4	VIII

10.	15XDAA	COMPUTER GRAPHICS	3:2:0:4	VI
11.	15XDAB	ALGORITHMS FOR BIOINFORMATICS	3:2:0:4	VIII
12.	15XDAC	MATHEMATICAL MODELING	3:2:0:4	V
13.	15XDAD	SOFTWARE ENGINEERING	3:2:0:4	V
14.	15XDAE	DESIGN PATTERNS	3:2:0:4	IX
15.	15XDAF	APPLIED GRAPH ALGORITHMS	3:2:0:4	IX
16.	15XDAG	GAME THEORY	3:2:0:4	IX
17.	15XDAH	SOCIAL NETWORK DATA ANALYTICS	3:2:0:4	IX
18	15XDAI	ARTIFICIAL INTELLIGENCE	3:2:0:4	VI
19.	15XDAJ	CLOUD COMPUTING	3:2:0:4	IX
20	15XDAK	DATA VISUALIZATION	3:2:0:4	VIII

OPEN ELECTIVES (OE)				
S.No.	**Course Code**	**Course Title**	**L:T:P:C**	**Preferred Semester**
1	15XDO1	COMPUTATIONAL FINANCE	3:2:0:4	VI or VIII
2	15XDO2	COMPUTATIONAL GEOMETRY	3:2:0:4	VI or VIII
3	15XDO3	RANDOMIZED ALGORITHMS	3:2:0:4	VI or VIII
4	15XDO4	PRINCIPLES OF MANAGEMENT AND BEHAVIOURAL SCIENCES	3:2:0:4	VI or VIII
5	15XDO5	ENTREPRENEURSHIP	3:2:0:4	VI or VIII
6	15XDO6	INFORMATION THEORY AND ERROR CONTROL CODING	3:2:0:4	VI or VII
7	15XDO7	COMPUTATIONAL COMPLEXITY THEORY	3:2:0:4	VI or VIII
8	15XDO8	ACCOUNTING AND FINANCIAL MANAGEMENT	3:2:0:4	VI or VIII
9	15XDO9	WIRELESS NETWORKS	3:2:0:4	VI or VIII

BASIC SCIENCES (BS)				
Sl. No.	**Course Code**	**Course Title**	**L:T:P:C**	**Preferred Semester**
1.	15XD12	CALCULUS AND ITS APPLICATIONS	3:2:0:4	I
2.	15XD13	APPLIED PHYSICS	3:0:0:3	I
3.	15XD14	DIGITAL ELECTRONICS	3:0:0:3	I
4.	15XD18	APPLIED PHYSICS AND DIGITAL ELECTRONICS LAB	0:0:4:2	I
5.	15XD21	DISCRETE STRUCTURES	3:2:0:4	II
6.	15XD22	TRANSFORMS AND ITS APPLICATIONS	3:2:0:4	II
7.	15XD32	ABSTRACT ALGEBRA	4:0:0:4	III
8.	15XD33	GRAPH THEORY	3:2:0:4	III
9.	15XD41	LINEAR ALGEBRA	3:2:0:4	IV
10.	15XD51	APPLIED NUMERICAL ANALYSIS	4:0:0:4	V

ENGINEERING SCIENCES (ES)				
Sl. No.	**Course Code**	**Course Title**	**L:T:P:C**	**Preferred Semester**
1.	15XD16	ENGINEERING GRAPHICS AND GEOMETRIC MODELING	0:0:4:2	I

HUMANITIES AND SOCIAL SCIENCES (HS)				
Sl. No.	**Course Code**	**Course Title**	**L:T:P:C**	**Preferred Semester**
1.	15XD11	ENGLISH FOR PROFESSIONAL SKILLS	3:0:0:3	I

EMPLOYMENT ENHANCEMENT COURSES (EEC)				
Sl. No.	**Course Code**	**Course Title**	**L:P:T:C**	**Preferred Semester**
1.	15XDP1	PROJECT WORK-I	0:0:0:12	VII
2.	15XDP2	PROJECT WORK – II	0:0:0:12	X

SEMESTER - I

15XD11 CALCULUS AND ITS APPLICATIONS

3 2 0 4

LIMITS AND CONTINUITY: Function of single variable – Definition, limit, continuity, piecewise continuity, periodic, differentiable, absolutely integrable, fundamental theorem of Calculus. (9+6)

SEQUENCES AND SERIES: Infinite Sequences – convergence, divergence, limit, Sandwich theorem, continuous function theorem, increasing, decreasing, bounded, function limit properties – Infinite Series – convergence and divergence – Integral test, comparison test, ratio test, root test. Alternating series - alternating series test, absolute and conditional convergence – power series, Taylor series and Maclaurin series. (9+6)

FUNCTIONS OF TWO VARIABLES: Models, partial derivative and its geometrical interpretation. Stationary points – maxima, minima and saddles. Taylor series about a point. Constrained maxima and minima – Lagrange multipliers method. (6+4)

MULTIPLE INTEGRALS: Double integrals in Cartesian form - Change of order of integration – double integrals in polar form, triple integrals in rectangular, cylindrical and spherical coordinates. Applications of multiple integrals to find areas, volume, moments, masses. (9+6)

ORDINARY DIFFERENTIAL EQUATIONS: Linear Differential Equations of first order - Exact differential equations, Integrating factors, Bernoulli equations - Linear Differential Equations of higher order with constant coefficients - Euler's equation with variable coefficients - Simultaneous equations - Method of variation of parameters. Modeling simple systems. (12+8)

Total: L: 45+T: 30=75

TEXT BOOK:

1. Hass M. D. J., Giordano Weir F.R., “Thomas Calculus”, Pearson Education, 2013.

REFERENCES:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2011.
2. Lian, Hungerford, and Holcomb “Mathematics with Applications”, Addison Wesley, 2010.
3. Riley K. F., Hobson M. P. and Bence S. J., "Mathematical Methods for Physics and Engineering", Cambridge University Press, 2006.
4. Michael D. Greenberg, “Advanced Engineering Mathematics”, Pearson Education, 2014.

15XD12 ENGLISH FOR PROFESSIONAL SKILLS

3 0 0 3

READING COMPREHENSION: Developing Reading Skills like Skimming and Scanning for information, Critical Reading, Inferential, Cognition, and analytical Skills- appropriate reading texts to be used from general, scientific, and literary genres. (10)

PRINCIPLES OF CLEAR WRITING: The fundamental aspects of formal writing like objectivity, conciseness, clarity, simplicity, coherence, parallelism, unity, cohesion and accuracy to be focused Writing in different ways to create an emphasis – samples from news items, creative articles and reports to be used. (4)

TECHNICAL WRITING: Technical Style, Mechanics, Critical Evaluation of different types of technical texts and different genres of technical writing. – Format and different types of formal reports – Technical Papers. (4)

CORRESPONDENCE: Memos, Principles of Official, Social, and E-mail Correspondence to be focused. (4)

FOCUS ON SOFT SKILLS: Intra and Interpersonal Communication, Telephone Etiquette, Body language and Interview Techniques. (5)

PRACTICALS: Listening exercises using Language Laboratory, Making short speeches, Group Discussions and Role-Plays. (18)

Total L : 45

TEXT BOOK:

1. Teaching Material prepared by the Faculty, Department of English.

REFERENCES:
1. Meenakshi Raman and Sangeeta Sharma, “Technical Communication”, Oxford University Press, 2012.
2. Dorothy E. Zemach and Lynn Stafford – Yilmaz,”Writers at Work**:** The Essay”, Cambridge University Press, 2008.
3. Jill Singleton, “Writers at Work: The Paragraph”, Cambridge University Press, 2005.
4. Garry Adams and Terry Peck, “Useful Exercises for IELTS”, Adams and Austen Press, 2001.
5. IMS Learning Resources, “Communication Skills Builder”, IMS Publications, 2008.
6. AyshaViswamohan, “English for Technical Communication”, Tata McGraw Hill, 2008.
7. Mark Ibboston, “Cambridge English for Engineering”, Cambridge University Press, 2011.
8. Suresh Kumar E and Sreehari P, “A Handbook for English Language Laboratories”, Cambridge University Press, 2013.

15XD13 APPLIED PHYSICS

4 0 0 4

LASERS AND FIBER OPTICS: Principle of Laser: spontaneous and stimulated emission, types of laser: He-Ne, CO2 and Nd:YAG laser. Applications: Laser diodes, holography, cutting, drilling, welding. Principle of Fiber optics. Modes of propagation. Classification based on materials, refractive index profile, modes. Splicing. Losses in optical fiber. Fiber optical communication system, Light sources and Detectors. Fiber optic sensors – temperature, displacement and strain. (12)

CONDUCTORS AND APPLICATIONS: Drude Lorentz theory of electrical conduction, Band theory of solids. Factors affecting resistivity of metals – temperature, alloying, magnetic field and strain.Applications of conductors – Strain gauge, conducting material, and resistance thermometer. (12)

SEMICONDUCTORS AND DEVICES: Elemental and compound semiconductors. Intrinsic and extrinsic semiconductors - Properties. Hall effect - Hall coefficient in extrinsic semiconductors, experimental determination of Hall coefficient. Application of Semiconductors –Solar Cells, LED and LCD. Introduction to semiconductor memory devices: Random Access Memory (RAM), Read only Memory (ROM), DRAM CCD. (12)

MAGNETIC MATERIALS AND MEMORY DEVICES: Origin of magnetism, Classification, Ferro magnetic materials – Properties. Domain theory of ferromagnetism.Hysteresis.Hard and soft magnetic materials. Ferrite – structure and properties. Applications – optical, magnetic and magneto optical memory devices. (12)

ADVANCED MATERIALS AND APPLICATIONS: NANO MATERIALS -Synthesis - PVD and ball milling techniques.properties, applications. Shape Memory alloys (SMA) – Characteristics, properties of NiTi alloy, application in MEMS. Superconductivity- types of superconductors - High Tc superconductors, Application of superconductors -SQUID, Levitation and cryotron. (12)

Total L: 60

TEXT BOOKS:
1. William D. Callister Jr., David G. Rethwisch, "Material Science and Engineering", John Wiley &Sons, 2010.
2. Rajendran and Marikani, “Materials Science", Tata McGraw Hill, 2011.

REFERENCES:
1. Leonid V. Azaroff and James J. Brophy, "Electronic Processes in Materials”, McGraw Hill, 1991.
2. Raghavan V, “Materials Science and Engineering- A First Course”, Prentice Hall, 2011.
3. Sze SM, “Modern Semiconductor Device Physics”, John Wiley & Sons, 1998.

15XD14 DIGITAL ELECTRONICS

4 0 0 4

SEMICONDUCTOR DEVICES AND CIRCUITS: (Qualitative treatment only) Fundamental aspects of semiconductors - PN junction diode -Zener diode - Rectifiers - Zener voltage regulators - Filters - Bipolar Junction Transistors - Transistor Amplifiers - Field Effect Transistor. (5)

NUMBER SYSTEM AND CODES: Binary - Octal - Hexadecimal - BCD - Excess three - Gray codes - Error correcting and detecting codes. (8)

DIGITAL CIRCUITS AND GATES: AND, OR, NOT, NAND and NOR gates - exclusive OR gates. Positive and negative logic systems - Digital integrated circuits-Characteristics -TTL and MOS logic circuits - Comparison. (8)

BOOLEAN ALGEBRA AND KARNAUGH MAPS: Boolean relations - Laws and theorems - Simplifications - Karnaugh maps and simplifications - Don’t care conditions - NAND-NAND realizations. (8)

COMBINATIONAL LOGIC: Design and Implementation of Half and Full adders - Subtractors – Parallel adders - Carry look ahead addition - Encoders and decoders - Multiplexers and De-multiplexers. (8)

SEQUENTIAL LOGIC: R-S, J-K, D and T type Flip-Flops - Binary counters: Ripple and synchronous types - UP/DOWN counters - Decade counters - Shift registers - Ring counters. (8)

OPERATIONAL AMPLIFIERS: Definition of terms - Inverting and non-inverting amplifiers, inverting summing amplifier, integrators and differentiators. (7)

A/D AND D/A CONVERTORS: DACs: weighted and binary ladder types - ADCs: counter, dual slope, successive approximation types. (8)

Total L: 60

TEXT BOOKS:

1. Leach D.P., "Digital Principles & Applications", Tata McGraw Hill, 2010.
2. Mottershed A., "Electronic devices and circuits", Prentice Hall, 2009.

REFERENCES:

1. Gothamann H., "Digital Electronics: An Introduction to Theory and Practice", Prentice Hall, 2000.
2. Paul Horowitz and Winfield Hill, "The Art of Electronics", Cambridge University Press, 2010.
3. Hamachar V. C., Vranesic Z. G. and Zaky S. G., "Computer Organization", McGraw Hill, 2011.

15XD15 PROBLEM SOLVING & C PROGRAMMING

3 0 0 3

PROBLEM SOLVING: Introduction to Problem Solving- Program development- Analyzing and Defining the Problem- Modular Design – Algorithm - Flow Chart - What is a programming language-Types of programming language- Program Development Environment. (3)

C LANGUAGE: Introduction to C Language - C character set - Identifiers and Keywords - Data Types - Constants - Variables - Arrays - Declarations - Expressions - Statements - Symbolic constants - Operators and Expressions - Library Functions - Data Input and Output Functions. (4)

CONTROL STATEMENTS: While Statement - Do While Statement – For Loop – Nested Loop - If Else - Switch - Break - Continue - Comma Operator – Goto Statement. (3)

FUNCTIONS: Defining Function - Accessing a Function - Passing Arguments to Functions - Specifying Arguments Data Types - Function Prototypes - Storage Classes - Auto - Static - Extern and Register Variables. (5)

ARRAYS: Defining Array – Processing array - Passing array to a function - Multi dimensional array - Array and strings. (4)

POINTERS: Declarations - Pointers to a function - Pointers and one dimensional arrays - Operating a pointer - Pointer and multi dimensional arrays - arrays of pointers - passing functions to other functions. (8)

STRUCTURES AND UNIONS: Definition of Structure and Union - Processing a structure – Bit field representations - Structures and pointers - Passing structure to functions - Self referential structures – Nested structure. (7)

FILES: File Structure concepts introduction - Definitions, concept of record, file operations: Storing, creating, retrieving, updating Sequential, relative, indexed and random access mode, Files with binary mode(Low level), performance of Sequential Files – Operations on Files – Types of Files, Various input and output functions on Files. (7)

Enumerated Data Type – Typedef - Preprocessor Directives - Command Line Arguments. (4)

Total L : 45

TEXT BOOKS:

1. Kernighan B. W. and Ritchie DM, "C Programming Language (ANSI C)", Prentice Hall, 2013.
2. Deitel H. M. and Deitel P. J., "C How to Program**",** Prentice Hall, 2012.

REFERENCES:

1. Herbert Schildt, "C The Complete Reference", Tata McGraw Hill, 2010.
2. Gottfried Byron, "Programming With C", Tata McGraw Hill, 2011.

15XD16 ENGINEERING GRAPHICS AND GEOMETRIC MODELLING

0 0 4 2

INTRODUCTION: BIS specifications - lines, lettering, and dimensioning. Projection –types. (4)

FIRST ANGLE PROJECTION: Introduction- Projection of points, lines, planes, and solids –parallel, perpendicular and inclined to planes. (8)

ISOMETRIC PROJECTION: Introduction- prismatic and cylindrical components. (2)

INTERACTIVE GRAPHICS: Parametric modeling –1D, 2D and 3D geometry – transformations - display – points, lines using software. (4)

CURVES: Types- parametric curves generation-displaying - evaluating points on curves. (4)

SURFACES: Types- parametric surface generation-displaying - evaluating points on surfaces. (5)

SOLIDS: Generation of part models using Computer Aided Geometric Modeling software. (3)

LABORATORY COMPONENT:
Engineering Graphics using CAD

1. Introduction to CAD Software.
2. First angle projection of a. Points b. Lines
3. Projection of a. Planes b. Solids
4. Conversion of isometric to orthographic projection.
5. Orthographic to isometric projection.
6. Sectioning of regular solids.
7. Perspective projection of simple solids.

Geometric Modeling using a graphical programming language

8. Modeling and displaying a point and line using orthographic projection and performing simple geometric transformation.
9. Modeling and displaying of parametrically represented analytical curves
   a. Circle b. Ellipse
10. Modeling and displaying of parametrically represented synthetic curves
    a. Bezier Curve b. B-spline
11. Modeling and displaying of parametrically represented NURBS curve.
12. Modeling and displaying of parametrically represented synthetic surface.
    a. Planar surface b. Ruled surface
13. Modeling and displaying of Bezier surface.
14. Modeling and displaying of B-Spline surface.

Total: P: 60

TEXT BOOKS:

1. "A Primer on Engineering Drawing using Pro Engineer", Department of Production Engineering and CAD/CAM Centre, PSG College of Technology, 2012.
2. Michael E. Mortensen, "Geometric Modeling (Digitized)", Industrial Press, 2011.

REFERENCES:

1. David F. Rogers, Alan Adams J., "Mathematical Elements in Computer Graphics (Digitized)", McGraw Hill, 2007.
2. David Solomon, "Computer Graphics and Geometric Modeling", Springer, 2013.
3. Michael E. Mortenson, "Geometric Modeling(Digitized)", Industrial Press, 2011.
4. Martti Mantyla, "An Introduction to Solid Modeling (Digitized)", Computer Science Press, 2007.

15XD17 C PROGRAMMING LAB

0 0 4 2

1. Simple programs to understand the concepts of data types.
2. Familiarizing conditional, control and repetition statements.
3. Usage of single and double dimensional arrays including storage operations.
4. Implementation of functions, recursive functions.

5. Defining and handling structures, array of structures and union.
6. Implementation of pointers, operation on pointers and dynamic storage allocation.
7. Creating and processing data files.

Total P: 60

15XD18 APPLIED PHYSICS AND DIGITAL ELECTRONICS LAB

0 0 4 2

APPLIED PHYSICS LABORATORY

1. Resistivity of an Alloy – Carey Foster's Bridge.
2. Band Gap of Thermistor – Post Office Box.
3. Thermal Conductivity of Metallic Wire – Wiedmann Franz law.
4. Temperature co-efficient of Resistance – Post Office Box.
5. Efficiency of Solar Cell.
6. Band Gap Determination – Reverse Saturation Current.
7. Photodiode Characteristics.
8. Determination of Wavelength of laser source using grating.

DIGITAL ELECTRONICS LABORATORY

1. Study of basic logic gates and realization of logic gates using universal gates.
2. Multiplexer and demultiplexer.
3. Half and full adder / subtractor.
4. Encoder and decoder.
5. Binary decade counter.
6. BCD to seven segment decoder.
7. Study of D/A converter.
8. Crystal Oscillator using logic gates

Total P: 60

SEMESTER - 2

15XD21 DISCRETE STRUCTURES

3 2 0 4

MATHEMATICAL LOGIC: Proposition - Logical operators - Truth tables – Laws of Logic – Equivalences – Rules of inference - Validity of arguments – Consistency of specifications – Propositional Calculus – Quantifiers and universe of discourse. (9+6)

PROOF TECHNIQUES: Introduction – Methods of proving theorems – Direct proofs, Proof by contraposition, Vacuous and trivial proofs, Proofs by contradiction – Mistakes in proofs – Mathematical induction – Strong mathematical induction and well ordering - Program correctness. (8+4)

RELATIONS AND FUNCTIONS: Definition and properties of binary relations – Representing Relations – Closures of Relations – Composition of Relations – Equivalence Relations – Partitions and Covering of Sets – Partial Orderings – n-ary Relations and their Applications. Functions- Injective, Surjective, Bijective functions, Composition, Identity and Inverse. (8+4)

COMBINATORICS: Basics of counting – The Pigeonhole principle - Permutations and Combinations with and without repetition, Permutations with indistinguishable elements, distribution of objects - Generating permutations and combinations in lexicographic order. (8+6)

RECURRENCE RELATIONS: Some Recurrence Relation Models- Solutions of linear homogeneous recurrence relations with constant coefficients- solution of linear non-homogeneous recurrence relations by the method of characteristic roots - Divide and conquer recurrence relations. (7+5)

LATTICES: Lattices as partially ordered set – Properties of Lattices– Lattices as algebraic system – Sublattices – Direct product and Homomorphism – Some special lattices. (5+5)

Total
L:45+T:30=75

TEXT BOOKS:

1. Kenneth H. Rosen, “Discrete Mathematics and its Application”, McGraw Hill, 2011.
2. Judith L. Gersting, “Mathematical Structures for Computer Science”, W.H. Freeman and Company, 2014.
3. Tremblay J. P. and Manohar R., “Discrete Mathematical structures with application to Computer Science”, Tata McGraw Hill, 2011.

REFERENCES:

1. Doerr Alan and Levasseur K., "Applied Discrete Structures for Computer Science", Galgotia Publications, 2002.
2. BenardKolman, Robert C. Busby and Sharan Ross, "Discrete Mathematical Structures", Pearson Education, 2014.
3. Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics – An Applied Introduction”, Addison Wesley, 2009.

15XD22 TRANSFORMS AND ITS APPLICATIONS

3 2 0 4

TRANSFORM METHODS: Concept of Transformation - Examples for Transformations. (2+2)

LAPLACE TRANSFORM: Definition - Transforms of Standard Functions - Transform of unit step function - Dirac delta function. – Transforms of derivatives and integrals -Transforms of Periodic functions - Inverse Laplace transform- Convolution Theorem. Method of solving ordinary linear differential equations with constant coefficient and solving integral equations by Laplace transform technique. (12+8)

FOURIER SERIES: Even and odd functions, Dirichlet’s conditions, statement of Fourier theorem, Fourier coefficients, change of scale, Half-range sine and cosine series, RMS value, Parseval’s theorem, (10+8)

FOURIER TRANSFORM : Fourier integrals - Fourier transform- Fourier sine and cosine transform - Transforms of standard functions - Properties, Convolution theorem (Statement only) – Discrete Fourier and Fast Fourier Transforms – Discrete Convolution – Periodic sequence and circular convolution – Discrete Fourier Transform – decimation–in-time algorithm – Decimation-in-frequency algorithm – Computation of inverse DFT. (12+8)

Z-TRANSFORM: Z - transform of standard functions, inverse Z-transform – properties of Z – transform – Difference equations – Modeling, Solution of difference equations. (9+4)

Total: L:45 + T:30 = 75

TEXT BOOKS:

1. EwinKreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2011.
2. Ray Wylie C, Louis C Barret, “Advanced Engineering Mathematics”, McGraw Hill, 2013.

REFERENCES:

1. Michael D. Greenberg, “Advanced Engineering Mathematics”, Pearson Education, 2009.
2. Roland E. Thomas and Albert J. Rosa, “The Design and Analysis of Linear Circuits”, John Wiley & Sons, 2011.
3. Thomas L. Harman, James Dabney and Norman Richert, “Advanced Engineering with MATLAB”, Brooks/Cole, 2000.

15XT23 DATA STRUCTURES

3 0 0 3

INTRODUCTION: Software Development process – Abstraction - Data structures - Abstract Data Types - Primitive data structures - Analysis of algorithms - Best, worst and average case time complexities - notations. (4)

ARRAYS: Operations - Implementation of one, two, three and multi dimensioned arrays – Sparse and dense matrices - Applications. (4)

STRINGS: Implementation - operations - String applications. SETS: Operations on sets - implementation of sets. (3)

STRUCTURES AND UNIONS: Implementation – operations – Applications. (3)

STACKS: Primitive operations - Sequential implementation - Applications: Subroutine handling - Recursion – Expression Processing. (3)

QUEUES: Primitive operations - sequential implementation - Priority Queues - Dequeues - Applications: Image component labeling; Machine shop simulation. (5)

LISTS: Primitive Operations - Singly linked lists, Doubly linked lists, Circular lists, Multiply linked lists - Applications: Addition of Polynomials; Sparse Matrix representation and Operations. – Linked Stacks - Linked queues - Linked Priority queues - Dynamic Storage Management. (8)

TREES: Terminologies - Implementation - BINARY TREE: Properties - Sequential and linked representation - Common binary tree operations - Traversals - Expression trees - Infix, Postfix and Prefix expressions - Threaded trees - Tournament trees - Heaps, Max heap, Min heap. (8)

HASHING: Hash function – Separate chaining – Open addressing – Linear probing – Quadratic probing – Double hashing - rehashing. (3)

SORTING: Bubble sort- Insertion sort- selection sort- quick sort – Heap sort – Radix sort – Time complexity analysis. (4)

Total L: 45

TEXT BOOKS:

1. Sahni Sartaj, "Data Structures, Algorithms and Applications in C++", Silicon Press, 2011.
2. Aaron M. Tanenbaum, Moshe J. Augenstein and YedidyahLangsam, "Data structures using C and C++", Prentice Hall, 2012.
3. Michael T. Goodrich, Roberto Tamassia and David Mount, " Data Structures and Algorithms in C++", John Wiley, 2011.

REFERENCES:

1. Alfred V. Aho, John E Hopcraft, Jeffrey D. Ullman, "Data structures and Algorithms", Pearson Education, 2009.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Addison-Wesley, 2014.
4. Nell Dale, "C++ Plus Data Structures", Jones and Bartlett Learning, 2011.
5. Robert L. Kruse and Clovis L. Tondo, "Data Structures and Program Design in C", Pearson Education, 2013.

15XD24 OBJECT ORIENTED PROGRAMMING

3 0 0 3

PRINCIPLES OF OBJECT ORIENTED PROGRAMMING: Software crisis Software Evolution - Procedure Oriented Programming - Object Oriented Programming Paradigm - Basic Concepts and Benefits of OOP - Object Oriented Programming Language - Application of OOP - Structure of C++ - Tokens, Expressions and Control Structures - Operators in C++ - Manipulators. (6)

FUNCTIONS IN C++: Function Prototyping - Call by Reference - Return by reference - Inline functions - Default, Const Arguments - Function - Overloading - Friend and Virtual Functions - Classes and Objects - Member functions - Nesting of Member functions - Private member functions - Memory allocation for Objects - Static data members - Static MemberFunctions - Arrays of Objects - Objects as Function Arguments - Friend Functions - Returning Objects - Const Member functions - Pointers to Members. (10)

CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors – Destructors overloading. (3)
OPERATOR OVERLOADING: Overloading Unary and Binary Operators - Overloading Binary Operators using Friend functions – Operator Type conversion. (3)

INHERITANCE: Defining Derived Classes - Single Inheritance - Making a Private Member Inheritable - Multiple Inheritance - Hierarchical Inheritance - Hybrid Inheritance - Virtual Base Classes - Abstract Classes - Constructors in Derived Classes - Member Classes - Nesting of Classes – Composition – Aggregation. (9)

POLYMORPHISM: Basics of polymorphism – Types of polymorphism - Compile and Run Time Polymorphism - Virtual function – Object Slicing – Virtual Destructor – Dynamic binding. (5)

TEMPLATES & EXCEPTION HANDLING: Introduction to Templates, Generic Functions and Generic Classes – Exception Handling – Examples. (4)

STREAMS: String I/O -Character I/O - Object I/O - I/O with multiple Objects - File pointers - Disk I/O with member functions. (5)

Total L: 45

TEXT BOOKS:

1. Bjarne Stroustrup, "The C++ Programming Language", Pearson Education, 2014.
2. Stanley B. Lippman, JoseeLajoie andBarbara E. Moo, "The C++ Primer", Addison Wesley, 2013.

REFERENCES:

1. Scott Meyers, "Effective C++", Addison Wesley, 2005.
2. Scott Meyers, "More Effective C++", Addison Wesley, 2008.
3. Bjarne Stroustrup, "The Design and Evolution of C++", Addison Wesley, 2005.
4. Stanley B Lippman, "Inside the C++ Object Model", Addison Wesley, 1996.

15XD25 THEORY OF PROBABILITY

3 2 0 4

PROBABILITY BASIC CONCEPTS: Introduction - Sample space and events - Axiomatic approach to probability – Basic theorems. Conditional Probability - Law of multiplication - Law of total probability and Bayes' Theorem - Independence. (8+8)

RANDOM VARIABLES: Discrete and continuous random variables - probability mass function and density function - distribution function - Expectation and variance. (4+2)

THEORETICAL DISTRIBUTIONS: Discrete: Binomial, Poisson and Geometric - Continuous: Uniform, Normal, Exponential, Weibull, Erlang and Gamma. (8+8)

BIVARIATE DISTRIBUTIONS Joint probability distributions - Marginal and conditional distributions - Statistical independence - Conditional expectation – Transformation of two random variables. (8+2)

LIMIT THEOREMS: Moments and moment generating functions- Sums of independent random variables - Limit theorems: Markov and Chebyshev inequalities, Law of Large numbers, Central Limit Theorem. (8+2)

RELIABILITY: Introduction - Structure Functions - Reliability of Systems of Independent Components - System Life as a Function of Component Lives - Expected System Lifetime. (9+8)

Total: L:45 + T:30 = 75

TEXT BOOKS:

1. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", Pearson Education, 2014.
2. Sheldon M.Ross, "Introduction to Probability Models", Academic Press, 2014.
3. K. S. Trivedi, "Probability and Statistics with Queuing, Reliability and Computer Science Applications", Prentice-Hall, 2011.

REFERENCES:

1. Anthony J. Hayter, "Probability and Statistics for Engineers and Scientists", Cengage Learning, 2013.
2. Jay L Devore, "Probability and Statistics for Engineering and Sciences", Cengage Learning, 2015.
3. Richard A. Johnson, Irwin Miller and John Freund, "Probability and Statistics for Engineers", Pearson Education, 2014.
4. Ronald E. Walpole, Raymond H. Meyers and Sharon L. Meyers, "Probability and Statistics for Engineers and Scientists", Pearson Education, 2014.

15XD26 OBJECT COMPUTING LAB

0 0 4 2

Exercises pertaining to the following outlines are to be experimented using C++:

1. Arithmetic operations using array of objects and dynamic data members.
2. Creation of a class having read-only member function and processing the objects of that class.
3. Creation of a class which keeps track of the member of its instances. Usage of static data member, constructor and destructor to maintain updated information about active objects.
4. Illustration of a data structure using dynamic objects.
5. Usage of static member to count the number of instances of a class.
6. Illustration for the need of default arguments.
7. Usage of a function to perform the same operation on more than one data type.
8. Creation of a class with generic data member.
9. Overloading the operators to do arithmetic operations on objects.
10. Acquisition of the features of an existing class and creation of a new class with added features in it.
11. Implementation of run time polymorphism.
12. Overloading stream operators and creation of user manipulators.
13. Implementation of derived class which has direct access to both its own and public members of the base class.
14. Implementation of Streams to store and maintain Library system, with the features of Book Issue and Book Return.

Total P: 60

15XD27 DATA STRUCTURES LAB

0 0 4 2

Implementation of the following problems:

1. Sparse and dense Matrix operations using arrays.
2. Library of string operations - representing strings using arrays.
3. Set operations.
4. Stack and Queue using array.
5. Linked Lists: Singly linked, Doubly linked and Circular lists.
6. Linked Stacks and Queues.
7. Conversion and Manipulation of Expressions.
8. Binary trees and Threaded trees (with graphical representation).
9. Hash Table linear probing and chaining.

Total P: 60

15XD28 MATHEMATICAL COMPUTING LAB

0 0 2 1

Implementation of the following problems using Matlab / R programming:

1. Differentiation and integration.
2. Finding Fourier series.
3. Solving ordinary differential equations using Laplace transform techniques.
4. Solving boundary value problems using Fourier series techniques.
5. Solving difference equations using Z transform.
6. Plotting Probability distributions using R Programming
7. Analyzing probability distributions to verify the limit theorems

Total P: 30

SEMESTER - 3

15XD31 APPLIED STATISTICS

3 0 0 3

DESCRIPTIVE STATISTICS: Frequency distribution – Bar graphs and Pie charts – Histogram- Ogive – Simpson's paradox – Measures of Location – Measures of Variability – Measures of distribution shape, relative location and detecting outliers – Exploratory Data analysis, Stem-and-leaf display – Measures of Association between two variables. (15)

STATISTICAL INFERENCE: Sampling distribution - Estimation: Point estimation, interval estimation - Criteria of a good estimator – Interval estimation of mean, proportion, and variance (single sample and two samples) - Maximum likelihood estimator. Hypothesis Testing: General concepts - Errors in Hypothesis testing - One-and two-tailed tests - Tests concerning mean, proportion, and variance - Tests for Goodness of fit and independence of attributes. (15)

CORRELATION AND REGRESSION: introduction - Estimation using the regression line - Correlation analysis -Limitations, errors, and caveats of using regression and correlation analyses - Multiple regression and correlation analysis - Inferences about population parameters – Modeling techniques. (10)

ANALYSIS OF VARIANCE: Introduction to design of experiments, Analysis of variance - Completely Randomized Design and Randomized Block Design. (5)

Total L: 45

TEXT BOOKS:

1. Richard I. Levin. David S. Rubin, "Statistics for Management", Pearson Education, 2014.
2. Ronald E. Walpole, Raymond H. Meyers and Sharon L. Meyers, "Probability and Statistics for Engineers and Scientists", Pearson Education, 2014.
3. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", Cengage Learning, 2015.
4. Anderson, Sweeney and Williams "Statistics for business and economics", Cengage Learning, 2014.

REFERENCES:

1. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", Pearson Education, 2014.
2. Sheldon M.Ross, "Introduction to Probability Models", Academic Press, 2014.
3. Douglas C Montgomery and George C Runges, "Applied Statistics and Probability for Engineers", John Wiley &Sons, 2014.
4. Roy D.Yates and David J. Goodman, "Probability and Stochastic Processes – A friendly Introduction for Electrical and Computer Engineers", John Wiley & Sons, 2015.
5. Trivedi K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", Prentice Hall, 2011.

15XD32 ABSTRACT ALGEBRA

4 0 0 4

ALGEBRAIC STRUCTURES: Groups - Definition and Example, Properties of Groups, Permutation Groups, Symmetric Groups, Cyclic Groups. (12)

SUBGROUPS AND NORMAL SUBGROUPS: Subgroups – Definition, Cosets and Lagrange's theorem, Homomorphism, Isomorphism, Automorphism – Cayley's theorem – Normal subgroups – Factor group – Fundamental theorem of group homomorphism (12)

GROUPS AND CODING: Coding of Binary information and Error detection – Group codes – Decoding and Error correction. (12)

RINGS: Definition and Properties – Subrings, Ring of Quaternions, Integral domain - Homomorphism – Ideals and Quotient Rings – Euclidean ring - Unique factorization theorem, Domain of Gaussian Integers. Polynomials Rings – Properties, Division Algorithm, Factorization of Polynomials – Primitive polynomials. (12)

FIELDS: Definition – subfields - Finite fields – structure of Finite field, GF (2^n). (12)

Total L : 60

TEXT BOOKS:

1. Herstein I. N., "Topics in Algebra", John Wiley & Sons, 2012.
2. Joseph A. Gallian, "Contemporary Abstract Algebra", Brooks/Cole, 2013.
3. Tremblay J. P. and Manohar R., "Discrete Mathematical Structures with Applications to Computer Science", Tata McGrawHill, 2011.

REFERENCES:

1. Ron M. Roth, "Introduction to Coding Theory", Cambridge University Press, 2007.
2. Ralph P. Grimaldi and Ramana B. V., "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education, 2014.

15XD33 GRAPH THEORY

3 2 0 4

BASIC CONCEPTS: Graphs - directed and undirected, subgraphs, graph models, degree of a vertex, degree sequence, Havel-Hakimi theorem, Hand-shaking lemma. Connectivity, walk, path, distance, diameter. Isomorphic graphs. Common classes of graphs – regular, complete, Petersen, cycle, path, tree, k-partite, planar, hypercube. Spanning trees – Matrix tree theorem, graph decomposition. (8+4)

CONNECTIVITY: Vertex and edge connectivity, Vertex and edge cuts, relationship between vertex and edge connectivity, bounds for connectivity. Harary's construction of k-connected graphs. (9+7)

EULERIAN AND HAMILTONIAN GRAPHS: Eulerian graphs, Route inspection problem, Hamiltonian graphs, Dirac's and Ore's theorems, Gray codes, Walecki's construction. (8+5)

MATCHING, VERTEX-COLORING AND DOMINATION: Matching, Perfect matching, Bipartite matching, Hall's theorem. Vertex-coloring – upper chromatic number, bounds using clique number, Δ(G), Welsh – Powell theorem. Dominating set, domination number, bounds. Applications of the above concepts to networks. (11+5)

RANDOM GRAPHS: Random graph – Definitions of G(n, p) and G(n, M) models. Ramsey number – definition, Erdos theorem. n-existentially closed graphs, asymptotically almost surely graphs and their existence theorem. Expectation and the first moment method, variance and second moment method, threshold function. Web graph models, applications to social networks. (9+9)

Total: L:45+T:30 = 75

TEXT BOOK:

1. Bondy J.A. and Murty U.S.R., "Graph Theory", Springer, 2013.

REFERENCES:

1. Anthony Bonato, "A Course on Web Graphs", American Mathematical Society, 2008.
2. BelaBollobas, "Random Graphs", Cambridge University Press, 2008.
3. Douglas B. West, "Graph Theory", Prentice Hall, 2014.
4. Jonathan Gross and Jay Yellen, "Graph Theory and its Applications", CRC Press, 2006.

15XD34 ADVANCED DATA STRUCTURES

3 0 0 3

INTRODUCTION: Algorithms – analysis of algorithms – best case and worst case complexities-analysis of some algorithms using simple data structures, Amortized time complexity. (5)

BINARY SEARCH TREES: Searching – Insertion and deletion of elements – randomly built binary search trees- analysis: height balancing techniques- AVL trees - Height – searching – insertion and deletion of elements- AVL rotations – analysis-Splay trees-notations-analysis. (8)

MULTIWAY SEARCH TREES: Indexed Sequential Access – m-way search trees – B-Tree – Searching, insertion and deletion - B+ trees, B*-trees, Tries and digital search trees, dictionary applications. (8)

MULTIDIMENSIONALSEARCH TREES: Range search–k-d trees**-** Quad trees (8)

PRIORITY QUEUES (HEAPS): d-Heaps- Leftist Heaps - Property and operations- Binomial heap- Fibonacci heaps. (6)

DATA STRUCTURES FOR DISJOINT SETS: Disjoint set operations-linked list representation of disjoint sets, disjoint set forests, tree representation, union by rank, find by path compression - analysis. (4)

GRAPHS: Definition – Representations (Adjacency matrix, packed adjacency list and linked adjacency list) – Network representation, shortest path- Dijkstra's algorithm, Graph search methods (Breadth first and depth first traversals)- Applications of depth first search-biconnectivity- finding strong components. (6)

Total L: 45

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms" , MIT Press, 2011.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Addison-Wesley, 2014.

REFERENCES:

1. Robert L. Kruse and Clovis L.Tondo, "Data Structures and Program design in C", Pearson Education, 2009.
2. Michael T. Goodrich, Roberto Tamassia,"Algorithm Design, Foundations, Analysis, and Internet Examples", Wiley 2011.
3. Sahni Sartaj, "Data Structures, Algorithms and Applications in C++", Silicon Press, 2009.

15XD35 COMPUTER ORGANIZATION AND ASSEMBLY LANGUAGE PROGRAMMING

3 0 0 3

DATA REPRESENTATION: Data types - Fixed point and floating point number representation (IEEE format) - Representation of signed numbers – arithmetic operation on signed numbers - Alphanumeric data representation. (4)

BASIC COMPUTER ORGANIZATION AND DESIGN: Instruction codes- Computer registers - Register transfer language - micro operations -Computer Instructions - Instruction Cycle - Memory Reference Instructions - Input - Output and Interrupts – Design of Basic Computer. (4)

CENTRAL PROCESSING UNIT: Processor Bus organization - Stack organization - Instruction formats - Data transfer and manipulation -– Multiprocessor Organization - RISC and CISC machine characteristics – Control Unit Design - Hardwired and micro programmed control. (4)

MEMORY INTERFACING: Memory hierarchy - Main memory: RAM and ROM - address spaces - Cache memory – Associative memory - Virtual memory, TLBs - Memory Interleaving. (6)

PERIPHERAL DEVICES INTERFACING : I/O interface - I/O bus versus memory bus - Isolated I/O versus Memory - Mapped I/O - Example of I/O interface – DMA - Input-Output processor. (4)

INTRODUCTION TO PARALLELISM: -Basic MIPS implementation – Building data path – Control Implementation scheme – Pipelining – Flynn's classification – Hardware multithreading – Multicore processors - Pipelining Concepts - Pipelined datapath and control –Handling Data hazards & Control hazards – Instruction Level Parallelism- Exceptions. (6)

INTEL 8086/88 PROCESSOR: Evolution of Micro processors - Micro processor based systems– Examples Functional units of 8086 – Pipelining in 8086 - Addressing modes – Instruction format - Instructions - assembler directives – Construction of Machine code – Data Transfer and Data Manipulation Instructions. (8)

ASSEMBLY LANGUAGE PROGRAMMING: Programs for multi precision addition, subtraction - Block moves - Array processing - String processing - Procedures and Interrupts - Interrupt Service Routines. (9)

Total L: 45

TEXT BOOKS:

1. Morris Mano, "Computer Systems Architecture", Pearson Education, 2008.
2. Barry B. Brey, "The Intel Microprocessors - 8086/88, and 80186, 80286, 80386, and 80486", Pearson Education, 2006.
3. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software interface”, Elsevier, 2012.

REFERENCES:

1. Hamachar V. C., Vranesic Z. G. and Zaky S. G., "Computer Organization", McGraw Hill, 2012.
2. John P. Hayes, “Computer Architecture and Organization”, Tata McGraw Hill, 2002.
3. Douglus V. Hall, "Microprocessors and Interfacing", McGraw Hill, 2010.
4. James L. Antonakos, “An Introduction to the Intel family of Microprocessors”, Pearson Education, 1999.

15XD36 APPLIED STATISTICS AND PYTHON PROGRAMMING LAB

0 0 4 2

Implementation of the following problems using Statistical Packages:

1. Classification and tabulation of data and Graphical and diagrammatic presentation of data.
2. Perform calculations that measure the central tendency and dispersion of data and Implementation of measures of Skewness, moments and kurtosis.
3. Determination of point and interval estimates.
4. Solving linear regression, polynomial regression and non-linear regression based problems and solving multiple regression and correlation analysis based problems.
5. Solving the problems based on Time series analysis and forecasting and implementing statistical quality control charts.

Exercises pertaining to the following outlines are to be experimented using **Python**:

6. Write a program that asks the user about textbook prices and reports how overpriced the textbooks are.
7. Create a new function called clubhouseAnimate(objlist) that loops through the window objects in the list and randomly switches them to either yellow (200, 190, 100) or dark (40, 50, 60). You can use a slice like mylist[1:] to loop over all the elements in a list except the first one
8. Create a main function that creates a GraphWin, calls clubhouseInit and assigns its return value to a variable like cbhouse. Then loop over the variable and call the draw method on each primitive object. Then call the getMouse and close methods of your GraphWin object. Test your clubhouse.
9. Problems to practice various image drawing functions to visualize data
10. Problems to practice lists and objects collections to analyse data
11. Problems to practice python function and parameters to code the calculations of measures of dispersion
12. Problems to practice classes, dictionaries and inheritance
13. Problems to practice command line arguments to find linear regression
14. Problems to Create your own Python module packages containing functions and data to visualize non-linear models
15. Problems to Import your own and other Python modules and use contained objects
16. Problems to understand the use local, global and built-in names within functions to package on applied statistical problems

Total P: 60

15XD37 ADVANCED DATA STRUCTURES LAB

0 0 4 2

Implementation of the following problems:

1. Problems related to sorting algorithms.
2. Problems using linear search and binary search.
3. Applications of binary search tree and its operations.
4. AVL tree including all rotations.
5. B-tree and its operations.
6. Disjoint set operations and some applications.
7. Problem using heap data structure.
8. Implementation of binomial heap and one application.
9. Problems related to graphs and graph traversals.
10. Implementation of shortest path algorithm.

Total: P: 60

15XD38 ASSEMBLY LANGUAGE PROGRAMMING LAB

0 0 4 2

Prerequisite:

- 15XD17 : Problem Solving Lab

Lab objectives

- To understand the arithmetic operation in various number representation.
- To practice on the DEBUGGER and 8086 Emulator tool.
- To enable the students to use the tools for checking the memory and internal register contents and debugging.
- To use arithmetic and logical instruction and control structures.
- To perform string operations and interrupt functions.
- To design a microprocessor based input /output system using interrupts.

LABORATORY COMPONENT:

1. Implementing the functionality of AND, OR and NOT gates.
2. Conversion of data between different number systems.
3. Arithmetic operations of binary numbers using both one's complement and two's complement arithmetic.
4. Implement parity bit generation for a n-bit binary data.
5. Practice on the DEBUGGER and 8086 Emulator Tool.
6. Conversion of BCD numbers into ASCII characters and vice versa.
7. Multiprecision addition and subtraction.
8. Packing and unpacking of BCD digits.
9. Programs on Logical and Arithmetic Instructions.
10. Implementation of Control Structures (FOR, LOOP, IF.. THEN, DO.. WHILE etc.,)
11. Programs using Arrays and Strings.
12. Programs using Special Instructions DAA, XCHG, CMPSW etc…
13. Programs using interrupt functions for input and output.

Total P: 60

SEMESTER - 4

15XD41 LINEAR ALGEBRA

3 2 0 4

SYSTEM OF LINEAR EQUATIONS AND MATRICES: System of linear equations ,Gauss – elimination, Elementary matrices and a method for finding inverse of a matrix. (7+8)

VECTOR SPACES: Vector spaces and subspaces – Linear combination, Span, Linear independence and dependence - Null space, Column space, and Row space – Basis and dimension of a vector space – Rank and nullity-Applications to Electrical network. (10+2)

INNER PRODUCT SAPCES: Inner product, Length, angle and orthogonality – Orthogonal sets – Orthogonal projections – Inner product spaces – Orthonormal basis: Gram-Schmidt process – QR Decomposition- Best Approximation, Least-squares. (10+8)

LINEAR TRANSFORMATION: Introduction to linear transformations – General Linear Transformations – Kernel and range – Matrices of general linear transformation- Geometry linear operators-Change of basis. (8+2)

EIGEN VALUES AND EIGEN VECTORS: Introduction to Eigen values- Diagonalizing a matrix- Orthogonal diagonalization-, Applications to differential equations- Positive definite matrices- Similar matrices –Quadratic forms-Quadratic surfaces Singular value decomposition. (10+10)

Total: L:45+T:30 = 75

TEXT BOOKS:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", Wiley, 2011.
2. David C. Lay, "Linear Algebra and its Applications', Pearson Education, 2011.

REFERENCES:

1. Gilbert Strang, "Linear Algebra and its Applications", Thomson Learning, 2009.
2. Steven J. Leon, "Linear Algebra with Applications", Prentice Hall, 2006.

15XD42 DATABASE DESIGN

3 0 0 3

BASIC CONCEPTS: Introduction to databases – Conventional file Processing – Data Modeling for a database – Three level architecture – Data Independency – Components of a Database Management System (DBMS) – Advantages and disadvantages of a DBMS – System Environment – Users of DBMS – Transaction Management. (6)

DATA MODELS: Introduction – Conceptual data modeling – Motivation - Entities, entity types, various types of attributes, relationships, relationship types - E/R Diagram(ERD) notation - Generalization – Aggregation – Conversion of ERD into relational schema – Introduction to Network data model and Hierarchical data model. (8)

RELATIONAL DATA MODEL: Introduction – Keys, relational algebra operators: selection, projection, cross product, various types of joins, division, examples, tuple relation calculus, domain relational calculus . (8)

RELATIONAL DATABASE MANIPULATION: Structured Query Language (SQL) - Basic data retrieval – nested queries - correlated and uncorrelated - SQL Join – Views. (4)

DATABASE DESIGN THEORY: Functional dependencies – Normal forms - Dependency theory - Functional Dependencies(FD) – Armstrong's axioms for FDs - Closure of a set of FDs, Minimal covers – 1NF, 2NF, 3NF and BCNF - Join dependencies and definition of 5NF – Examples. (9)

DATA STORAGE AND INDEXING: Storage device Characteristics – Operations on file - Sequential files - Index Sequential files – Direct files – Indexing using Tree structures. (10)

DATABASE SECURITY, INTEGRITY AND CONTROL: Security and Integrity threats – Defense mechanisms - Transaction processing – concepts - ACID properties - concurrency control - recovery methods. (4)

Total L: 45

TEXT BOOKS:

1. Silberschatz A., Korth H. and Sudarshan S., "Database System Concepts", McGraw Hill, 2011.
2. Elmasri R. and Navathe S.B., "Fundamentals of Database Systems", Pearson Education, 2011.
3. Raghu Ramakrishnan and Johannes Gehrke, "Database Management System", McGraw Hill, 2010.

REFERENCES:

1. Graeme C. Simsion, "Data Modeling Essentials", WileyDreamtech, 2006.
2. Bipin C.Desai, "An Introduction to Database System ", Galgotia Publishers, 2012.

15XD43 DESIGN AND ANALYSIS OF ALGORITHMS

3 0 0 3

INTRODUCTION: Fundamentals of algorithmic problem solving - Methods of specifying an algorithm – proving the correctness – analyzing an algorithm, Asymptotic notations, Recurrences – Master theorem. (6)

DIVIDE AND CONQUER: Integer multiplication,Strassen's matrix multiplication, closest pair. (5)

GREEDY METHOD: Minimum cost spanning tree (Kruskal and Prim's algorithms) , topological sorting, Huffman codes and data compression. (5)

DYNAMIC PROGRAMMING: Principles of dynamic programming – 0/1 knapsack problem, all pairs shortest problem, travelling salesman problem. (7)

STRING MATCHING: The naïve string-matching algorithm, Rabin-karp algorithm and analysis. (4)

NP AND COMPUTATIONAL INTRACTABILITY: Basic concepts – Polynomial time reductions, efficient certification and NP, NP hard and NP complete problems. (5)

COPING WITH NP-COMPLETENESS: Backtracking-n queens problem, Graph coloring problem - branch and bound - 0/1 knap sack problem , Traveling salesman problem, Approximation algorithm – Introduction – traveling salesman problem. (8)

NETWORK FLOW: Flow networks and Flows – Flow networks with multiple sources and sinks, The Ford – Fulkerson Method, Augmenting paths – Max Flow min cut theorem, The Edmonds – Karp algorithm. (5)

Total L: 45

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, and Ronald LRivest, "Introduction to Algorithms", MIT Press, 2009.
2. Jon Kleinberg and Eve Tardos, "Algorithm Design", Pearson Education, 2012.

REFERENCES:

1. Anany Levitin, "Introduction to Design and Analysis of Algorithms", Pearson Education, 2012.
2. Michael T. Goodrich and Roberto Tamassia, "Algorithm Design, Foundations, Analysis, and Internet Examples", Wiley, 2011.

15XD44 OPERATING SYSTEMS

3 0 0 3

INTRODUCTION: Abstract view of an operating system - Operating Systems Objectives and Functions – Evolution of Operating Systems - Dual-mode operation - Protecting I/O, memory, CPU, Kernels and micro-kernels – system calls- Structure of Operating System – Components of Computers – various components of operating systems. (5)

PROCESS DESCRIPTION AND CONTROL: Job/process concepts - Process Creation – Process Termination - Process states – Process Description – Process Control. (3)

PROCESS AND THREADS: Relationship between process and threads – Thread State – Thread Synchronization – Types of Thread – Multithreading model. (3)

PROCESS SCHEDULING: Scheduling basics - CPU-I/O interleaving- (non-)preemption - context switching- Types of Scheduling – Scheduling Criteria – Scheduling Algorithms. (3)

PROCESS SYNCHRONIZATION: Concurrent Process – Principles of Concurrency – Race Condition - Mutual Exclusion – Critical section problems – Software support – Hardware Support – Operating System Support – Deadlock: Deadlock Prevention, Avoidance and Detection and recovery. (5)

MEMORY MANAGEMENT: Memory hierarchy – Linking and Loading the process – Memory Management requirement - Fixed partitioning - Dynamic partitioning – Buddy Systems – Simple paging – Multilevel paging – Inverted paging – Simple Segmentation – segmentation and paging. (8)

VIRTUAL MEMORY MANAGEMENT: Need for Virtual Memory management – Demand Paging –Copy on write - Page Fault handling – Demand Segmentation – Combined demand segmentation and paging –Thrashing- working set model. (6)

FILE SYSTEM MANAGEMENT: Files – Access methods - File System Architecture – Functions of File Management –Directory and disk structure – file sharing –File system implementation – directory implementation - File Allocation – free space management. (6)

I/O MANAGEMENT AND DISK SCHEDULING: Organization of I/O function – Evolution of I/O function – Types of I/O devices – Logical Structure of I/O functions – I/O Buffering – Disk I/O – Disk Scheduling algorithms – Disk Cache. (6)

Total: L:45

TEXT BOOKS:
1. Silberschatz A., Galvin P.B. and Gagne G., "Operating System Concepts Essentials", John Wiley & Sons, 2014.
2. Elmasri E., Carrick A.G. and Levine D., "Operating Systems: A Spiral Approach", McGraw Hill, 2010.

REFERENCES:
1. William Stallings, "Operating Systems", Pearson Education, 2010.
2. McHoes, A.M. and Flynn, I.M. "Understanding Operating Systems", Cengage Learning, 2013.
3. Charles Crowley, "Operating System a Design Oriented Approach", McGraw Hill, 2000.
4. Andrew S. Tanenbaum, "Modern Operating System", Prentice Hall, 2008.

15XD45 PREDICTIVE ANALYTICS

4 0 0 4

LINEAR REGRESSION: Coefficient of determination, Significance test, Residual analysis, Confidence and Prediction intervals. (10)

MULTIPLE LINEAR REGRESSION: Coefficient of determination, Interpretation of regression coefficients, Categorical variables, heteroscedasticity, Multi-co linearity outliers, Auto regression and Transformation of variables, Regression, Model Building. (15)

(10)

LOGISTIC AND MULTINOMIAL REGRESSION: Logistic function, Estimation of probability using Logistic regression, Variance, Wald Test, HosmerLemshow Test, Classification Table, Gini Co-efficient. (10)

FORECASTING: Moving average, Exponential Smoothing, Casual Models. (10)

TIME SERIES ANALYSIS: Moving Average Models, ARIMA models , Multivariate Models (10)

CASE STUDIES (5)

(5)

Total L: 60

TEXT BOOKS:
1. Anderson, Sweeney and Williams "Statistics for business and economics", Cengage Learning, 2011.
2. Richard I. Levin. David S. Rubin, "Statistics for Management", Pearson Education, 2012.

REFERENCES:
1. Richard A. Johnson, Irwin Miller and John Freund, "Probability and Statistics for Engineers", Pearson Education, 2014.
2. Ronald E. Walpole, Raymond H. Meyers, Sharon L. Meyers, "Probability and Statistics for Engineers and Scientists", Pearson Education, 2014.

15XD46 UNIX SYSTEMS LAB

0 0 4 2

Unix- History - General structure - Unix file system - file abstraction, directories, mount points, implementation details - Processes: memory image, life cycle, start of day. The shell: basic operation, commands, standard I/O, redirection, pipes, signals. Character and block I/O. Process scheduling.

1. Overview of an Operating System, Boots and Shutdown.
2. UNIX File System Commands.
3. UNIX Commands.
4. SHELL Programming.
5. Writing programs using UNIX System Calls.
6. Process Creation and Execution.
7. Thread Creation and Execution.
8. Process / Thread Synchronization using semaphore.
9. Developing Application using Inter Process communication (using sharedmemory, pipes or message queues).
10. Implementation of Memory Management Schemes.
11. Creating Linux Modules.

Total P: 60

TEXT BOOKS:
1. Neil Matthew and Richard Stones, "Beginning Linux programming", Wiley Publishing, 2011.

2. Dale Doughhertyand Arnold Robbins, “SED & AWK programming”, O’Reilly, 2010.
3. Kay A Robbins, Steven Robbins, “UNIX System programming Communication, Concurrency and Threads”, Pearson Education, 2008.

REFERENCES:

1. Das and Sumitabha , “Unix Concepts and Applications”, Tata McGrawHill, 2006.
2. Richard Stevens W., “UNIX Network Programming”, Pearson Education, 2010.

15XD47 RDBMS LAB

0 0 4 2

1. Working with DDL and DML commands of SQL for creation and manipulation of single, multiple tables, Report Generation.
2. Working with PL/SQL- Triggers and stored procedures.
3. Developing Packages using a database.

Total P: 60

15XD48 DESIGN AND ANALYSIS OF ALGORITHMS LAB

0 0 4 2

Implement the following:

1. Problem using closest pair algorithm.
2. Prim’s minimum cost spanning tree.
3. Kruskal’s minimum cost spanning tree using min heap data structure, union and find operation.
4. Problem related to topological sorting.
5.Application of all pairs shortest path problem.
6. Optimal binary search tree.
7. Optimal caching.
8. Application of graph coloring using back tracking.
9. TSP using branch and bound.

Total P: 60

SEMESTER - 5

15XD51 APPLIED NUMERICAL ANALYSIS

4 0 0 4

TYPES OF ERRORS: Different types of error. (4)

SOLUTION OF ALGEBRAIC EQUATIONS: Newton Raphson method, Modified Newton Raphson method, Method of false position, Graffe’s root squaring method, Bairstow’s method. (6)

SOLUTION OF ALGEBRAICSIMULTANEOUS EQUATIONS: Gauss – Jordan elimination, Cholesky method, Crout’s method, Gauss – Jacobi method, Gauss – Seidel method. Matrix Inverse by Gauss – Jordan method. (8)

EIGENVALUES AND EIGENVECTORS: Power method for finding dominant eigenvalue and inverse power method for finding smallest eigenvalue, Jacobi method for symmetric matrices. (8)

SPARSE MATRICES : Introduction – Storage Schemes – Basic sparse matrix operations – Sparse direct solutions – random walk problems. (4)

INTERPOLATION AND CURVE FITTING: Finite difference operators-Interpolating Polynomials, Divided Difference, Spline Curves, Bezier Curves and B-Spline Curves.Solution of linear second order difference equations with constant coefficients. (8)

NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical Differentiation using Newton forward and backward formulas. Numerical Integration: Newton –Cotes formula, Trapezoidal rule, Simpson”s $(1/3)^{rd}$ and $(3/8)^{th}$ rule . Gaussian Quadrature Applications of Cubic Splines. (10)

PARTIAL DIFFERENTIAL EQUATIONS: Classification of partial differential equations of second order. Liebmann’s method for Laplace equation and Poisson equation, Explicit method and Crank – Nicolson method for parabolic equations. Explicit method for hyperbolic equations. (12)

Total: L:60

TEXT BOOKS:

1. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers with Software and Programming Applications", McGraw Hill, 2011.
2. Curtis F. Gerald,and Patrick O. Wheatley, "Applied Numerical Analysis" Pearson, 2011.
3. Yousef Saad. "Numerical methods for large eigen value problems", University Press, 2011.

REFERENCES:

1. Richard L. Burden and Dougglas Faires J., "Numerical Analysis" Thomson Brooks/Cole, 2005.
2. Brian Bradie, "A Friendly introduction to Numerical Analysis", Pearson, 2006.

15XD52 STOCHASTIC MODELS

4 0 0 4

STOCHASTIC PROCESSES: Introduction – Classification of Stochastic Processes – Markov Chain: Introduction -Transition Probability Matrices – Chapman Kolmogorov Equations - Classification of States – Limit Theorems – Branching Processes – Time Reversible Markov chains – Markov Decision Processes - Applications. (14)

CONTINUOUS TIME MARKOV CHAINS: Introduction – Poisson Process - Birth and Death Processes – Kolmogorov Differential Equations – Pure Birth Process - Pure Death Process - Applications. (15)

RENEWAL THEORY: Introduction – Distribution - Renewal Theorems - Residual and Excess Life Times -Alternating Renewal Process - Renewal Reward Processes – Regenerative Processes. (10)

GENERAL QUEUEING MODELS: Single and Multi server Poisson Queues - Single Server Queue with Poisson input and general service M / G/1 – General input and exponential service – G/M/1 Queueing model. (10)

BROWNIAN MOTION: First Passage time distribution – The maximum of a Brownian Motion – The Zeros of Brownian Motion – Brownian Motion with Drift - Geometric Brownian Motion. (11)

Total L:60

TEXT BOOKS:

1. SaeedGhahramani, "Fundamentals of Probability with Stochastic Processes", Pearson, 2014.
2. Sheldon M. Ross, "Introduction to Probability Models", Academic Press, 2014.
3. Roy D.Yates and David J. Goodman, "Probability and Stochastic Processes – A friendly Introduction for Electrical and Computer Engineers", John Wiley & Sons, 2014.

REFERENCES:

1. Sheldon M. Ross, "Stochastic Processes", John Wiley & Sons, 2007.
2. Medhi J., "Stochastic Processes", New Age International Publishers, 2009.
3. Samuel Karlin Howard E.Taylor, "A First course in Stochastic Processes", Academic Press, 2011.
4. Gross.D and Harris C.M, "Fundamentals of Queueing theory", John Wiley & Sons, 2013.

15XD53 COMPUTER NETWORKS

3 0 0 3

INTRODUCTION: Network goals - Applications of Networks - Design issues for the layers - OSI Reference Model - Types of Network - Network Topologies- Analog and Digital data transmission- Data encoding- Bandwidth and data rate-.Bit Rate, Baud Rate.- Sampling Rate. (6)

TRANSMISSION OF DIGITAL DATA: Transmission Impairments - Single and Multiple bit error correction-Error Detection and Correction - Cyclic Redundancy Check Code -.Hamming Code. (5)

DATA COMMUNICATION: Multiplexing - Synchronous and Asynchronous TDM – FDM –CDM - Switching, Circuit Switching, Packet Switching. (3)

DATA LINK CONTROL AND PROTOCOLS: Line Discipline - Flow Control - Sliding Window Protocol - Error Control - Automatic Repeat Request – Stop – and - wait ARQ. Go – back – by - n ARQ, Selective Reject ARQ. (4)

LOCAL AREA NETWORKS: Random Access protocols- Ethernet – Fast Ethernet – Gigabit Ethernet – Wireless LANs- Internetworking- LAN -LAN Connections – Repeaters- Hubs - Bridge – Spanning tree-Switches – Routers. (5)

TCP/IP: TCP/IP Protocol Structure - Internet Protocol – IP addressing-ICMP-ARP-BOOTP-DHCP- Transport layer- TCP concepts-Port number-UDP – TCP-UDP Vs TCP. (7)

ROUTING AND CONGESTION CONTROL: Distance vector routing _ Link state Routing – RIP – OSPF- BGP- Congestion control-TCP congestion control- Rate limiting and traffic shaping. (7)

APPLICATIONS: FTP, SMTP - MIME Format, DNS, HTTP- Content distribution networks. (8)

Total L: 45

TEXT BOOKS:

1. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 2013.
2. Behrouz A. Forouzan, “TCP/ IP Protocol Suite”, Tata McGraw Hill, 2010.

REFERENCES:

1. Keshav S., “An Engineering Approach to Computer Networking: ATM Networks, the Internet, and the Telephone Network”, Addison-Wesley, 2009.
2. Kevin Fall R. and Richard Stevens W., "TCP/IP Illustrated, Volume 1: The Protocols”, Addison-Wesley, 2011.
3. James F. Kurose, Keith Ross, “Computer Networking: A Top-Down Approach”, Pearson Addison-Wesley, 2013.
4. Douglas Comer, “Internetworking with TCP/IP”, Prentice Hall, 2014.
5. William Stallings, "Data and Computer Communications", Prentice Hall, 2014.
6. Keshav S., “Mathematical Foundations of Computer Networking”, Addison-Wesley, 2012

15XD54 SUPERVISED AND UNSUPERVISED LEARNING

3 0 0 3

INTRODUCTION: Machine learning - supervised and un supervised learning – Classification – Regression – Generative models – Discriminative models - Model selection and generalization.-VC Dimension. (7)

GENERATIVE MODELS : Bayesian decision theory- Classification- losses and risks – Discriminant functions. (4)

PARAMETRIC METHODS: Maximum likelihood estimation - Evaluating an estimator – Bayes estimator- Univariate Classification-Multivariate methods – Multivariate classification and regression. (7)

DISCRIMINATIVE MODELS: Logistic regression- Support Vector Machines: Classification. (4)

NON-PARAMETRIC METHODS: Decision Trees - Entropy – Information gain - Univariate trees – Rule extraction from trees – Pruning trees - Multivariate trees.k-Nearest neighbor – Classification and regression using k.NN. (7)

SEMI-PARAMETRIC METHODS: Unsupervised learning **–**Clustering - Assumptions – Distance metrics - Expectation maximization (EM) –Partitioning Algorithms - K means clustering – K – medoids clustering -, Lloyds algorithm for k-means clustering.

DIMENSIONALITY REDUCTION: Principal Component Analysis – Discriminant analysis-Greedy algorithm. (3)

LARGE SCALE MACHINE LEARNING: Parallel SVM – dealing with high dimensional Euclidean and non-Euclidean data.

GRAPHICAL MODELS : Bayesian networks – Hidden Markov models : Discrete Markov process – Finding the state sequence – Model selection. (5)

Total L : 45

TEXT BOOKS:

1. AlpaydinEthem, “Introduction to Machine Learning”, Prentice Hall, 2009.
2. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification*”,* Wiley and Sons, 2012.
3. Tom Mitchell, “Machine Learning”, McGraw Hill, 2010.

REFERENCES:

1. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2013.
2. Trevor Hastie, Robert Tibshirani and Jerome Friedman, “The Elements of Statistics Learning”, Springer, 2013.
3. David Barber, “Machine Learning: A Probabilistic Approach”, http://www.idiap.ch/~barber, 2006.
4. John HopCroft and Ravi kannan, “Foundations of Data Science”, 2011.
5. Anand Rajaraman and Jeffrey Ullman, “Mining Massive Data sets”, Cambridge University Press, 2014.

15XD56 JAVA PROGRAMMING LAB

0 0 4 2

JAVA PROGRAMMING: Introduction - Data Types - Operators - Declarations - Control Structures - Arrays and Strings - Input/Ouput.-Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword - object based vs oriented programming.- -Inheritance-Reusability - Composing class - Method overriding - Abstract classes - Virtual Functions.

PACKAGES AND INTERFACES: Packages - Access protection - Importing packages – Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces.

EXCEPTION HANDLING: Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested Try statements - Throw - Throws - Java Built-in Exception - Creating your own subclasses.

MULTI THREADED PROGRAMMING: Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization - Interthread Communication - Deadlock.

I/O, APPLETS: I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input - Applet fundamentals - Native methods.- GUI Components - Applets – overview of Java Scripts – Swing.

NEW FEATURES IN J2SE V5.0: Collections Frame works – List – Set – Map - Generics – Enhanced for Loop – Autobox – Auto unboxing – Enums – Varargs

TUTORIAL PRACTICE:

1. To create runtime polymorphism using abstract class, interface.
2. To create callback feature using interface.
3. To create a program for interface inheritance.
4. To implement a user defined package.
5. To implement a user defined checked exception and unchecked exception.
6. To create threads, thread groups.
7. To create inter-thread communication using shared memory, piper stream.

Total P:60

REFERENCES:

1. Joyce Farrell , “Java Programming”, Cengage Learning, 2015
2. Patrick Naughton and Herbert Schildt, "JAVA - The Complete Reference", McGraw Hill, 2011.
3. Deitel and Deitel, "JAVA - How to Program", Prentice Hall, 2010.
4. Douglas Lea, “Concurrent Programming in Java: Design Principles and Patterns”, Addison-Wesley, 2000.

15XD57 COMPUTER NETWORKS LAB

0 0 4 2

1. Familiarize with GNS3 simulator.
2. Implement Hamming code and CRC.
3. Implement a primitive email server.
4. Familiarize with packet capturing tools in Java and Wireshark.
5. Implement a simple firewall system.
6. Analyse the existing routing protocols and implement any one of them.
7. Write a program where a single entity can communicate with other entities by using IP-multicasting.
8. Assignments using the network simulator.

Total P: 60

15XD58 SUPERVISED AND UNSUPERVISED LEARNING LAB

0 0 4 2

Implement the following algorithms using R Package

1. K-Nearest Neighbor.
2. Naïve Bayes Classifier for discrete and continuous data.
3. Naïve Bayes Classifier using Smoothing.
4. Bayesian Decision making with loss function.
5. Entropy and information gain calculation.
6. Decision tree construction.
7. Clustering algorithms K-means, K-medoids, Agnes, DIANA.

Total P: 60

SEMESTER – 6

15XD61 PARALLEL AND DISTRIBUTED COMPUTING

3 0 0 3

INTRODUCTION: Concepts and Terminology – Generic Processor / ASIC Processor Architecture – Pipeline Architecture – Instruction Set Architecture - Types of Parallelism - Flynn's Classical Taxonomy – Terminology. (6)

PARALLEL COMPUTER MEMORY ARCHITECTURES: Shared Memory - Distributed Memory -Hybrid Distributed-Shared Memory Multiprocessors: Communication and Memory issues - Message Passing Architectures - Vector Processing and SIMD Architectures. (5)

PARALLEL PROGRAMMING MODELS: Overview -Shared Memory Model - Threads Model - Message Passing Model - Data Parallel Model - Other Models. (5)

DESIGNING PARALLEL PROGRAMS: Automatic vs. Manual Parallelization - Understand the Problem and the Program - Partitioning -Communications - Synchronization -Data Dependencies - Load Balancing -Granularity -I/O -Limits and Costs of Parallel Programming - Performance Analysis and Tuning - Parallel Examples -Array Processing – Compiler Transformation techniques for High performance computing: - Transformations for parallel Machines. (6)

PRAM ALGORITHMS& BSP: PRAM model of computation- Work-Time formalism and Brent's Theorem; algorithm design techniques-parallel prefix, pointer jumping, Euler tours, divide and conquer, symmetry breaking; survey of data-parallel algorithms; relative power of PRAM models - Bulk synchronous parallel model. (6)

HIGH PERFORMANCE COMPUTING ARCHITECTURES - Latency Hiding Architectures -Multithreading Architectures -Dataflow Architectures - **GPGPU Architecture-** Overview of basic Accelerators /GPU / GPGPU and its programming model – CUDA - OpenCL. (6)

DISTRIBUTED COMPUTING: Introduction -- Definitions, motivation - Communication Mechanisms - Communication protocols,- RPC- RMI- Distributed Algorithms – snapshots - leader election – Synchronization -Traditional synchronization - lock free - clocks. Replication and Coherence - Consistency models and protocols –overview of Fault Tolerance. (6)

DENSE LINEAR ALGEBRA: Matrix transposition - Matrix product - Gaussian elimination - Data distribution - Parallel linear algebra libraries. (5)

Total L: 45

TEXT BOOKS

1. Andrew S. Tanenbaum and Maarten van Steen, " Distributed Systems, Principles and Paradigm" Prentice Hall, 2013.
2. Michael J Quinn, "Parallel Computing : Theory And Practice" , Tata Mcgraw-Hill,2004
3. Joel M.Crichlow, "Distributed And Parallel Computing" , Prentice Hall Of India, 2004
4. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General-Purpose GPU Programming", Pearson Education, 2011

REFERENCES

1. Vijay K Garg, "Principles of Distributed Computing", Kluwer AcademicPublisher, 2014.
2. Shane Cook , "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of Gpu Computing)", Elsevier Inc,. 2013
3. Tom White, "Hadoop Definitive Guide", O'Reily, 2012.
4. Srinath Perera, Thilina Gunarathne, Mapreduce Cook book, Packy Publishing, 2013
5. David F. Bacon, Susan L. Graham and Oliver J. Sharp, "Compiler Transformations for High Performance Computing" Technical report, 1994

15XD62 DATA MINING

3 0 0 3

INTRODUCTION: Motivation for Data Mining - Data Mining Issues -Importance - Data Mining from a Database Perspective - Statistical Perspective on Data Mining, Similarity Measures, Classification of Data Mining Systems – Major issues in Data Mining. (4)

DATA PREPROCESSING: Types of data - Data cleaning – Aggregation - Sampling – Feature subset selection –wrapper and filter methods. (6)

MINING FREQUENT PATTERNS, ASSOCIATIONS AND CORRELATIONS: Basic concepts – Efficient and Scalable Frequent Itemset Mining methods – Apriori, FP-Tree- Handling large larger data sets in main memory. (5)

ENSEMBLE OF CLASSIFIERS: Classification – Prediction – Voting, Bagging, Boosting, Stacking, Cascading, Random forest, Semi supervised Learning. (6)

CLUSTERING: Similarity and Distance Measures, Hierarchical Algorithms, Clustering Large Data sets, Clustering with Categorical Attributes-Outlier analysis. (5)

MINING DATA STREAMS: Challenges–Stream data model – Sampling data in a stream, Frequency moments of data stream-Counting frequency items in a stream- Mining time- Series databases. (8)

MINING MASSIVE DATA SETS: Challenges- Mining high dimensional association rules – CARPENTER- classifying high-dimensional data- PLANET- clustering high-dimensional Data – BIRCH Distributed Data Mining. (8)

CASE STUDIES: Web Mining, Spatial Mining, Graph Mining, Temporal Mining. (3)

LABORATORY COMPONENT:
1. Study of Data mining tool WEKA and Statistical package R
2. Association rule mining using Apriori algorithms.
3. Classification rules using Decision Tree classifier, Ensemble of Classifiers.
4. Implementation of Clustering Algorithms
5. Analyzing data with log liner models and graphical models using R
6. Handling massive data using map reduce

Total L: 45

TEXT BOOKS:

1. Jiwai Han and Micheline Kamber , “Data Mining – Concepts and Techniques”, Morgan Kaufmann, 2012.
2. Tan, Steinbach, Kumar, “Introduction to Data Mining”, Pearson Education, 2014.

REFERENCES:

1. AnandRajaraman and Jeffrey Ullman, “Mining Massive Data sets”, Cambridge University Press, 2014.
2. Giovanni Seni, John Elder, “Ensemble methods in data mining: Improving accuracy through combining prediction”, Morgan & ClayPool, 2010.
3. Ian Witten, Frank Eibe and Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques”, Elsevier, 2011.
4. Hand D., Mannila H. and P. Smyth, “Principles of Data Mining”, Prentice-Hall, 2012.
5. John HopCroft and Ravi kannan, “Foundations of Data Science”, 2011.

15XD63 MODERN DATABASE SYSTEMS

3 0 0 3

PARALLEL AND DISTRIBUTED DATABASES: Architecture of parallel databases – Parallel query evaluation, Par**a**llel query optimization – Introduction to parallel and distributed databases, DDBMS Architecture, Distributed Database Design, Distributed Query Processing and Optimization. (6)

DATA MODELING FOR BIG DATA: Big Data and Challenges, Big Data models, NoSQL data models, Basic principles of NoSQL models, SQL databases VsNoSQL databases. (9)

NOSQL DATABASES (PART 1): Key - Value Stores: Oracle Coherence – FoundationDB – Amazon’s DynamoDB, Key -Value Stores (in-memory) : Redis , Key-value Stores (B-tree): Berkeley DB, Column Oriented Store: Google BigTable - Apache Cassandra – Hbase. (10)

NOSQL DATABASES (PART 2): Document Oriented Stores – Amazon’s SimpleDB for cloud – MongoDB - Apache CouchDB - XML databases - ClusterPoint, Graph databases: Neo4J- OrientDB, Object Database: Db4o - Perst. (10)

MAP-REDUCE: Apache Hadoop and HDFS, Pig, Hive, Microsoft Azure –Big data Applications. (5)

DATABASE INTEGRATION: Data warehousing, Schema directed data integration - Data exchange: Schema mapping and information preservation - automatic schema matching - Information Preserving XML Schema Embedding. (5)

Total L: 45

TEXT BOOKS:

1. Ramez Elmasri and Shamkrant Navathe, “Fundamentals of Database Systems”, Addison Wesley, 2013.

2. Corbett J.C., “Spanner: Google's Globally-Distributed Database”, OSDI, 2012.

REFERENCES:

1. Stonebraker M, SQL Databases v. NoSQL Databases, Communications of the ACM, 2010.
2. Stonebraker M, Intel "Big Data" Science And Technology Center Vision And Execution Plan, SIGMOD Record, 2013.
3. www. Hbase.apache.org.
4. www.MongoDB.org.

15XD64 OPTIMIZATION TECHNIQUES

3 2 0 4

LINEAR PROGRAMMING: Graphical method for two dimensional problems – Central problems of Linear Programming - Definitions – Simplex method – Two-phase Simplex Method. (8)

SIMPLEX MULTIPLIERS: Dual and Primal – Dual Simplex Method – Revised Simplex Method - Sensitivity Analysis – Transportation problem and its solution – Assignment problem and its solution by Hungarian method. (13)

INTEGER PROGRAMMING: Gomory cutting plane methods for integer and mixed integer programming problems - Branch and Bound method (Land – Dolg and Dakin algorithms) – Zero-One Implicit enumeration Algorithm. (8)
DYNAMIC PROGRAMMING: Principle of Optimality – Backward and forward recursion methods- Tabular method of solution – Shortest path network problems – Cargo-loading model. (4)

PERT: Arrow networks - Time estimates - Earliest expected time, latest allowable occurrence time and slack of events - Critical path - Probability of meeting scheduled date of completion of project. (4)

CPM: Calculations on CPM networks - Various floats for activities - Critical path - Updating a project - Operation time cost trade off curve - Project time cost trade off curve - Selection of schedule based on cost analysis. (4)

NON LINEAR PROGRAMMING : Unconstrained algorithm: Direct search method, Gradient method –Constrained Algorithm: Separable Programming. (4)

TUTORIALS PRACTICE:

1. Solving inequalities using Simplex, Two-Phase, Dual Simplex, Revised Simplex method.
2. Finding initial basic feasible solution using North-West corner rule, Matrix minimum and Vogel’s approximation method and optimal test using MODI method.
3. Solving Assignment problem using Hungarian method.
4. Gormory’s cutting plane methods for all IPP and mixed IPP
5. Solving Dynamic programming problems
6. To find the critical path for the given PERT and CPM networks
7. Gradient Method for non-linear programming problems

Total L: 45+T:30 =75

TEXT BOOKS:

1. Hamdy A. Taha, “Operations Research – An Introduction”, Prentice Hall, 2011.
2. Hillier F. and Liberman G. J., “Introduction to Operations Research”, McGraw Hill, 2014.

REFERENCES:

1. Kambo N. S., “Mathematical Programming Techniques”, East-West Press, 1991.
2. Singiresu S. Rao, “Engineering optimization theory and Practice”, John Wiley & Sons, 2009.

15XD66 PARALLEL AND DISTRIBUTED COMPUTING LAB

0 0 4 2

1. Basic Master – Worker program and send messages.
2. Write a program to find the summation of largest number in a very larger array of integers. (The contents of the array should be equally distributed to all processes).
3. Write a parallel program in SPMD to calculate the PI value using integral approximation method.
4. Matrix multiplication, Transpose, using parallel algorithm.
5. Select your own choice of very dense computational problem having divide and conquer method and implement it in parallel algorithm. And produce the performance chart with 2, 4, 6 and 8 nodes.

Total P: 60

15XD67 MODERN DATABASE SYSTEMS LAB

0 0 4 2

1. Distribution of Databases and Paralleling Operations.
2. Implementation of No-SQL databases- DynamoDB, MongoDB, Google's BigTable, DBo4, Neo4J.
2. Implementation of Map-Reduce on Big Data (Hadoop).
3. Data Integration from heterogeneous Databases.

Total P:60

15XD68 SCRIPTING LANGUAGES LAB

0 0 4 2

INTRODUCTION: What is a scripting language? Motivation and applications of scripting - How scripting languages differ from non-scripting languages - Biased, naive and thoughtful position papers and debates on the meritsofscripting languages - Types of scripting languages. (2)

OVERVIEW OF POPULAR SCRIPTING LANGUAGES: Important features of and sample code in bash, Ruby, JavaScript, Perl, Python, Tcl.- A list of other scripting languages with uninformative but possibly interesting synopses. (2)

COMMON SCRIPTING LANGUAGE CONSTRUCTS: List comprehensions- iterators- complex datatype literals- higher-order functions- closures- unlimited extent- regular expressions- threads and others - Implementation strategies. (2)

DYNAMIC LANGUAGE FEATURES: Metaprogramming – introspection – reflection – distribution – mobility – instrumentation – reconfiguration - garbage collection.

TYPING: Static vs. dynamic typing; Manifest vs. inferential typing; Duck typing; Tradeoffs; Debates; Object orientation in dynamic typing. A detailed look at the typing systems of Ruby and Python; Classical (e.g. Ruby) vs. Prototype-based (e.g. JavaScript) inheritance. (3)

INTERPRETATION AND COMPILATION: Interpretation vs. Compilation; Virtual machines; interpretations at compile-time (e.g. Perl's BEGIN and END blocks) and compilation at run-time.

PERFORMANCE OF SCRIPTING ENGINES: The real or imagined tradeoff between - expressiveness, flexibility, extensibility, and rapid development, and high performance - compile-time type safety - scripts optimization - Modern garbage collection algorithms - A look at some runtime engines. (3)

SHELL SCRIPTS: Responsibilities of a shell; A tour of the most popular Unix shells. **CLIENT-SIDE WEB SCRIPTING:** The DOM; JavaScript; DHTML; Ajax; XSLT scripting.**SERVER-SIDE WEB SCRIPTING:** Rails, PHP, Zope, the JSP expression language; The evils of scriptlets; Scripting and the SemanticWeb. **EXTENSION LANGUAGES**: The concept of command hooks; Classic applications (Emacs); Other applications; Interoperability, e.g. Groovy and Java. (3)

LABORATORY COMPONENT:

1. Input validation using PHP
2. Implementing a linked list RUBY / Python
3. Basic programs in RUBY / PHP / Python
4. Server Side Scripting using RUBY
5. Server Side Scripting using PHP
6. Server Side Scripting using Python

Total P: 60

REFERENCES:

1. Michael Scott, "Programming Language Pragmatics", ISBN 0123745144, Morgan Kaufmann, 2011.
2. Larry Wall, Tom Christiansen, and Jon Orwant, "Programming Perl", ISBN 0-596-00492-3, O'Reilly, 2012.
3. RasmusLerdorf, Kevin Tatroe, and Peter MacIntyre, "Programming PHP", ISBN 1449392776, O'Reilly, 2013.
4. David Flanagan and JavaScript, "The Definitive Guide", ISBN 0-596-80552-7, O'Reilly, 2011.
5. James Payne, "Beginning Python" , Wiley Publishing, 2010.
6. Dave Thomas, with Chad Fowler and Andy Hun, Programming Ruby 1.9 & 2.0, "The Pragmatic Programmers' Guide", The Pragmatic Brocshelf, 2012.
7. Peter Cooper, "Beginning Ruby", APress 2009.

SEMESTER 7

15XDP1 PROJECT WORK I 0 0 0 12

SEMESTER – 8

15XD81 REINFORCEMENT LEARNING

3 0 0 3

REINFORCEMENT PROBLEM: Introduction - Elements of RL, History of RL- Evaluative feedback -Goals and rewards – Returns – Markovian Decision Problem (MDP) – Value functions-Optimality Criterion in MDPs. (10)

DYNAMIC PROGRAMMING(DP): Policy Evaluation- Policy Improvement- Value Iteration, asynchronous DP- Efficiency of DP. (6)

MONTE CARLO METHODS: Policy Evaluation- Policy Improvement- On-policy and off- policy Monte Carlo controls-Incremental implementation. (6)

TEMPORAL DIFFERENCE LEARNING(TD): TD-prediction- Optimality of TD - Sarsa- Q-Learning – R- Learning-Actor-Critic Model-Unifying Monte Carlo and TD-Traces- Games. (9)

FUNCTION APPROXIMATION- Value prediction and control – Gradient Descent methods-Linear methods – Artificial Neural Network based approximation. (6)

PLANNING AND LEARNING: Model based learning and planning- prioritized sweeping-Heuristic search. (6)

CASE STUDIES (2)

Total L: 45

TEXT BOOKS:

1. Sutton R. S. and Barto A. G., "Reinforcement Learning: An Introduction", MIT Press, 2012.
2. CsabaSzepesvári, “Algorithms for Reinforcement Learning”, Morgan & Claypool, 2013.
3. Kevin Murphy , “Machine Learning - A Probabilistic Perspective” , MIT press, 2012.

REFERENCES:

1. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
2. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, 2010.

15XD82 DATA PRIVACY AND SECURITY

4 0 0 4

INTRODUCTION: Security Problems in computing – security goals –threats and attacks. – Services and mechanisms. (4)

CRYPTOSYSTEMS: Introduction– symmetric key cryptography-substitution cipher – transposition cipher -stream ciphers and block ciphers – Advanced Encryption Standard (AES) – cryptanalysis of symmetric key cryptosystems. Public key cryptography - Introduction – RSA cryptosystem- attacks on RSA – Elliptic curve cryptosystem. (12)

MESSAGE INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT: Message digest – Message authentication code – Cryptographic hash function – Digital signatures- Anonymous protocols- Challenge response system- zero knowledge protocol-secure two party computation-DSS. Symmetric key distribution – kerberos- Diffie – Hellman key agreement– Public key distribution – Certificates. (12)

NETWORK SECURITY: Application Layer Security – PGP and S/MIME, Transport Layer security – SSL - Network layer security – IPSec. (6)

PROGRAM SECURITY : Secure Coding – Malicious and non-Malicious program errors - OWASP/SANS Top Vulnerabilities - Malwares – types - Buffer Overflows – defense mechanisms- Incomplete mediation - XSS - Redirection - Inference – Application Controls - Evaluation of Security Systems. (6)

DATA BASE SECURITY : Security Requirements – database administration security – SQL injection and exploitation and defense methods - database roles and permissions – Object level security - Sensitive data – Multilevel Databases – Multi level security. (8)

DATA PRIVACY : Introduction – Foundations of privacy- Logical methods for specification and enforcement of privacy policies-Privacy preserving data publication- An introduiction to Differential privacy: Definitions and early uses – Noiseless differential privacy- Applications of Differential privacy – Synthetic datasets and network trace analysis- Differential privacy for large data-

Differentially private social network analysis – Web privacy: online tracking and advertisement – Privacy and machine learning – case study: HIPAA privacy rule . (12)

Total L: 60

TEXT BOOKS:

1. Charles P. Pfleeger and Shari Lawrence Pfleeger, "Security in Computing", Pearson Education, 2009.
2. Behrouz A.Forouzan and Debdeep Mukhopadhyay, “Cryptography and Network Security”, Tata McGraw Hill, 2011.
3. Mark Stamp, “Information Security: Principles and Practice”, Wiley Inter Science, 2011.

REFERENCES:

1. Basta, Alfred, and Melissa Zgola. “Database Security”. Cengage Learning, 2011.
2. Cynthia Dwork and Aaron Roth, “The Algorithmic Foundations of Differential Privacy,” Nova publishers Inc, 2014.

15XD83 ADVANCED ANALYTICS

3 0 0 3

COMPONENT AND FACTOR ANALYSIS: Principal Component analysis, Factor analysis, Conjoint analysis, Discriminant analysis, ARCH (autoregressive conditional heteroscedasticity) and GARCH(general autoregressive conditional heteroscedasticity), Monte Carlo Simulation. (10)

SURVIVAL ANALYSIS AND ITS APPLICATIONS: Life tables, KapMeier estimates, Proportional hazards, Predictive hazard modeling using Customer history data. (10)

SIX SIGMA : Six sigma as a problem solving methodology, Six Sigma Tool Box; Seven quality tools, Quality function deployment (QFD), Statistical Process Control, Value Stream mapping. (10)

CLASSIFICATION: Classification and regression trees (CART), Chi-Squared automatic interaction detector (CHAID). (10)

CASE STUDIES (5)

Total L: 45

TEXT BOOKS:

1. Jolliffe I. T., “Principal Components Analysis (Springer Series in Statistics)”, Springer publications, 2013.
2. Xian Liu, “Survival Analysis: Models and Applications”, Wiley Publications, 2013.
3. Johannes Ledolter, ”Data Mining and Business Analytics with R”, John Wiley & Sons, 2013.
4. Thomas Pyzdek and Paul A.Keller, “The Six Sigma Handbook”, McGraw-Hill , 2012.

REFERENCES:

1. Michael L.George, and John Maxey, “The Lean Six Sigma Pocket Toolbox: A Quick Reference”, McGraw-Hill, 2005.
2. Leandre R.Fabrigar and Duane T.Wegener , “Exploratory Factor Analysis (Understanding Statistics)”, Oxford University Press, 2012.

15XD86 REINFORCEMENT LEARNING LAB

0 0 4 2

1. Ranking of nodes of a graph using Q-Learning (PageRank, TrustRank, DistanceRank).
2. Implementing n-armed Bandit problem.
3. Finding shortest paths in graphs using RL.
4. Solving GridWorld problems.
5. RL for Stochastic grid word.
6. Automated Chess player.
7. Multi-agent system.
8. Distributed RL.
9. Policy search algorithm.
10. Feed forward neural network.

Total P: 60

15XD87 DATA PRIVACY AND SECURITY LAB

0 0 4 2

1. Design of a Client server application for a basic cryptosystem.
2. Performing a frequency analysis attack on a cipher text enciphered with Affine cipher.
3. Detection of a Buffer overflow attack.
4. Packet Sniffing using Wireshark Tool to perform the traffic analysis attack.
5. Implementation of RSA cryptosystem.
6. Key distribution using RSA(KDC) – Key hacking.
7. Key exchange using Diffie-Hellman technique – MITM attack.
8. Authentication of File transfer using Hashing / Message digest.
9. Digital signature, generation and verification.
10. Password authentication.
11. Securing transaction by defending SQL Injection attacks.
12. Cross - Site scripting.
13. Implementation of security techniques to safeguard the database against accidental or deliberate breaches.
14. Security testing for applications.
15. Analysis and removal of vulnerabilities from a web application.

Total P: 60

15XD88 ADVANCED ANALYTICS LAB

0 0 4 2

Implement the following problems using R/ Perl Programming

1. Classification Algorithms.
2. SIX sigma implementation.
3. Extract information from customer support data.
4. Predictive analytics to find the trend of stock market level.
5. To implement Survival analysis tools.
6. Different outlier analysis techniques.
7. Dimensionality reduction using PCA.

Total P: 60

SEMESTER – 9

15XD91 WEB ANALYTICS

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3 0 0 3

INTRODUCTION: Understanding web analytics – The foundations of Web analytics: Techniques and Technologies – Present and Future of Web analytics. (4)

DATA COLLECTION: Importance and Options –Web server log files: Click stream data – User submitted information – Web server performance data – Page tags –First and third party tracking. (12)

WEB ANALYTICS STRATEGY: Key performance indicators – Web analytics process – Heuristics evaluations – Site visits – Surveys – Measuring reach – Measuring acquisition – Measuring conversion – Measuring retention – Security and privacy implications of Web analytics. (13)

WEB ANALYTICS TOOLS: Content organization tools –Process measurement tools – Visitor segmentation tools – Campaign analysis tools – Commerce measurement tools – Google analytics – Omniture – Web trends – Yahoo! Web analytics. (12)

GOOGLE ANALYTICS: Key features and capabilities – Quantitative and qualitative data - Working of Google analytics – Privacy - Tracking visitor clicks, Outbound links and Non HTML files. (4)

Total L: 45

TEXT BOOKS:

1. Bernard J. Jansen, “Understanding User-Web Interactions via Web analytics”, Morgan and Claypool, 2009.
2. Avinash Kaushik, “Web Analytics2.0”, John Wiley and Sons, 2010.

REFERENCES:

1. Brian Clifton, “Advanced web metrics with Google analytics”, John Wiley and Sons, 2012.
2. Justin Cutroni, “Google Analytics”, O’Reilly, 2015.
3. Jerri L. Ledford, Joe Teixeira and Mary E. Tyler, “Google Analytics”, John Wiley and Sons, 2013.

15XD92 NETWORK SCIENCE

3 0 0 3

INTRODUCTION: Basics of networks and graphs, random network model - degree distribution, evolution, small world property, six degrees of separation, Watts-Strogatz model, local clustering coefficient, random networks and network science. (5)

BARABÁSI-ALBERT MODEL: Growth and preferential attachment, Barabási-Albert model, degree dynamics, degree distribution, diameter and the clustering coefficient, preferential attachment - absence of growth, measure, non-linearity, the origins. (8)

SCALE-FREE PROPERTY: Power laws and scale-free networks, Hubs, Universality, Ultra-small property, role of the degree exponent, Generating networks with a pre-defined degree distribution. (8)

EVOLVING NETWORKS: Bianconi-Barabási model, measuring fitness, Bose-Einstein condensation, evolving networks. (8)

DEGREE CORRELATIONS: Assortativity and disassortativity, Measuring degree correlations, Structural cutoffs, Degree correlations in real networks, Generating correlated networks, impact of degree correlations. (8)

NETWORK ROBUSTNESS: Percolation theory, robustness of scale-free networks, attack tolerance, cascading failures, modeling cascading failures, building robustness. (8)

Total: L: 45

TEXT BOOK:

1. Ted G. Lewis, “Network Science: Theory and Practice”, Wiley, 2013.

REFERENCES:

1. Estrada, E., Fox**,** M., Higham, D.J. and Oppo**,** G.L., “Network Science - Complexity in Nature and Technology”, Springer, 2010.
2. Laszlo Barabasi**,** Network Science, http://barabasilab.neu.edu/networksciencebook/downlPDF.html

15XD93 INFORMATION RETRIEVAL

3 0 0 3

INTRODUCTION: Overview of IR Systems - Historical Perspectives - Goals of IR - The impact of the web on IR - The role of artificial intelligence (AI) in IR. (3)

TEXT REPRESENTATION: Statistical Characteristics of Text: Zipf's law; Porter stemmer; morphology; index term selection; using thesauri. **Basic Tokenizing, Indexing:** Simple tokenizing, stop-word removal, and stemming; inverted indices; Data Structure and File Organization for IR - efficient processing with sparse vectors. (8)

RETRIEVAL MODELS: Similarity Measures and Ranking - Boolean Matching – Extended Boolean models - Ranked retrieval - Vector Space Models -, text-similarity metrics - TF-IDF (term frequency/inverse document frequency) weighting - cosine similarity, Probabilistic Models, Evaluations on benchmark text collections. (10)

QUERY PROCESSING: **Query Operations and Languages**- Query expansion; Experimental Evaluation of IR: Performance metrics: recall, precision, and F-measure. (5)

TEXT CATEGORIZATION AND CLUSTERING: Categorization : Rocchio; Naive Bayes, kNN; Clustering: Agglomerative clustering; k-means; Expectation Maximization (EM); Dimension Reduction: LSI, PCA. (6)

INFORMATION FILTERING TECHNIQUES: Introduction to Information Filtering, Relevance Feedback - Applications of Information Filtering: **RECOMMENDER SYSTEMS**: Collaborative filtering and Content-Based recommendation of documents and products. (4)

WEB SEARCH: IR Systems and the WWW - Search Engines: Spidering, Meta Crawlers; Link analysis : Hubs and Authorities, Google PageRank, Duplicate Detection. (4)

INFORMATION EXTRACTION AND INTEGRATION: Extracting data from text; Basic Techniques: NE Recognition, Co-reference Resolution, Relation Extraction, Event Extraction; Extracting and Integrating specialized information on the web, Web Mining and Its Applications. (5)

Total L : 45

TEXT BOOKS:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2012.
2. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval", Pearson Education, 2010.
3. Croft B., Metzler D., Strohman T., Information Retrieval in Practice, Pearson Education, 2010. (Digitized).

REFERENCES:

1. Stephan Buttcher, Charles L. A. Clarke and Gordon Gormack, "Information Retrieval Implementing and Evaluating Search Engines", MIT Press, 2010.
2. Francesco Ricci, Lior Rokach, BrachaShapira, Paul B. Kantor "Recommender Systems – Handbook", 2011.
3. Anand Rajaraman and Jeffrey Ullman, "Mining Massive Data sets", Cambridge University Press, 2014.

15XD96 INFORMATION RETRIEVAL LAB

0 0 4 2

1. Building a web crawler.
2. HITS/PageRank for ranking of Web Pages.
3. Spam detection personal mails in R.
4. Build a simple recommender system.
5. Designing a personalized Search Engine.
6. Identifying near duplicates in web pages.
7. Extracting information from web pages.
8. Designing a Desktop search engine.

Total P: 60

15XD97 - WEB ANALYTICS LAB

0 0 4 2

1. Data collection using different analytics tools.
2. Web log analysis.
3. Identifying reach.
4. Measuring acquisition.
5. Calculating the conversion from search to purchase.
6. Retain ratio computation.
7. Report generation.
8. Implementing the working of Google analytics.
9. Implementing the working of Yahoo! Analytics.
10. Implementing the working of Omniture.

Total P: 60

15XD98 NETWORK SCIENCE LAB

0 0 4 2

1. Implementation of Barabási-Albert model.
2. Implementation of Watts-Strogatz model.
3. Implementation of Bianconi-Barabási model.
4. Obtaining Degree correlations in real networks.
5. Case studies of the theory concepts on real networks.

Total P: 60

SEMESTER 10
15XDP2 PROJECT WORK II

0 0 0 12

ELECTIVES

15XDA1 DATA COMPRESSION

3 2 0 4

DATA COMPRESSION LEXICON: Introduction to Data Compression - Dawn Age - Coding - Lossy Compression. (4)

MINIMUM REDUNDANCY CODING (THE DAWN AGE): The Shannon - Fano Algorithm, The Huffman Algorithm - Into the Huffman Code : Counting the Symbols, Building the tree . (5)

ADAPTIVE HUFFMAN CODING: Adaptive Coding - Updating the Huffman Tree - Escape code. (5)

ARITHMETIC HUFFMAN CODING: Arithmetic Coding with floating point data type – Arithmetic coding with integral data type. (6)

STATISTICAL MODELING: Higher-order Modeling - Finite Context Modeling – Order one modeling – Order two Modeling. (5)

DICTIONARY-BASED COMPRESSION: LZ77 Compression and Decompression - LZSS Compression and Decompression - LZ78 Compression and Decompression - LZW Compression and Decompression – LZMW Compression and Decompression - LZAP Compression and Decompression – LZY Compression and Decompression.

(10)

SPEECH COMPRESSION: Digital Audio Concepts - Lossless Compression of Sound. (5)

VIDEO COMPRESSION: JPEG Compression - Implementing DCT - Complete Code Listing. (5)

TUTORIAL PRACTICE:

1. Implement Shannon Fano algorithm and Huffman algorithm.
2. Design compression and decompression program using adaptive Huffman coding.
3. Implement arithmetic coding algorithm.
4. Design compression program using statistical modeling upto 3 order.
5. Design compression and decompression program using L277 algorithm.

Total: L: 45+T: 30 = 75

TEXT BOOK:

1. Mark Nelson, "The Data Compression Book", BPB Publications, 2007.

REFERENCES:

1. Yun Q. Shi and Huifang Sun, “Image and Video Compression for Multimedia Engineering”, CRC Press, 2008.
2. David S. Tanbman and Michael W Marcellin, “JPEG – 2000 Image Compression Fundamentals, Standards and Practice” Kluwer Academic, 2002.
3. Khalid Sayood, “Introduction to Data Compression”, Morgan Kaufmann, 2006.
4. David Salomon, “Data Compression: The Complete Reference”, Springer, 2005.

15XDA2 MOBILE COMPUTING

3 2 0 4

INTRODUCTION: Introduction to wireless networking, Advantages and disadvantages of wireless networking, Evolution of mobile communication generations- CDMA, FDMA, TDMA. Challenges in mobile computing – Vertical and horizontal applications of Wireless Networking–Wireless LAN and Wireless WAN. (4)

CELLULAR CONCEPT: Wireless transmission - Frequencies for radio transmission - Regulations - Signals , Antennas , Signal propagation ,Path loss of radio signals , Additional signal propagation effects - Multi-path propagation - Multiplexing - Space division multiplexing - Frequency division multiplexing -Time division multiplexing - Code division multiplexing - Spread spectrum - Direct sequence spread spectrum - Frequency hopping spread spectrum. (6)

GSM: Mobile services - System architecture -- Handover – GPRS – Mobile services – System Architecture. (6)

MOBILE DEVICES: Overview of mobile devices – input mechanism – Device classification – 3 G devices – 3 G Applications. (4)

MOBILE APPLICATIONS ARCHITECTURE: Wireless Internet – Wireless Internet Architecture – Smart Client – Smart Client Architecture – Messaging Architecture – Sample Applications. (6)

Building smart client applications – Mobile Operating systems – Client development process – Design, Development, implementation, testing and deployment phase. Thin client development process – design, development, implementation, testing and deployment phase. (8)

MOBILE INFORMATION MANAGEMENT: PIM architecture – Standardization – SyncML – vCalendar/iCalendar – vCard – Mobile device Management Software – Features. (6)

WIRELESS INTERNET TECHNOLOGY: World Wide Web – WAP - Architecture - Wireless datagram protocol, Wireless transport layer security, Wireless transaction protocol, Wireless session protocol, Wireless application environment, Wireless markup language (WML), WML script. (5)

TUTORIAL PRACTICE:
Developing Mobile based applications using J2ME, Windows CE , Symbian OS , Android OS.
Suggested Applications:
1. Online Shopping Cart.
2. Airline Reservation System.
3. WAP Portal Site.
4. M-Commerce applications.
5. Location based Services.
6. Mobile games.

Total L: 45+T: 30=75

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", Addison Wesley, 2011.
2. Andreas F. Mohisch, "Wireless Communications", Wiley 2010**.**

REFERENCES:

1. David Taniar, 'Mobile Computing Concepts, Methodologies, Tools and Applications', IGI Global, 2009.
2. Wen-Chen Hu, 'Internet Enabled Handheld Devices, Computing and Programming: Mobile Commerce and personal data applications', IGI Global, 2008.
3. Rifaat A. Dayem, "Mobile Data & Wireless Lan Technologies", Prentice Hall, 1997.

15XDA3 DIGITAL IMAGE PROCESSING

3 2 0 4

DIGITAL IMAGE PROCESSING: Elements of a Digital image processing system – Structure of the Human eye – Image formation and contrast sensitivity – Sampling and Quantization – Neighbours of a pixel – Distance measures – Photographic firm structure and exposure – Film characteristics – Linear scanner – Video camera – Image processing applications. (6)

IMAGE TRANSFORMS: Introduction to Fourier transform – DFT – Properties of two dimensional FT – Separability, Translation, Periodicity, Rotation, Average value – FFT algorithm – Walsh transform – Hadamard transform – Discrete Cosine transform. (5)

IMAGE ENHANCEMENT: Definition – Spatial domain methods – Frequency domain methods – Histogram modification technique – Neighborhood averaging – Media filtering – Lowpass filtering – Averaging of multiple images – Image sharpening by differentiation and high pass filtering. (8)

IMAGE RESTORATION: Definition – Degradation model – Discrete formulation – Circulant matrices – Block circulant matrices – Effect of diagnolization of circulant and block circulant matrices – Unconstrained and constrained restorations – Inverse filtering – Wiener filter – Restoration inspatial domain. (8)

IMAGE ENCODING: Objective and fidelity criteria – Basic encoding process – The mapping – The quantizer – The coder – Differential encoding – Contour encoding – Runlength encoding – Image encoding relative to fidelity criterion – Differential pulse code modulation. (8)

IMAGE ANALYSIS AND COMPUTER VISION: Typical computer vision system – Image analysis techniques – Spatial feature extraction – Amplitude and Histogram features. Transform features – Edge detection – Gradient operators – Boundary extraction – Edge linking – Boundary representation – Boundary matching – Shape representation. (10)

TUTORIAL PRACTICE:

1. Implementation of Viewing digital images, bits and bytes, sampling and quantization.
2. Apply scaling, translation and rotation, sums and differences with the grayscale and color images.
3. Implementation of Histograms and stretches, convolutional filters.
4. Construct edge detection algorithms using Operators.
5. Implement Fourier transforms and the frequency domain, non-linear filters.
6. Implement the image restoration techniques.
7. Apply various image encoding methods with grayscale images.
8. Implement the conversion between color spaces.
9. Extract the Spatial, Histogram, and Transform features.
10. Implement the boundary and shape representation of digital images.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Prentice Hall, 2011.
2. Kenneth R. Castleman, "Digital Image Processing", Pearson Education, 2007.

REFERENCES:

1. Maria Petrou , Costas Petrou, "Image Processing: The Fundamentals", Wiley,2010.

15XDA4 MULTIMEDIA ANALYTICS

3 2 0 4

MULTIMEDIA DATABASES: Architectures - Schema, Functional, System, Distributed, Interoperability, Hypermedia. Metadata for Multimedia Databases. (5)

DEALING WITH MULTIMEDIA DATABASES: Text Databases - Querying Character Data Using SQL, Statistical Methods for Text Analysis, Querying Multimedia Text, Content-dependent Metadata, Indexing Technologies for Text. Image Databases - Technologies for Image Processing, Role of Feature Extraction, Retrieval Methods, Developing Image Media Databases. Video Databases - Video Analysis and Segmentation, Storage of Video Objects, Dealing with Moving Images, Metadata for Speech and Video, Manipulating Video Data, Video Query Process. (10)

MULTIMEDIA DATA MINING: Technologies, Architectural Support, Process of Multimedia Data Mining, Outcomes, Approaches and Techniques. (5)

TEXT MINING - Overview, From Textural Information to Numerical Vectors - Collection Documents, Document Standardization, Tokenization, Lemmatization, Vector Generation for Prediction, Sentence Boundary Determination, Part-Of-Speech Tagging, Word Sense Disambiguation, Phrase Recognition, Named Entity Recognition, Parsing, Feature Generation. Using Text for Prediction - Recognizing that Documents Fit a Pattern, Document Classification, Learning to Predict from Text, Evaluation of Performance, Applications. (10)

DESIGNING A CONTENT-BASED IMAGE RETRIEVAL SYSTEM: Feature Extraction and Representation, Similarity Measurements, Dimension Reduction and High-dimensional Indexing, Clustering, The Semantic Gap, Learning, Relevance Feedback, Benchmarking Solutions. (7)

DESIGNING A CONTENT-BASED VIDEO RETRIEVAL SYSTEM: Video Parsing, Video Abstraction and Summarization, Video Content Representation, Indexing and Retrieval, Video Browsing Schemes, Samples of Video Retrieval Systems. (6)

AUDIO MINING: Overview, Audio Retrieval, Audio Mining, Taxonomy for Audio Mining. (2)

TUTORIAL PRACTICE:

1. Construct the following multimedia databases and manipulate them.
   a. Text Databases
   b. Image Databases
   c. Audio Databases
   d. Video Databases
2. Implement the various phases of text mining algorithm.
3. Construct a document classification system and analyze its performance.
4. Develop a CBIR system for a benchmark database with semantic and relevance feedback.
5. Construct an index based video retrieval system.
6. Develop an audio retrieval system.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Sholom M. Weiss, NitinIndurkhya, Tong Zhang and Fred Damerau, "Text Mining: Predictive Methods for Analyzing Unstructured", Springer, 2010.
2. Oge Marques andBorkoFurht, "Content-Based Image and Video Retrieval", 2012.
3. Dunckley Lynne, "Multimedia Databases: An Object Relational Approach", Pearson Education, 2003

REFERENCES:

1. Bhavani M. Thuraisingham, "Managing and Mining Multimedia Databases", CRC Press, 2001.
2. Oge Marques, "Practical Image and Video Processing Using MATLAB", John Wiley & Sons, 2011.

15XDA5 COMPUTATIONAL NEUROSCIENCE

3 2 0 4

INTRODUCTION: Introduction and history of Computational Neuroscience - Tools and specialization in neuroscience – Levels of organization in the brain – Levels of analysis and Computational Theory of the brain. (5)

MATHEMATICAL BACKGROUND: Linear systems - eigenvalues, eigenvectors for symmetric matrices – quadratic forms, solving a system of linear equations - Dynamic systems, bifurcation map in terms of trace and determinant - Phase plane analysis: null clines - Hopf bifurcation and limit cycles . (9)

HODGKIN HUXLEY MODEL: Neuron - Membrane potential, action potential, Electrophysiology - Goldman-Hodgkin-Katz voltage equation - Hodgkin-Huxley model. (9)

Components of Neural Signaling – Neurotransmission - Models of Sensory Systems: Vision – Touch –Hearing -Motor Systems (4)

REVIEW OF ARTIFICIAL NEURAL NETWORKS: McCulloch-Pitts Neuron, Perceptron, MLP, Self-organizing map, Hopfield network.Neural Network: Perception – MLP: Back Propogation – case studies - Past tense learning, NetTalk, biological plausibility of backpropagation algorithm – Hebbian Learning and PCA - Linsker's model of the visual system - Reinforcement Learning - Spiking neuron networks. (7)

INTRODUCTION TO INFORMATION THEORY: Communication channel and information gain – Information measure and Entropy – Properties of Joint and Conditional Information Measures and A Markov Source – Non-linear correlation measures. (5)

CASE STUDIES: Complex network analysis- Structural and functional brain networks. (6)

TUTORIAL PRACTICE:

1. Familiarity with tools such as EEGLab, MATLAB, UCINET.
2. Implementation of signal processing concepts – Frequency Component Analysis of signals etc.
3. Implementation of various Artificial Neural Network algorithms using real time neuroscience datasets.
4. Implementation of complex network metrics using UCI Net / PAJEK.
5. Statistical Analysis on Neuroscience data.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Eric Kandel, James Thomas Schwartz and Jessel, "Principles of Neural Science", McGraw-Hill, 2013.
2. Feng J., "Computational Neuro Science: A Comprehensive Approach", Chapman and Hall / CRC, 2004.
3. Randall C. O'Reilly and Yuko Munakata, "Computational Explorations in cognitive Neuroscience: Understanding the Mind" , MIT Press, 2000.
4. Thomas P. Trappenberg, "Fundamental of Computational Neuroscience", Oxford University press, 2010.

REFERENCES:

1. Raymond W. Yeung, "Information Theory and Network Coding", Springer, 2011.
2. Cover T. M. and Thomas J. A., "Elements of Information Theory", Wiley Publications, 2006.
3. Claude Elwood Shannon and Warren Weaver, "The Mathematical Theory of Communication", University of Illinois Press, 1999.

WEB LINKS:

1. http://en.wikipedia.org/wiki/Computational_neuroscience
2. http://www.scholarpedia.org/article/Encyclopedia_of_computational_neuroscience
3. http://home.earthlink.net/~perlewitz/

15XDA6 PERVASIVE COMPUTING

3 2 0 4

INTRODUCTION: Basics and visions of pervasive computing - Moore's law - living in a digital world - modeling key for pervasive computing properties - pervasive system environment interaction - architectural design for pervasive system - computing devices and their characteristics - pervasive information access devices-smart identification, smart card, labels, tokens- embedded controls, smart sensors, actuators, appliances, home networking, entertainment - various operating systems for pervasive devices - Middleware – Connecting the world – WWAN, SRWC, DECT, Bluetooth, IrDA – mobile internet – internet protocols. (9)

APPROACHES FOR DEVELOPING PERVASIVE APPLICATIONS: Categorization - smart services for pervasive application development - developing mobile applications – presentation transcoding – device independent view component – heterogeneity of device platforms - Context Awareness and Mobility to building pervasive applications. (7)

COMMUNICATION TECHNOLOGIES FOR PERVASIVECOMPUTING: Audio networks, data networks - wireless data networks - pervasive networks - service oriented networks - network design issues - Managing smart devices in virtual environments, human user-centered and physical environments - pervasive computing issues and outlook. (8)

CONTEXT AWARE SYSTEMS: Modeling - mobility awareness - spatial awareness - temporal awareness - ICT system awareness - Intelligent Systems - basic concepts- autonomous systems - reflective and self aware systems - self management and autonomic computing - complex systems. (7)

LOCATION AWARE SYSTEMS: Basic concepts - location modeling - Introduction to location management – DNS Server, server process, client process – location update – location inquiry-location management cost – network topology – mobility pattern, memory less movement model, Markovian Model, Shortest distance model, Gauss-Markov model, Activity Based Model, Mobility Trace, Fluid-flow Model, Gravity Model. (8)

Location Updates - Location relatedness and the query model – location dependent data – location aware queries – location dependent queries – moving object database queries – query classification – query transition steps in LDQ processing. (6)

TUTORIAL PRACTICE:

1. Create Application with onClick, onKeyDown, onFocusChanged Event Handlers.
2. Create Application with Toast Notifications.
3. Create Application with Android's Advanced User Interface Functions.
4. Create Android Audio/Video Application.
5. Create Application to Create, Modify and Query an SQLite Database.
6. Create Application that Works with an Android Content Provider.
7. Create application that performs Data Storage and Retrieval from Android External Storage.
8. Create Location-Aware application that uses Proximity Alerts and Google Maps API.
9. Implementation of small packages to demonstrate all apis.
10. Design and Implement the query classification and query transition in LDQ processing.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Stefan Poslad, "Ubiquitous Computing - Smart Devices, Environment and Interactions", John Wiley & Sons, 2013.
2. Adelstein F and Gupta S.K.S., "Fundamentals of Mobile and Pervasive Computing" Tata McGraw-Hill, 2005.
3. Mohammed Ilyas and Imad Mahgoub: "Mobile Computing Handbook", Auerbach Publications, 2005.

REFERENCES:

1. Burkhardt, Henn, Hepper, Rintdorff and Schaeck. "Pervasive Computing", Addison Wesley, 2002.
2. AshokeTalukdar and RoopaYavagal, "Mobile Computing:Technology, Applications, and Service Creation", Tata McGraw Hill, 2010.

15XDA7 MARKETING ANALYTICS

3 2 0 4

INTRODUCTION: Marketing Analytics, Models and metrics- Market Insight – Market data sources, sizing, PESTLE trend analysis, and porter five forces analysis – Market segment identification and positioning. (8)

COMPETITIVE ANALYSIS AND BUSINESS STRATEGY: Competitor identification, Intelligence gathering, analysis and strategy-Analytics based strategy selection, with strategic models and metrics , Forecasting, balanced scorecard, and critical success factors. (8)

PRODUCT, SERVICE AND PRICE ANALYTICS: Conjoint analysis model, decision tree model, portfolio resource allocation, Pricing techniques, pricing assessment, pricing for business markets, price discrimination. (12)

DISTRIBUTION AND PROMOTION ANALYTICS: Retail location selection, distribution channel evaluation, and multi-channel distribution, Promotion budget estimation and allocation, promotion metrics for traditional media and social media. (8)

SALES ANALYTICS: E Commerce sales mode, sales metrics, profitability metrics and support metrics. (9)

TUTORIAL PRACTICE:

1. Implementation of different metrics in marketing analytics.
2. Implementation of forecasting techniques for sales data.
3. Implementation of portfolio analysis.

Total: L: 45+T: 30 = 75

TEXT BOOK:

1. Stephan Sorger, "Marketing Analytics – Strategic Models and Metrics", Admiral Press, 2013.

REFERENCES:

1. Mark Jeffery, "Data Driven Marketing: The 15 Metrics Everyone in Marketing should know", Wiley, 2013.
2. Paul W. Farris, Neil T. Bendle, Phillip E. Pfeifer, David J. Reibstein "Marketing Metrics: The Definitive Guide to Measuring Marketing Performance", Pearson FT press, 2012.

15XDA8 NATURAL LANGUAGE PROCESSING

3 2 0 4

INTRODUCTION: Applications of NLP techniques and key issues - MT - grammar checkers – dictation - document generation - NL interfaces - Natural Language Processing key issues - The different analysis levels used for NLP: morpho-lexical - syntactic – semantic - pragmatic - markup (TEI, UNICODE) - finite state automata - Recursive and augmented transition networks – open problems. (8)

LEXICAL LEVEL: Error-tolerant lexical processing (spelling error correction) - Transducers for the design of morphologic analyzers – Features - Towards syntax: Part-of-speech tagging (Brill, HMM) - Efficient representations for linguistic resources (lexica, grammars,...) tries and finite-state automata. (7)

SYNTACTIC LEVEL: Grammars (e.g. Formal/Chomsky hierarchy, DCGs, systemic, case, unification, stochastic) - Parsing (top-down, bottom-up, chart (Earley algorithm), CYK algorithm) - Automated estimation of probabilistic model parameters (inside-outside algorithm) - Data Oriented Parsing - Grammar formalisms and treebanks - Efficient parsing for context-free grammars (CFGs) - Statistical parsing and probabilistic CFGs (PCFGs) - Lexicalized PCFGs. (8)

SEMANTIC LEVEL: Logical forms - Ambiguity resolution - Semantic networks and parsers - Procedural semantics - Montague semantics - Vector Space approaches - Distributional Semantics - Lexical semantics and Word Sense Disambiguation - Compositional semantics. Semantic Role Labeling and Semantic parsing. (7)

PRAGMATIC LEVEL: Knowledge representation – Reasoning - Plan/goal recognition - speech acts/intentions - belief models-discourse – reference. (5)

NATURAL LANGUAGE GENERATION: content determination - sentence planning - surface realization. (3)

SUBJECTIVITY AND SENTIMENT ANALYSIS: Information extraction - Automatic summarization - Information retrieval and Question answering - Named entity recognition and relation extraction - IE using sequence labeling - Machine translation: Basic issues in MT - Statistical translation - word alignment - phrase-based translation and synchronous grammars. (7)

TUTORIAL PRACTICE:

1. Implementing word similarity.
2. Implementing simple problems related to word disambiguation.
3. Simple demonstration of part of speech tagging.
4. Lexical analyzer.
5. Semantic analyzer.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice Hall, 2009.
2. Ian H. Witten and Eibe Frank, Mark A. Hall, “Data Mining: Practical Machine Learning Tools and Techniques”, Morgan Kaufmann, 2013.

REFERENCES:

1. Christopher Manning and Hinrich Schütze, “Foundations of Statistical Natural Language Processing”, MIT Press, 2008.
2. James Allen, “Natural Language Understanding”, Addison Wesley, 1995.
3. Steven Bird, Ewan Klein, and Edward Loper, “Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit”, O'Reilly Media, Sebastopol, 2009.

15XDA9 SOFT COMPUTING

3 2 0 4

ARTIFICIAL INTELLIGENCE AND SOFT COMPUTING: Subject of AI – Problem solving by intelligent search – Breadth First Search, Depth First Search, Iterative Deepening, Hill Climbing, Iterative Deepening, A*, Best First Search. (7)

GENETIC ALGORITHM: Basic Concepts – Encoding – Binary, Permutation, Tree, Value – Fitness Function – Reproduction – Roulette Wheel, Boltzmann, Tournament, Rank, Elitism – Operators - Crossover – Single point, Two point, Multi point, Uniform, Matrix, Partially Matched, Order and Cycle – Mutation – Flip, Swap, Inverse – Application. (10)
FUZZY SET THEORY: Basic Definitions and Terminologies – Set theory operations – Membership function formulation and parameterization – Fuzzy rules and reasoning – Extension principle and fuzzy relations, Fuzzy if then rules, Fuzzy reasoning – Fuzzy Inference Systems – Mamdani fuzzy model, Sugeno Fuzzy models, Tsukamoto fuzzy models. (12)

NEURAL NETWORKS: Fundamentals – Neural Network Architecture – Learning methods - Simple neural nets – McCulloch Pitts – Linear separability – Hebb Net – Perceptron – Standard Back Propagation Network – Radial Basis Function Network - Pattern Association – Hebb rule – Hetero associative memory – Auto associative memory – Iterative Associative net – Discrete Hopfield Net – Bidirectional Associative Memory – Competitive net – Kohonen Self Organizing Map – Adaptive Resonance Theory.
(16)

TUTORIAL PRACTICE:

1. Genetic algorithm for Travelling Salesman Problem.
2. Genetic algorithm for Feature Selection.
3. Fuzzy set for Classification and Feature Selection.
4. Perceptron for XOR Problem.
5. Backpropagation for fine-tuning the parameters of any algorithm.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Amit Konar, “Artificial Intelligence and Soft Computing : Behavioral and Cognitive Modeling of the Human Brain”, CRC Press, 2008.
2. Ross Timothy J., “Fuzzy Logic with Engineering Applications”, John Wiley and Sons, 2010.
3. Laurene Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Pearson Education, 2011.

REFERENCES:

1. Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmann,2003.
2. Rajasekaran S., Vijayalaskhmi Pai G. A., “Neural Networks, Fuzzy Logic and Genetic Algorithms”, Prentice Hall, 2006.
3. David E. Goldberg, “Genetic Algorithms in search, optimization and machine learning”, Addison Wesley, 2012.
4. Jang J. S. R., Sun C. T. and Mizutani E., “Neuro-fuzzy and Soft Computing”, Prentice Hall, 2010.

15XDAA COMPUTER GRAPHICS

3 2 0 4

GRAPHICS INPUT - OUTPUT DEVICES: Raster scan Displays - Random scan displays - Direct view storage tubes - Flat panel displays - Joy Stick - Digitizers - Touch panels - LCD. GRAPHICAL USER INTERFACE AND INTERACTIVE INPUT METHODS: The user dialog - Input of graphical data - Input function - Interactive picture construction techniques - Virtual reality environments.
(3)

TWO DIMENSIONAL GRAPHICS: Basic transformations - Matrix representation and homogeneous coordinates - Composite transformations - Line drawing algorithms: DDA and Bresenham's algorithms - Circle generation algorithms: Midpoint circle algorithm - Point clipping - Line clipping: Cohen Sutherland algorithm - Polygon clipping: Sutherland Hodgeman algorithm - Line covering. (8)

RASTER GRAPHICS: Fundamentals: generating a raster image, representing a raster image, scan converting a line drawing, displaying characters, speed of scan conversion, natural images - Solid area scan conversion: Scan conversion of polygons,Y-X algorithm, properties of scan conversion algorithms - Interactive raster graphics: painting model, moving parts of an image, feed back images. (8)

CURVES AND SURFACES: Parametric representation of curves - Bezier curves – B-Spline curves - Parametric representation of surfaces - Bezier surfaces - Curved surfaces - Ruled surfaces - Quadric surfaces – Concatenation of two curve segments – Order of Continuity. (5)

IMAGE PROCESSING FUNDAMENTALS: Sampling and Quantization, Image Enhancement - Histogram Processing, Filtering, Edge Detection, Image Transforms. (7)

THREE DIMENSIONAL GRAPHICS: 3D transformations - Viewing 3D graphical data - Orthographic, oblique, perspective projections - Hidden lines and hidden surface removal. (5)

FRACTAL-GEOMETRY METHODS: Tiling the plane - Recursively defined curves - Koch curves - C curves - Dragons - Space filling curves - Fractals - Grammar based models - Graftals - Turtle graphics - Ray tracing. (5)

OPENGL: Architecture, The OpenGL API, Primitives and Attributes, Color, Viewing, Control Functions, Programming Event-Driven Input, Transformations, OpenGL Extensions. (4)

TUTORIAL PRACTICE:

1. Drawing a line, circle using algorithms.
2. Implementation of 2D Transformations (translation, scaling, rotation).
3. Window – viewport simulation with various aspect ratios.
4. Polygon clipping and line clipping using algorithms.
5. Drawing a 2D curve using Bezier generation.
6. Drawing a 2D curve using B-Spline generation.
7. Model a primitive (car / Aircraft) with OpenGL API.
8. Simulate the primitive.
9. Animate the primitive.

Note: Algorithms in the Computer Graphics have to be implemented by the student using C++/ OpenGL. (Wherever applicable).

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Pearson Education, 2011.
2. William M. Newmann, Robert F.Sproull, “Principles of Interactive Computer Graphics”, McGraw Hill, 2002.

REFERENCES:

1. Rankin John R., "Computer Graphics Software Construction", Prentice Hall, 1989.
2. Foley James D., Vandam Andries and Hughes John F., "Computer Graphics: Principles and Practice", Pearson Education, 2005.
3. Rafael C. Gonzalez., and Richard Eugene Woods, “Digital Image Processing”, Pearson Education, 2010.
4. Anil K. Jain., “Fundamentals of Digital Image Processing”, Pearson Education, 2007.
5. Angel, “Interactive Computer Graphics- A top down approach with OpenGL”, Addison-Wesley, 2012.
6. Hill F. S., “Computer Graphics Using OpenGL”, Prentice Hall, 2007.

15XDAB ALGORITHMIC BIOINFORMATICS

3 2 0 4

INTRODUCTION: Biological data, DNA, RNA, Amino acids, Protein, Structural databases, genomes, Central dogma – Molecular Biology, Prediction of molecular function and structure. (7)

SEQUENCE COMPARISON ALGORITHMS: Dynamic Programming Algorithms, Edit Distance and Alignments, Alignment with Gap Penalties, Spliced Alignment, Similarity-Based Approaches to Gene Prediction, Multiple Alignment, HMM, Profile HMM Alignment, Viterbi Algorithm, Randomized Algorithms-Gibbs sampling, Genetic, Expectation Maximization Algorithm. (10)

EXHAUSTIVE SEARCH ALGORITHMS: Repeat finding Hash tables, Exact, approximate, combinatorial pattern matching, profile search, Motifs, Motif finding using Greedy algorithm, Dynamic Programming Algorithms, Divide-and-Conquer Algorithms, Keyword Trees, Suffix Trees, Heuristic Similarity Search Algorithms, BLAST: Sequence against a Database. (10)

GRAPH BASED ALGORITHMS: Shortest superstring problem – sequencing by hybridization – SBH as a Hamiltonian path problem – SBH as an Eulerian Path problem – Fragment assembly in DNA sequencing – Protein sequencing and Identification. (8)

CLUSTERING ALGORITHMS: Support Vector Machine, Ant Colony Algorithm**,** Clustering and Trees, Hierarchical Clustering, k-Means Clustering, Evolutionary Trees, Distance-Based, Additive Matrices, parsimony Tree Reconstruction. (10)

TUTORIAL PRACTICE:

1. Motif Finding.
2. Sequence Comparison.
3. Searching biological databases.
4. Applications of HMM.
5. Finding SBH using Hamilton cycle / Eulerian Path.
6. Implementation of some clustering algorithms.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Neil Jones and PavelPevzner, “An Introduction to Bioinformatics Algorithms”, MIT Press,2009.
2. Jonathan Pevsner, "Bioinformatics and Functional Genomics", John Wiley & Sons, 2009.

REFERENCE:

1. Mount, “Bioinformatics: Sequence and Genome Analysis”, Cold Spring Harbor Laboratory Press, 2006.

15XDAC MATHEMATICAL MODELLING

3 2 0 4

INTRODUCTION TO MODELING: Modeling process, Overview of different kinds of model. (3)

EMPIRICAL MODELING WITH DATA FITTING: Error function, least squares method; fitting data with polynomials and splines. (3)

CAUSAL MODELING AND FORECASTING: Introduction, Modeling the causal time series, forecasting by regression analysis, predictions by regression. Planning, development and maintenance of linear models, trend analysis, modeling seasonality andtrend, trend removal and cyclical analysis, decomposition analysis. Modeling financial time series. Econometrics and time seriesmodels. Non seasonal models: ARIMA process for univariate and multivariate. (9)

PORTFOLIO MODELING AND ANALYSIS: Portfolios, returns and risk, risk-reward analysis, asset pricing models, mean variance portfolio optimization, Markowitz model and efficient frontier calculation algorithm, Capital Asset Pricing Models (CAPM). (5)

DISCRETE-TIME FINANCE: Pricing by arbitrage, risk-neutral probability measures, valuation of contingent claims, and fundamental theorem of asset pricing, Cox-Ross-Rubinstein (CRR) model, pricing and hedging of European and American derivatives as well as fixed-income derivatives in CRR model, general results related to prices of derivatives. (9)

STOCHASTIC CALCULUS: Brownian motion, martingales, Itô’s formula, Itô integral, risk-neutral measure, SDE; Risk-neutral measure, Girsanov's theorem for change of measure, martingale representation theorems, representation of Brownian martingales, Feynman-Kac formula. (8)

MODELING WITH BIOINFORMATICS: Introduction, Biological data- types, mode of collection, documentation and submission. Sequence alignment- Definition, significance, dot matrix method, dynamic programming- Global and local alignment tools, scoring matrices and gap penalties. Multiple sequence alignment: Iterative methods. Genetic algorithm, Hidden Markovian models, statistical methods, position specific scoring matrices. (8)

TUTORIAL PRACTICE:

Softwares **:** MATLAB programming, Mathlab, Mathematica, Maple.
Topics **:** Some of the major topics to be covered include (not necessarily in the order given):

1. Algebraic Models: Linear, Quadratic, and Exponential.
2. Polynomial curve fitting and cubic spline curve fitting.
3. Time series analysis and forecasting models.
4. Portfolio optimization models.
5. Cox-Ross-Rubinstein (CRR) model.
6. Risk analysis models.
7. Pair wise sequence alignment using dynamic programming.
8. Multiple sequence alignment using Hidden Markovian models.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Giordano F. R., Weir M. D., and Fox W. P., "A First Course in Mathematical Modeling". Brooks/Cole, Belmont, 2014.
2. Christoffersen P., "Elements of Financial Risk Management", Academic Press, 2012.
3. Capinski M. and ZastawniakT,"Mathematics for Finance: An Introduction to Financial Engineering", Springer, 2011.
4. Mount D.W., "Bioinformatics Sequence and genome analysis", Cold Spring Harbor Laboratory, Press, 2006.

REFERENCES:

1. Hamdy A. Taha, "Operation Research- An Introduction", Pearson Education, 2012.
2. Borovkov K., "Elements of Stochastic Modeling", World Scientific, New Jersey,2014.
3. Shreve S., "Stochastic Calculus for Finance", Springer, Pittsburgh, 2005.
4. Salzberg, Searls and Kasif, "Computational Methods in Molecular Biology", Elsevier, 1999.

15XDAD SOFTWARE ENGINEERING

3 2 0 4

INTRODUCTION: System - System Development - Types of systems – People involved in the systems development - The project life cycle models - Need for Software Engineering - Objectives and Benefits of Software Engineering - Factors that influence Quality & Productivity – Quality attributes of a software product. (4)

SOFTWARE PLANNING: Software Project Estimation - Different techniques of Project cost estimation Decomposition techniques - COCOMO & PUTNAM models. (4)

SOFTWARE ANALYSIS: Functional and non-functional requirements- Requirements engineering process – Elicitation – validation and management – software prototyping - Principles of Analysis - Analysis tools - Analysis Models. (8)

DESIGN CONCEPTS AND PRINCIPLES: Design process and concepts – Levels of Design - Coupling – Cohesion -Design Tools - Software Design Methods – Design Techniques - Design of Input and control - Design of Output. (8)

SOFTWARE TESTING : Quality Assurance versus Quality Control-The Cost of Quality-Software Quality Factors - Importance - Testing Types -Testing Techniques- Test Design-Test Scenarios-Test Cases Design-types-Test Scenario-Test cases for sample case studies - Smoke Testing-Sanity Testing-Regression Testing, Re-Testing, Ad-Hoc Testing-Gorilla Testing. Test Management-Test Policy-Test Strategy-Test Plan-Test Process-Levels of Testing-Testing Metrics-Review-Walk through – Inspection-Desk Checking - Testing Tools. (6)

OBJECT ORIENTED SYSTEMS DEVELOPMENT: Object Oriented Systems Development life Cycle - Object oriented methodologies -Rational Unified Process – Unified Modeling Language –Process workflows – Importance of Modeling – Types of Modeling. (15)

TUTORIAL PRACTICE:

Case Studies

Total L: 45+T:30=75

TEXT BOOKS:

1. Pressman R.S., "Software Engineering – A Practitioner's Approach", Tata McGraw Hill, 2014.
2. John Hunt, "The Unified Process for Practitioners", Springer, 2001.
3. William Perry, "Effective methods for software testing", John Wiley & Sons, 2010.
4. Boriz Beizer, "Software System Testing & Quality Assurance", Thomson Publishing group, 2004.
5. Glenford J. Myers, "Art of Software Testing", John-Wiley, 2011.

REFERENCES:

1. Shari Lawrence Pfleeger, "Software Engineering Theory and Practice", Pearson Education, 2010.
2. Philippe Krucheten, "The Rational Unified Process – An Introduction", Pearson Education, 2005.
3. Grady Booch , James Rumbaugh and Ivar Jacobson , "The Unified Modeling Language User Guide", Addison Wesley, 2011.
4. Martin Fowler and Kendall Scott, "UML Distilled", Addison Wesley, 2004.
5. Ian Sommerville, "Software Engineering", Pearson Addison Wesley, 2012.

6. Hans-Erik Eriksson, Magnus Penker, Brain Lyons, David Fado, “UML 2 Toolkit”, Wiley Publishing, 2011.
7. Craig Larman, “Agile and Interactive Development-A Managers Guide”,Pearson Edition, 2010.

15XDAE DESIGN PATTERNS

3 2 0 4

INTRODUCTION TO PATTERNS: Reusable object oriented software – Motivation - Best design practices of object oriented software - Benefits of patterns – Definition – Types - Pattern description - How design patterns solve design problems - Pattern Language - IDIOMS. (10)

DESIGN PATTERNS: Creational pattern: Abstract factory – Builder - Factory method – Prototype – Singleton, Structural patterns: Adapter – Bridge – Composite – Decorator – Façade – Flyweight - Proxy, Behavioral patterns: Command – Interpreter - Iterator, Mediator - Memento – Observer - State – Strategy - Template method – Visitor - Chain of Responsibility, Case Studies. (15)

ARCHITECTURAL PATTERNS: From Mud to Structure: Layers - Pipes and Filters - Blackboard, Interactive Systems: Model View Controller (MVC), Case studies. (10)

CODE REFACTORING: What is refactoring - Principles in refactoring - Bad smells in code - Composing methods - Moving features between objects - Organizing data - Simplifying conditional expressions - Making method calls simpler - Dealing with generalization. (10)

TUTORIAL PRACTICE:

1. ATM Simulation – Singleton pattern.
2. Image Viewer Application – Bridge pattern.
3. Address Book Maintenance – Prototype pattern.
4. US, Canada Tax and Freight charges – Factory Method pattern.
5. The Fast Food Franchise – Builder pattern.
6. Computer Models with different architectures – Abstract Factory pattern.
7. An Evaluation Application – Decorator pattern. **Total: L: 45+T: 30 = 75**

TEXT BOOKS:

1. Erich Gamma, Richard Helm, Ralph Johnsons and John Vlissides, “Design Patterns: Elements of Reusable Object Oriented Software”, Pearson Education, 2012.
2. Frank Buschman, RegineMeunier, Hans Rohnert, PeterSommerlad and Michael Stal, “Pattern-Oriented Software Architecture: A System of Patterns”, Wiley, 2011.

REFERENCES:

1. Craig Larman, “Applying UML and Patterns”, Pearson Education, 2012.
2. Martin Fowler, Kent Beck, William Opdyke and Don Roberts, “Refactoring: Improving the Design of Existing Code”, Addison Wesley, 2013.
3. SherifYacoub, HanyAmmar, “Pattern-Oriented Analysis and Design: Composing Patterns to Design Software Systems”, Addison Wesley, 2004.
4. ParthaKuchana, “Software Architecture Design Patterns in Java”, Auerbach Publications, 2004.
5. William J. Brown, Raphael C. MalveauHays W. McCormick and Thomas J. Mowbray, “AntiPatterns: Refactoring Software, Architectures, and Projects in Crisis”, Wiley, 1998.

15XDAF APPLIED GRAPH ALGORITHMS

3 2 0 4

BASIC CONCEPTS: Graphs – representations, Planar graphs- Euler’s formula, crossing number, doubly connected edge list data structure, Algorithm complexity – time and space. (4)

GEOMETRIC GRAPHS: Planar straight line graph, Euclidean minimum spanning tree algorithm, Art gallery problem, visibility graphs, Computing point visibility for polygons with and without holes. (10)

VLSI PHYSICAL DESIGN: Manhattan distance, overlap graph, containment graph, interval graph, neighborhood graph, hypergraphs, Rectilinear minimum spanning tree, Rectilinear Steiner minimum tree, Kernighan-Lin partitioning algorithm, Partitioning based algorithms for floorplanning and placement, Lee’s algorithm for routing, Shadow propagation algorithm for compaction. (11)

VERTEX-PURSUIT GAME: Graph homomorphism, retracts, cops and robbers - cop number (k), bounds, cop-win graphs. Polynomial algorithm for fixed k, NP-hard with k not fixed. (10)

VORONOI DIAGRAMS: plane sweep algorithm, Voronoi Diagram – definition and properties, Fortune's algorithm. Delaunay triangulation. (10)

TUTORIAL PRACTICE:

1. Storing planar graphs using doubly connected edge list.
2. Borůvka'sEuclidean minimum spanning tree algorithm.
3. Computing point visibility for polygons with and without holes.
4. Polynomial time approximation algorithms for vertex guarding.
5. Vertex guard algorithm using set cover.
6. Kernighan-Lin partitioning algorithm.
7. Partitioning based algorithms for floorplanning and placement.
8. Lee's algorithm for routing.
9. Shadow propagation algorithm for compaction.
10. Polynomial algorithm for fixed cop number.
11. Plane sweep algorithm.
12. Fortune's algorithm for Voronoi diagram.
13. Divide and conquer Delaunay triangulation.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", PHI Learning, 2013.
2. Ghosh S. K., "Visibility Algorithms in the Plane", Cambridge University Press, 2007.
3. Naveed A. Sherwani, Algorithms for VLSI Physical Design Automation, Springer, 2013.

REFERENCES:

1. Anthony Bonato, The Game of Cops and Robbers on Graphs, AMS, 2011.
2. Mark De Berg, Computational Geometry Algorithm and Applications, Springer, 2010.

15XDAG GAME THEORY

3 2 0 4

INTRODUCTION: Game theory the theory of rational choice – Interacting decision makers. (2)

NASHEQUILIBRIUM: Strategic games – Best response – Dominance – Examples from economics, business, environment, military - Symmetric games and symmetric equilibria. Illustrations: Cournot's model of oligopoly, Electoral competition. (7)

MIXED STRATEGIES: Dominance – Equilibrium – Illustrations: Expert diagnosis, Reporting a crime – Formation of players' beliefs. (4)

EXTENSIVE GAMES WITH PERFECT INFORMATION: Strategies and outcomes – Nash equilibrium – Subgame perfect equilibrium - Stackelberg's model of duopoly, Buying votes – Illustrations: Entry into a monopolized industry, Electoral competition with strategic voters, Committee decision making. (7)

GAMES WITH IMPERFECT INFORMATION: Bayesian games – Examples – Strategic information – Transmission – Agenda Control with imperfect Information – Signaling games - Education as a signal of ability. (6)

REPEATED GAMES: The prisoner's dilemma – Finitely repeated and infinitely repeated – Strategies – Nash equilibrium – Subgame – Perfect equilibria and the one – deviation – Property – General results – Finitely replaced games – Variation on a theme: Imperfect observability. (6)

INTRODUCTION TO ALGORITHMIC GAME THEORY: Auction and mechanism design basics - the Vickrey auction - Sponsored Search Auction - Social choice theory - VCG mechanism. Algorithmic Aspects of Equilibria: Existence and computational complexity equilibria - Market Equilibrium - Correlated Equilibrium. Quantifying the inefficiency of equilibria: Routing Games and Congestion Games - Network Formation - Price of Anarchy and Price of Stability - Bandwidth Sharing. (13)

TUTORIAL PRACTICE:

Implement the following using GAMBIT Software.

1. Display the Normal Form game.
2. Find all strongly dominant strategies.
3. Find all weakly dominant strategies.
4. Find all very weakly dominant strategies.
5. Find Strongly dominant strategy equilibrium, if one exists.
6. Find Weakly dominant strategy equilibrium, if one exists.
7. Find Very Weakly dominant strategy equilibrium, if one exists.
8. Find all pure strategy Nash Equilibria, if they exist.
9. Displaying and solving the Extensive Form games.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Martin J. Osborne, "An Introduction to game theory", Oxford University Press, New York, 2004.
2. Nisan N., Roughgarden T., Tardos E., Vazirani V., "Algorithmic Game Theory", Cambridge University Press, Cambridge, 2007.

REFERENCES:

1. Thomas L.C, "Games, Theory and Applications", Dover Publications, New York, 2011.
2. Ken Binmore, "Playing for Real: A Text on Game Theory", Oxford University Press, New York, 2007.
3. David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, New York, 2010.
4. Matthew O. Jackson, "Social and Economic Networks", Princeton University Press, New Jersey, 2008.
5. YoavShoham, Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations", Cambridge University Press, New York, 2008.

15XDAH SOCIAL NETWORK DATA ANALYTICS

3 2 0 4

INTRODUCTION: On line Social Networks – Terminologies - Research topics. (5)

STATISTICAL PROPERTIES OF SOCIAL NETWORKS: Static properties – Dynamic properties. (5)

RANDOM WALKS IN SOCIAL NETWORKS – Random walks on graphs – Algorithms – Applications. (5)

COMMUNITY DISCOVERY IN SOCIAL NETWORKS: Communities – Core methods – Applications. (8)

NODE CLASSIFICATION IN SOCIAL NETWORKS: Methods using local classifiers – Random walk based methods – Algorithms - Applications - Node classification to large scale social networks. (10)

MODELS AND ALGORITHMS: Social influence analysis – Expert location in social networks – link prediction. (12)

TUTORIAL PRACTICE:

Do the following on Twitter, Facebook or any social network data set.
1. Study of the different metrics of social network.
2. Visualization of social network .
3. Power law distribution of social data.
4. Node classification using iterative method.
5. Node classification using label probagation.
6. Usage of Graph laplacian.

Total: L: 45+T: 30 = 75

TEXT BOOK:

1. Charu C. Aggarwal, "Social Network Data Analytics", Springer Publications, 2011.

REFERENCES:

1. Marshall Sponder "Social Media Analytics Effective tools for building, interpreting, and using metrics", McGrawHill, 2011.
2. Stanley Wasserman, Katherine Faust, "Social network analysis: Methods and applications ", Cambridge University Press, 1995.
3. Stephen Borgatti, Martin Everett, Jeffrey Johnson, " Analysing Social Networks", SAGE Publications Ltd., 2013.

15XDAI ARTIFICIAL INTELLIGENCE

3 2 0 4

INTRODUCTION: The foundations of AI - The History of AI- Intelligent agents- Agent based system. (3)

PROBLEM SOLVING: Searching for solution- Uninformed/Blind search - Informed/ Heuristic search - A* search - Hill-climbing search -Constraint satisfaction problem. (6)

KNOWLEDGE REPRESENTATION AND REASONING: Logics – First order logic, Inference in first order logic, Knowledge representation. (4)

PLANNING: The planning problem - Planning with state space search - Partial order search - Planning with proportional logic - Planning and acting in the real world. Adversarial planning. (7)

UNCERTAIN KNOWLEDGE AND PROBABILISTIC REASONING: Uncertainty-Probabilistic reasoning - Semantics of Bayesian network -Approximate inference in Bayesian network, Exact inference in Bayesian network - Probabilistic reasoning over time. (9)

LEARNING: Learning from observation - Knowledge in learning -Statistical learning methods - Reinforcement learning.(8)

DECISION-MAKING: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications. (6)

ROBOTICS: Introduction (2)

TUTORIAL PRACTICE:

1. Implement A* / Hill Climbing algorithms for 8 –puzzle and Missionaries and Cannibals problem.
2. Logic based exercises.
3. Implementation of planning- Partial order planning.
4. Supervised, Unsupervised and Reinforcement algorithms.
5. Implementing decision problems and simple games.

Total: L: 45+T: 30 = 75

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Education, 2014.
2. David Pool, Alan Mackworth, “Artificial Intelligence: Foundations of Computational agents”, Cambridge University, 2011.

REFERENCES:

1. Christopher M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2013.
2. Nils J. Nilsson, “The Quest for Artificial Intelligence: A History of Ideas and achievements”, Cambridge University Press, 2010.

15XDAJ CLOUD COMPUTING

3 2 0 4

INTRODUCTION TO PARALLEL AND DISTRIBUTED COMPUTING: Introduction, Architecture and Distributed computing models and technologies SOA, Web Services. (5)

GRID, CLUSTER AND UTILITY COMPUTING: Introduction, Architecture, Pros & Cons, Real time applications. (4)

INTRODUCTION TO CLOUD COMPUTING: Definition, History, Comparison of Cloud Computing with Grid, Cluster and Utility Computing, Deployment models – Private, Public, Hybrid and Community - Pros and Cons of Cloud Computing. SaaS, PaaS, IaaS etc. (8)

VIRUTUALIZATION : Types of Virtualization, Tools for Virtualization, Architecture of VMM, Virtualization for Cloud. (4)

ADVANCED WEB TECHNOLOGIES: AJAX and Mashup – Programming examples using applications. (4)

MAP REDUCE PARADIGMS: Introduction, GFS Architecture, HDFS Architecture, Hbase, Google big Table, Amazon's (key value) pair storage and Microsoft's Azure infrastructure, Map reduce programming examples. (6)

CLOUD COMPUTING FRAMEWORK: Amazon EC3, S3 storage revises, Aneka frame work, IBM blue Cloud. (7)

APPLICATIONS: Distributed search engine and distributed data mining in the cloud (7)

TUTORIAL PRACTICE:
1. Implement a distributed search engine.
2. Implement distributive data mining for an application.
3. Package to be developed using Virtualization and other cloud concepts.

Total: L: 45+T: 30 = 75

TEXT BOOK:
1. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter "Cloud Computing: A Practical Approach", McGraw Hill, 2012.

REFERENCES:
1. Liu M. L., "Distributed Computing Principles and Applications", Pearson Education, 2012.
2. Ron Schmelzer "XML and Web Services", Pearson Education, 2012.
3. Dean J. and Ghemawat S., " MapReduce: Simplified Data Processing on Large Clusters", In Proceedings of Operating Systems Design and Implementation (OSDI), San Francisco, 2004.
4. DeCandia et al G., "Dynamo Amazon's Highly Available Key-Value Store", In Proceedings of the 21st ACM Symposium on Operating Systems Principles, Stevenson, 2007.
5. Ghemawat S., Gobioff H. and Leung S. T., "The Google File System", In Proceedings of the 21st ACM Symposium on Operating Systems Principles, Stevenson, 2003.
6. www.gridcomputing.com.
7. www.cloudcomputing.com.
8. https://computing.llnl.gov/tutorials/parallel_comp/.

15XDAK DATA VISUALIZATION

3 2 0 4

INTRODUCTION: Information visualization – Theoretical foundations – Information visualization types – Design principles - A framework for producing data visualization (8)

STATIC DATA VISUALIZATION – tools – working with various data formats (4)

DYNAMIC DATA DISPLAYS : Introduction to web based visual displays – deep visualization – collecting sensor data – visualization – D3 framework - Introduction to Many eyes and bubble charts (10)

MAPS – Introduction to building choropleth maps (3)

TREES – Network visualizations – Displaying behavior through network graphs (10)

BIG DATA VISUALIZATION – Visualizations to present and explore big data – visualization of text data and Protein Sequences (10)

TUTORIAL PRACTICE:
Note : Explore softwares like R, Python, Google Vision, Google Refine, and ManyEyes ; Data sets are available on Gap minder, Flowing data

1. Visualization of static data.
2. Visualization of web data.
3. Visualization of sensor data.
4. Visualization of protein data.

Total L: 45 + T: 30 = 75

TEXT BOOK:
1. Ware C and Kaufman M "Visual thinking for design", Morgan Kaufmann Publishers, 2008.

REFERENCES:
1. Chakrabarti, S "Mining the web: Discovering knowledge from hypertext data ", Morgan Kaufman Publishers, 2003.
2. Fry ,"Visualizing data", Sebastopo", O'Reily, 2007.

OPEN ELECTIVES

15XDO1 COMPUTATIONAL FINANCE

3 2 0 4

INTRODUCTION : Law of one price – Risk neutral pricing – Arbitrage and Hedging – Financial Products and capital markets – Futures, Forwards and options – Options pricing problem and three types of solutions. (3)

MATHEMATICAL PRELIMINARIES : Conditional expectation – Sigma Algebra – Filtrations, Time series analysis - Covariance stationary – autocorrelations - MA(1) and AR(1) models, Stochastic Calculus - Random walk – Brownian motion – Martingales – Ito's Lemma. (12)

PORTFOLIO THEORY - Introduction - Portfolio theory with matrix algebra - Review of constrained optimization methods, Markowitz algorithm, Markowitz Algorithm using the solver and matrix algebra – Portfolio choice and linear pricing – Statistical analysis of efficient portfolios. (10)

BASIC OPTIONS THEORY – Definitions – Pay off diagrams – Single period binomial options theory – Multi period binomial options theory – Real options – American options, Simulation methods for options pricing – Random variable generation – simulation of stochastic processes. (10)

THE CAPITAL ASSET PRICING (CAP) AND RISK BUDGETING - Mean variance portfolio theory – Asset returns – Variance as a risk measure - The one and two fund theorems, The capital market line – CAP as a pricing formula – Systematic and unsystematic risk – Euler's theorem – Asset contributions to volatility – beta as a measure of portfolio risk , Limitations of mathematical models in finance. (10)

TUTORIAL PRACTICE:

1. Problems using Capital Asset Pricing model.
2. Problems using Auto correlation.
3. Plot time series data and find outliers
4. Problems using Autoregressive models
5. Problems using Moving average models
6. Monte Carlo Simulation of options pricing

Total L: 45+T:30 = 75

TEXT BOOKS:

1. David Ruppert, "Statistics and Data Analysis for Financial Engineering", Springer-Verlag, 2011.
2. Edwin J. Elton, Martin J. Gruber, Stephen J. Brown and William N. Goetzmann "Modern Portfolio Theory and Investment Analysis", Wiley, 2014.

REFERENCES:

1. Simon Benninga, "Financial Modeling", MIT Press, 2008.
2. Steven E Shreve, "Stochastic Calculus for Finance – I" , Springer, 2004

15XDO2 COMPUTATIONAL GEOMETRY

3 2 0 4

MATHEMATICAL & GEOMETRICAL REVIEW: Algorithm analysis – sorting, binary search, balanced binary search, divide and conquer, plane sweep, Kd-trees, Dijkstra's algorithm, points, lines and planes, basic geometric objects – polygons, polytopes, convexity, graphs - vertex coloring, planar, Euler's formula. (2)

CONVEX HULLS: Definition, lower bounds, algorithms - Graham's scan, divide and conquer, Jarvis march, 3D hulls. (5)

LINE SEGMENT INTERSECTION: Plane sweep algorithm, Doubly-connected edge list, computing overlay of two subdivisions, Map overlay algorithm, half-plane intersection, arrangements of lines. (8)

POLYGON TRIANGULATION: Art gallery problem – introduction, triangulation, bounds, partition into monotone pieces, triangulating monotone polygon, placement of guards. (8)

ORTHOGONAL RANGE SEARCHING: 1-D and 2-D range searching, range trees. (4)

VORONOI DIAGRAMS: Properties, beach line, computing Voronoi diagram, Delaunay triangulations, computing Delaunay triangulations. (8)

ROBOT MOTION PLANNING: Work space and configuration space, point robot, free space, Minkowski sums for convex and nonconvex polygons, translational motion planning, motion planning with rotations, Point location and trapezoidal maps. Visibility graphs - Shortest paths for a point robot, computing visibility graph, shortest paths for a translating polygonal robot. (10)

Total: L:45+T:30 = 75

TUTORIAL PRACTICE:

Implementation of various algorithms for the following problems.

1. Convex hull problems.
2. Line and half plane intersections.
3. Map overlay problems using Doubly-connected edge list.
4. Triangulation and Art gallery problem.
5. Orthogonal range searching (1D and 2D) using Kd-trees.
6. Construct Voronoi diagrams.
7. Translational algorithms for robot motion planning.

TEXT BOOKS:

1. M. De Berg, M. van Kreveld, M. Overmars and O.Schwarzkopf, “Computational Geometry - Algorithms and Applications”, Springer Verlag, 2008.
2. Joseph O’Rourke, “Computational Geometry in C”, Cambridge University Press, 2001.

REFERENCES:

1. Franco P. Preparata and Michael Ian Shamos, “Computational Geometry - An Introduction”, Springer-Verlag, (Digitized) 2011 .
2. Goodman J E and O'Rourke, “Handbook of Discrete and Computational Geometry”, CRC Press, 2004.
3. Subir Kumar Ghosh, “Visibility Algorithms in the Plane”, Cambridge University Press, 2007.

15XDO3 RANDOMIZED ALGORITHMS

3 2 0 4

INTRODUCTION: Randomized algorithms, randomized quick sort, Karger’s min-cut algorithm Las Vegas and Monte Carlo algorithms, computational models and complexity classes. (5)

MOMENT, DEVIATION AND TAIL INEQUALITIES: Occupancy problem**,** Markov and Chebyshev inequalities- randomized selection- coupon collector’s problem, the Chernoff bound- routing in a parallel computer- a wiring problem. (7)

PROBABILISTIC METHODS: Overview of the method-maximum satisfiability - finding a large cut , Expander graphs. (5)

MARKOV CHAINS AND RANDOM WALKS: Markov chains, Random walk on graphs - connectivity in undirected graphs – Expanders and rapidly mixing random walks. (6)

DATA STRUCTURES AND GRAPH ALGORITHMS: Random Treaps, hashing – hash tables – perfect hashing, skip lists **-** Fast min-cut. (6)

ONLINE ALGORITHMS: Paging problem-adversary models- paging against an oblivious adversary-relating the adversaries-the adaptive online adversary, k-server problem. (5)
PARALLEL AND DISTRIBUTED ALGORITHMS: Sorting on a PRAM – Maximal Independent sets. (4)

NUMBER THEORETIC ALGORITHMS:, Polynomial roots and factoring, primality testing. (3)

DERANDOMIZATION: The method of Conditional Probabilities – Derandomizing max-cut algorithm – Constructing pairwise independent values modulo a prime - Pairwise independent – large cut. (4)

TUTORIAL PRACTICE:

1. Implementation of randomized quick sort and solve real time problems using it.

2. Find solution for s-t min-cut problem adapting min cut algorithm.
3. Implementation of randomized selection and problems related to it.
4. Implementation of treap data structure.
5. Problems using randomized hash table.
6. Implement the shortest path and fast min-cut algorithms.
7. Implementation of randomized primality testing.
8. Implement the K-server on-line algorithms.

Total: L:45+TP:30 = 75

TEXT BOOKS:

1. Motwani R and Raghavan P,"Randomized Algorithms", Cambridge University Press, 2010.
2. Michael Mitzenmacher and Eli Upfal, "Probability & Computing: Randomized Algorithms and Probabilistic Analysis", Cambridge University Press, 2009.

15XDO4 PRINCIPLES OF MANAGEMENT AND BEHAVIOURAL SCIENCES

3 2 0 4

PRINCIPLES OF MANAGEMENT: Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. Organizational Environment – Social, Economic, Technological and Political. Corporate Social Responsibility - Case discussion.

(5)

INDUSTRIAL AND BUSINESS ORGANIZATION: Growth of Industries (Small Scale, Medium Scale and Large Scale Industries). Forms of Business Organizations. Resource Management – Internal and External Sources

(8)

ORGANIZATIONAL BEHAVIOUR: Significance of OB, Impact of culture on organization. Role of leadership and leadership styles. Personality and Motivational Theories. Attitudes, Values and Perceptions at work - Case discussion

(8)

GROUP BEHAVIOUR: Group dynamics, Group formation and development, group structure and group cohesiveness. Informal organization – Sociometry – Interaction analysis – Exercises

(8)

GLOBALISATION: Issues for global competitiveness, proactive and reactive forces of globalization. Cross cultural management – Management of work force diversity.

(8)

HUMAN RESOURCE MANAGEMENT: Objectives and Functions, Selection and Placement, Training and Development – Conflict management – Stress management - Human resource management in global environment - Human resource information system(HRIS) - Case discussion.

(8)

TUTORIAL PRACTICE:
Case studies

Total L:45+T:30=75

TEXT BOOKS:

1. Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management", Tata McGraw Hill, 2014.
2. Mamoria C B, "Personnel Management", Sultan Chand & Sons, 2005.

REFERENCES:

1. John W Newstrom and Keith Davis, "Organizational Behavior", Tata McGraw Hill, 2010.
2. Stephen P Robbins, "Organisational behavior", Prentice Hall, 2010.
3. Khanna O P, "Industrial Engineering & Management", Dhanpat Rai Publications, 2010.

15XDO5 ENTREPRENEURSHIP

3 2 0 4

INTRODUCTION TO ENTREPRENEURSHIP: Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance or Entrepreneurship. Seminar in R5 & R6. (5)

CREATIVITY AND INNOVATION: The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. (6)

DEVELOPING AN EFFECTIVE BUSINESS MODEL: The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. (5)

APPRAISAL OF PROJECTS: Importance of Evaluating Various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques. (8)

FORMS OF BUSINESS ORGANIZATION: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. (4)

FINANCING THE NEW VENTURE: Determining Financial Needs – Sources of Financing – Equity and Debt Funding – Case studies in Evaluating Financial Performance. **(**8)

THE MARKETING FUNCTION: Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process**.** (5)

INTELLECTUAL PROPERTY PROTECTION AND ETH ICS: Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges. (4)

TUTORIAL PRACTICE:
Case studies

Total L:45+T:30=75

TEXT BOOKS:

1. Donald F.Kuratko and Richard M.Hodgetts, “Entrepreneurship”, South-Western.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2010.

REFERENCES:

1. S.L.Gupta, Arun Mittal, Entrepreneurship Development, International Book House, 2012.
2. G. S. Sudha, Management and Entrepreneurship Development, Indus Valley Publication, 2009.
3. V. Badi, N. V. Badi , Business Ethics, R, Vrinda Publication (P) Ltd.,, 2012.
4. Prasanna Chandra Projects- Planning, Analysis, Financing, Implementation and review, TATA McGraw Hill, 2012.

15XDO6 INFORMATION THEORY AND ERROR CONTROL CODING

3 2 0 4

MEMORYLESS FINITE SCHEMES : Self information measure – Entropy function – Conditional entropies – Characterisitics of entropy function – Derivation of the noise characteristics of a channel – Mutual information – Redundancy – Efficiency and channel capacity – Capacities of channels with symmetric noise structure. (10)

CONTINUOUS CHANNELS: Definitions of different entropies – Mutual information – Maximization of the entropy of a continuous random variable – Entropy maximization problems – channel capacity under the influence of additive white Gaussian noise – parallel Gaussian channel. (7)

ELEMENTS OF ENCODING : Source coding techniques – Necessary and sufficient conditions for noise less coding – Fundamental theorem of discrete noise-less coding – Fundamental theorem of discrete coding in presence of noise.

(8)

ERROR CONTROL CODING – Need for error control coding – Linear block codes – Optimum soft decision decoding of linear block codes – Hard decision decoding – Polynomial representation of codes – Cyclic codes – Convolutional codes – viterbi decoding algorithm – Other decoding methods of convolutional codes – Galois fields – BCH Codes – Reed Solomon codes – Berlecamp Algorithm – Interleaving and concatenated codes – Turbo codes – Low density parity check codes. (10)

ITERATIVE DECODING – Serial concatenation using inner block codes – serial concatenation using inner convolutional codes – product codes – generalized array codes – applications of multi stage coding – The BCJR algorithm – use of extrinsic information – recursive systematic convolutional codes – MAP decoding of RSC codes – Interleaving and Trellis termination – The soft output Viterbi algorithm – Galleger codes – Serial concatenation with iterative decoding – Performance and complexity issues – application to mobile communication. (10)

TUTORIAL PRACTICE:
Case studies

Total L:45+T:30=75

TEXT BOOKS:
7. Reza F M, " An introduction to Information theory", McGraw Hill, 2012.
8. Joy A Thomas and Cover M, " Elements of Information theory", John Wiley, 2006.
9. Peter Sweeney, "Error Control coding from theory to practice", John Wiley, 2002.

REFERENCES:
1. Salvatore Gravano, " Introduction to Error Control codes", Oxford University Press, 2001.
2. Viterbi A and Omura J K, " Principles of Digital Communication and Coding", McGraw Hill, 2009.

15XDO7 COMPUTATIONAL COMPLEXITY THEORY

3 2 0 4

INTRODUCTION: The computational model - Modeling computation and efficiency - Review of Turing machines – Universal Turing machines – Uncomputable functions – Deterministic time and the class P (5)

COMPLEXITY CLASSES - P, NP, NP Complete , NP-Hard - P vs NP – NP completeness – Relation between NP and NP completeness – The cook Levin theorem – The web of reductions – Decision vs Search – coNP, EXP and NEXP (6)

DIAGONALIZATION – Time hierarchy theorem – Space hierarchy theore – non deterministic time hierarchy theorem – Oracle machines - Space complexity – Configuration graphs – Some space complexity classes – PSPACE completeness – NL Completeness. (8)

POLYNOMIAL HIERARCHY AND ALTERNATIONS – The classes $\sum_2^p$ and π_2^p – The polynomial hierarchy – Alternating turing Machines – Time versus alternations – Defining the hierarchy via oracle machines (8)

CIRCUITS – Boolean circuits – Karp Lipton theorem – Circuit lower bounds (5)

RANDOMIZED COMPUTATION : Probabilistic Turing Machines (PTM) –Examples - RP (Randomized Polynomial) , BPP (Bounded Error probabilistic polynomial) ,Complement Randomized Polynomial (Co-RP) – Probabilistic Polynomial (PP) – Randomized logarithmic space polynomial time (RL) – Related problems. (6)

COUNTING PROBLEMS – Counting classes – Complexity of counting problems – An approximate comparison procedure - Constructing A-Comp - Non-Uniform Classes – Oracles – Relativization (5)

APPLICATIONS - Randomized decision tree – Pseudo random number generators (2)

TUTORIAL PRACTICE:
Case studies

Total L:45+T:30=75

TEXT BOOKS:
1. Sanjeev Arora, Boaz Barak, "Computational Complexity : A modern approach", Cambridge University Press, 2009.
2. Goldreich, "Computational Complexity: A Conceptual Perspective", CUP 2008.

REFERENCES:
1. Michael Sipser, "Introduction to the Theory of Computation", Cengage learning, 2005.
2. Luca Trevisan, "Lecture Notes on Computational Complexity", 2004.

15XD08 ACCOUNTING AND FINANCIAL MANAGEMENT

3 **2 0 4**

COST ACCOUNTING: Cost classification - significance of overhead Cost - Preparation of Cost sheet - Concept of cost volume profit analysis - Concept of variance - Principles of Job Costing, batch costing and Process costing - Operating Costing - Modern techniques/concepts of Cost Control/ Cost Management. (10)

FINANCIAL ACCOUNTING: Double Entry Book keeping concepts - Journalisation of Business Transactions - Subsidiary Books - Preparation of Profit and Loss Account and Balance sheet from Trial balance - Simple problems - Methods of depreciation. (10)

FINANCIAL RATIO ANALYSIS: Uses and Nature - preparation of Liquidity Ratios - coverage Ratios and profitability Ratios from profit & Loss Account and Balance sheet - common size Income statement and common size Balance sheet. (10)

GOALS AND FUNCTIONS OF FINANCIAL MANAGEMENT: Finance function - Importance of Corporation finance - objectives of Financial Management - organization of the finance function - concept of time value of money. (5)

PRINCIPLES OF CAPTIAL BUDGETING: Kinds of capital Budgeting Decisions - Evaluation of proposals from the given cash inflows - Net present value versus Internal rate of return method problems. (5)

WORKING CAPITAL MANAGEMENT: Definition and importance of working capital - factors affecting working capital - Inventory management - simple problems - Receivables Management - cash Budget Preparation - Estimate of overall working capital requirements - Various sources of financing . (5)

TUTORIAL PRACTICE:
Case studies

Total L:45+T:30=75

TEXT BOOKS :
1. Khan M Y, Jain P K, "Cost Accounting and Financial Management", Tata McGraw Hill, 2008.
2. Gupta R L, Radhaswamy M, "Advanced Accountancy", Sultan Chand & Sons, 2009.

REFERENCES :
1. Sharma R K and Shashi K Gupta, "Management Accounting - Principles and Practice", Kalyani Publishers, 2011.
2. Kuchal S C, "Financial Management", Chaitanya Publishing House, 2006.

15XDO9 WIRELESS NETWORKS

3 2 0 4

WIRELESS FUNDAMENTALS: Introduction to cellular networks,-wireless local area networks- Spectrum allocations – Radio propagation models-Narrowband digital modulation and wireless fading environments. – Modern Communications Systems – MAC – SDMA – TDMA – FDMA - CDMA - Cellular and Ad-hoc-Concepts. (7)

WLAN TECHNOLOGIES: wireless network architectures – 802.11 PHYs – 802.11 MAC – WPA and 802.11i: Security – 802.11e: MAC Enhancements for Quality of Service – Related Wireless Standards (Hyperlan, HomeRF, Bluetooth, Zigbee, Wireless USB)- WiFi and Wi MAX Standards. (8)

AD HOC AND SENSOR NETWORKS: Ad hoc Network- Characteristics- Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols - Routing in intermittently connected mobile networks. Wireless Sensor networks- Classification, MAC and Routing Protocols. (8)

MOBILE NETWORK AND TRANSPORT LAYERS: Mobile IP – Dynamic Host Configuration Protocol-Mobile Ad Hoc Routing Protocols–Multicast routing-TCP over Wireless Networks – Indirect TCP – Snooping TCP – MobileTCP – Fast Retransmit / Fast Recovery – Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP- TCP over 2.5 / 3G wireless Networks . (8)

WIRELESS PANs MANs – Physical and MAC layer details, Wireless PANs – Architecture of Bluetooth Systems, Physical and MAC layer details, Standards- WLAN deployment issues- Interference – Resource Allocation (6)

FUTURE TRENDS: Emerging WLAN Related Technologies – 802.11 Trends – Cellular – 802.16 – 802.20 – 802.22 – UWB, Cognitive Radios, RFID – 4G and Data Communications Convergence. (8)

TUTORIAL PRACTICE:

1. Study of NS-2 simulator.
2. Simulation of a IEEE 802.11 LAN under various conditions using NS-2 simulator.
3. Simulation of a priority MAC protocol using NS-2 simulator.
4. Simulation of different routing protocols using simulators.

5. Simulation of TCP over error-prone wireless network using NS-2 simulator.
6. Development of Mobile application using blue tooth.

Total: L:45+T:30 = 75

TEXT BOOKS:

1. Gary. S. Rogers and John Edwards, “An Introduction to Wireless Technology”, Pearson Education, 2012.
2. SivaRam Murthy C and B.S Manoj, “Ad hoc Wireless Networks Architecture and Protocols”, Pearson Education, 2005.
3. KavehPahlavan, Prashant K. Krishnamurthy, “Principles of wireless networks : A unified approach”, John Wiley, 2011.

REFERENCES:

1. William Stallings, “Wireless Communication and Networks”, Pearson Education, 2009.
2. Dharma Prakash Agrawal and Qing-An Zeng, “Introduction to Wireless and Mobile Systems”, Thomson Press, 2007.
3. Feng Zhao and Leonidas Guibas, “Wireless Sensor Networks-An Information Processing Approach”, Elsevier, 2004.
4. Clint Smith, P.E. and Daniel Collins, “3G Wireless Networks”, Tata McGraw Hill, 2007.
5. Ivan stojmenovic, “Handbook of wireless networks and mobile computing”, John wiley, 2006.
6. SavoGlisic, “ Advanced wireless Communications 4G Technologies”, Wiley Publications, 2006.