APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SYLLABUS

MASTER OF COMPUTER APPLICATIONS (REGULAR)

Semesters I to IV

	Master of Computer Applications (Regular)	**Hours / week**			**IA Marks**	**ESE Marks**	**Total Marks**	**Credits**	**Exam Slot**
Course No	**Course (Semester 1)**	**L**	**T**	**P**					
RLMCA101	Problem Solving and Computer Programming	3	1		40	60	100	4	A
RLMCA103	Discrete Mathematics	3	1	-	40	60	100	4	B
RLMCA105	Applied Probability and Statistics	3	1	-	40	60	100	4	C
RLMCA107	Principles of Management	3	1	-	40	60	100	4	D
RLMCA109	Digital Fundamentals	3	1	-	40	60	100	4	E
RLMCA131	Programming Lab	-		4	100		100	1	S
RLMCA133	Applied Statistics Lab	-		4	100		100	1	T
		15	**5**	**8**	**400**	**300**	**700**	**22**	

	Master of Computer Applications (Regular)	**Hours / week**			**IA Marks**	**ESE Marks**	**Total Marks**	**Credits**	**Exam Slot**
Course No	**Course (Semester 2)**	**L**	**T**	**P**					
RLMCA102	Object Oriented Programming	3	1	-	40	60	100	4	A
RLMCA104	Data Structures	3	1	-	40	60	100	4	B
RLMCA106	Operating Systems	3	1	-	40	60	100	4	C
RLMCA108	Operations Research	3	1	-	40	60	100	4	D
RLMCA112	Computer Organization and Architecture	3	1	-	40	60	100	4	E
RLMCA132	Object Oriented Programming Lab	-		4	100		100	1	S
RLMCA134	Data Structures Lab	-		4	100		100	1	T
		15	**5**	**8**	**400**	**300**	**700**	**22**	

	Master of Computer Applications (Regular)	**Hours / week**			**IA Marks**	**ESE Marks**	**Total Marks**	**Credits**	**Exam Slot**
Course No	**Course (Semester 3)**	**L**	**T**	**P**					
RLMCA201	Computer Networks	3	1	-	40	60	100	4	A
RLMCA203	Software Engineering	3	1	-	40	60	100	4	B
RLMCA205	Database Management Systems	3	1	-	40	60	100	4	C
RLMCA207	Design and Analysis of Algorithms	3	1	-	40	60	100	4	D
RLMCA209	Web Programming	3	1	-	40	60	100	4	E
RLMCA231	Database Lab	-		4	100		100	1	S
RLMCA233	Web Programming Lab	-		4	100		100	1	T
		15	**5**	**8**	**400**	**300**	**700**	**22**	

	Master of Computer Applications (Regular)	Hours / week			IA Marks	ESE Marks	Total Marks	Credits	Exam Slot
Course No	**Course (Semester 4)**	**L**	**T**	**P**					
RLMCA202	Application Development and Maintenance	3	1	-	40	60	100	4	A
RLMCA204	Big Data Technologies	3	1	-	40	60	100	4	B
RLMCA206	Mobile Computing	3	1	-	40	60	100	4	C
RLMCA208	Introduction to Machine Learning	3	1	-	40	60	100	4	D
RLMCA2 - -	Elective I	3	1	-	40	60	100	4	E
RLMCA232	System Design Lab	-		4	100		100	1	S
RLMCA234	Mobile Application Development Lab	-		4	100		100	1	T
		15	**5**	**8**	**400**	**300**	**700**	**22**	

ELECTIVE-I	
RLMCA262	Functional Programming
RLMCA264	Design and Analysis of Parallel Algorithms
RLMCA266	Advanced Database Systems
RLMCA268	Computational Science
RLMCA272	Advanced Java Programming
RLMCA274	Business Intelligence and its Applications

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA101	Problem Solving & Computer Programming	3-1-0-4	2016

Course Objectives

- To introduce a basic step towards Software Development
- To learn the C language
- To develop the programming skill, using C language

Syllabus

Program Development, Structured Programming, Introduction to C, Operators and Expressions, Data Input and Output, Control Statements, Functions, Program Structure, Arrays, Strings, Structure and Union, Pointers, File Handling, Low Level Programming, Additional Features of C.

Expected Outcome

The students will be able to

i. Solve problems systematically and to implement the solution in C language.
ii. Develop programming skills
iii. Develop the knowledge of how to learn a programming language, which will help in learning other Computer Languages in the curriculum

References

1. A. N. Kamthane, "Programming in C", Pearson Education, 3rd Edition (2015)
2. Brian W Kernighan & Dennis Ritchie, "The C programming language", 2nd Edition, Prentice Hall (2015)
3. Byron S Gottfried, "Programming with C", Schaum's outline, 3rd Edition, McGraw Hill
4. K N King, "C Programming: A Modern Approach", W. W. Norton & Co, 2nd Edition (1996)
5. Reema. Thareja, "Programming in C", Oxford University Press, 2nd Edition (2016)
6. Stephen Prata K, "C Primer Plus", Pearson Education, 5th Edition (2013)

Suggested MOOC

1. https://www.edx.org/course/programming-basics-iitbombayx-cs101-1x
2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-087-practical-programming-in-c-january-iap-2010/

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introductory concepts: Program Development - Algorithm, Flowchart, Pseudocode, Structured Programming – Program Design, Modular Programming, Structuring of Control Flow. Introduction to C Language: The C character set, identifiers and keywords, data types, constants, variables and arrays, declarations, expressions, statements, Symbolic Constants, Library Functions.	8	10%
II	Operators and expressions: Arithmetic operators, Unary operators, Relational and Logical operators, Assignment operators, Conditional operator. Data input and output: Single character input, single character output, scanf, printf, puts, gets, functions, interactive programming.	8	10%
FIRST INTERNAL EXAMINATION			

III	Control statements: Branching - if else statement, Looping, nested control structure, switch statement, break statement, continue statement, comma operator, go to statement. Functions: Overview, function prototypes, passing arguments to a function, recursion. Program structure: Storage classes, automatic variables, external variables, static variables, multi file program, Library files, Header files.	12	20%
IV	Arrays: Defining an array, passing array to functions, multidimensional arrays. Strings: Defining a string, Null Character, Initialization, Reading, writing and processing a string. Structures and unions: Defining a structure, processing a structure, user defined data types, structure and pointers*, passing structure to function*, self-referential structures*, union.	9	20%
V	Pointers: Fundamentals, Declaration, Passing pointers to a function, pointers and one dimensional arrays, dynamic memory allocation, operations on pointers, pointers and multidimensional arrays, array of pointers, Array of strings, pointers and variable length arguments list, passing functions to other functions.	9	20%
SECOND INTERNAL EXAMINATION			
VI	File Handling: opening and closing a data file, reading and writing a data file, processing a data file, unformatted data file, Random accessing. Low level programming: Register variable, bitwise operations, bit fields. Additional features of C: Enumeration, Command line parameters, Macros, C Preprocessor.	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

*****_May be covered after Module V_

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA103	**Discrete Mathematics**	**3-1-0-4**	**2016**

Course Objectives

- To give an understanding of important mathematical concepts together with a sense of why these concepts are important for computer science.
- To provide a foundation of set theory, Congruences, Counting techniques and Graph theory

Syllabus

Logic, Sets, Relations, Functions, Division algorithm, Congruences, Counting techniques, Advanced Counting Techniques, Graphs and Graph Models.

Expected Outcome

- The students will be capable of using the mathematical methods and algorithms learned for analyzing and solving problems related to Computer Science.

References

1. C. Liu, "Elements of Discrete Mathematics: A Computer Oriented Approach", McGraw-Hill, 4th Edition (2012).
2. David M. Burton, "Elementary Number Theory", McGraw-Hill, 7th Edition (2012).
3. Jean-Paul Tremblay , "Discrete Mathematical Structures with applications to Computer science", ", McGraw-Hill, 1st Edition (2001).
4. Joe R. Mott, Abraham Kandel, Theodore P Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", Pearson Education, 2nd Edition (2015)
5. Kenneth H. Rosen , "Discrete mathematics and its applications", McGraw-Hill, (7th Edition), (Smartbook available).
6. Marty Lewinter, Jeanine Meyer, "Elementary Number Theory with Programming", Wiley- Blackwell (2015).
7. R.K Bisht and H.S Dhami, "Discrete Mathematics ", Oxford University Press, 1st Edition (2015)
8. Ralph P Grimaldi, "Discrete and Computational Mathematics: An applied introduction", Pearson Education, 5th Edition, (2007).
9. Swapan Kumar Chakroborthy ,Bikash Kanthi Sarkar, "Discrete Mathematics ", Oxford University Press (2010).
10. Y.N. Singh, "Discrete Mathematical Structures ", Wiley India Pvt. Ltd (2010)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Basic Structures** - Sets, Set Operations, Relations, Classification of relations, Equivalence Relations, Closures of Relations, Matrix Representation of Relations, Partial Ordering, n-ary Relations, Functions. **Relevant Portions from Text 2 primarily and Text 1 for additional reference**	9	15%
II	Division Algorithm, GCD, Primes, Euclidean Algorithm, Congruences, Properties of Congruences, Solutions of Linear Congruences, Chinese Remainder Theorem. **Text 3: 2.2, 2.3, 2.4, 4.2, 4.4 and Text 1 for additional reference**	9	15%

FIRST INTERNAL EXAMINATION			
III	Permutations, Circular Permutations, Combinations, Combinations with repetition, Binomial Theorem, Pigeonhole Principle, Principle of Inclusion and exclusion **Text 4: 1.2, 1.3, 5.5, 8.1 and Text 1 for additional reference**	9	15%
IV	Generalization of Principle of Inclusion and Exclusion, First Order Linear Recurrence Relation, Second Order Linear homogeneous Recurrence Relations with Constant coefficients, Non Homogeneous Recurrence Relation, Divide-and-Conquer Algorithms and Recurrence Relations **Text 4: 8.3, 10.1, 10.2, 10.3 and Text 1 for additional reference**	9	15%
V	Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring Graphs, Directed Graph, Multigraph, Connected graph, Graph Isomorphism, Euler circuit and trail, Fleury's Algorithm, Planar and NonPlanar Graphs, Bipartite Graph, Kuratowski's Theorem(without proof), Cut-set, Hamiton path and cycle. **Text 4: 11.1, 11.2, 11.3, 11.4, 11.5 and Text 1 for additional reference (proof of theorems 11.6, 11.8 and 11.9 are not required)**	10	20%
SECOND INTERNAL EXAMINATION			
VI	**Logic** - Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of inference. **Text 1**	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA105	**Applied Probability and Statistics**	**3-1-0-4**	**2016**

Course Objectives

- To introduce probability theory and statistics from a computational perspective.
- To prepare students for learning advanced courses like machine learning and big data
- To do simulations using software packages like R, Excel, SPSS, PSPP or any other suitable software.

Syllabus

Introduction to Statistics, Concepts of probability theory, Probability Distributions, Mathematical expectations, Inferential statistics, Hypothesis testing

Expected Outcome

- The students will get an overall view of concepts in probability and statistics.

References

1. David S. Moore and George P. McCabe, "Introduction to practice of statistics", W.H. Freeman & Company, 5th Edition (2005).
2. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Wiley India, 5th Edition (2012).
3. G. Jay Kerns, "Introduction to Probability and Statistics Using R", Chapman & Hall (2010)
4. Gupta S.C and Kapoor V .K, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons (2014).
   https://cran.r-project.org/web/packages/IPSUR/vignettes/IPSUR.pdf
5. Mendenhall, Beaver, Beaver, Introduction to Probability & Statistics, Cengage Learning, 14th Edition (2014)
6. Richard A .Johnson, Miller and Freunds, "Probability and Statistics for Engineers", Prentice Hall of India, 8th Edition (2015).

Web Resources

1. Probability and statistics EBook
   http://wiki.stat.ucla.edu/socr/index.php/EBook
2. https://www.openintro.org/stat/textbook.php
3. http://www.math.uah.edu/stat/index.html
4. Statistics Online Computational Resource
   http://www.socr.ucla.edu/

Suggested MOOCs

1. https://www.edx.org/course/explore-statistics-r-kix-kiexplorx-0
2. https://www.coursera.org/course/probability
3. http://www.math.uah.edu/stat/

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Statistics and Data, Types of Data - Quantitative Data, Qualitative Data, Logical Data, Multivariate Data etc. Features of Data distributions - Center, Spread, Shape, Symmetry, Skewness and Kurtosis (Definitions only), Stem and Leaf Diagrams, Frequency Distributions and Histogram, Measures of Center - Mean, Median, Mode, Measures of Spread - Range, Variance, Standard Deviation, Interquartile range, Measures of Relative Position: Quartiles, Percentiles.	8	15%

II	Introduction to Probability Theory - Classical empirical and subjective probabilities, Random Experiments, Sample Spaces & Events, Axioms of Probability, Addition Rules, Conditional Probability, Multiplication and Total Probability Rules, Independence, Bayes's Theorem (without proof).	8	15%
FIRST INTERNAL EXAMINATION			
III	Random Variables, Discrete Random Variables, Probability Distributions and Probability Mass Functions, Mean and Variance of a Discrete Random Variable, Discrete Uniform Distribution - Mean and Variance, Binomial Distribution - Mean and Variance, Geometric Distribution - Mean and Variance, Poisson Distribution - Mean and Variance.	10	20%
IV	Continuous Random Variables, Probability Distributions and Probability Density Functions, Mean and Variance of a Continuous Random Variable, Continuous Uniform Distribution, Mean and Variance, Normal Distribution, Mean and Variance (Proof not required), Standard Normal Distribution, Joint and Marginal Probability Distributions, Conditional Probability Distributions, Independent Random Variables.	10	20%
V	Statistical Inference, Types of sampling and sampling error, Random Sample & Statistic, Sampling Distribution, Central Limit Theorem (Statement Only), Distribution of sample mean and sample variance, t,$\chi^2 \wedge F$distributions (derivation not required), Confidence Interval on the Mean, Confidence Interval on the Variance, Confidence Interval for a Population Proportion, Confidence Interval on the Difference in Means, Confidence Interval on the Ratio of two Variances.	10	20%
SECOND INTERNAL EXAMINATION			
VI	Hypothesis Testing, General Procedure for Hypothesis Tests, Tests on the Mean, Tests on a population Proportion, Tests on the Difference in Means.	8	10%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA107	**Principles of Management**	**3-1-0-4**	**2016**

Course Objectives

- To develop ability to critically analyze and evaluate a variety of management practices.
- To understand and apply a variety of management and organisational theories in practice.
- To be able to mirror existing practices or to generate their own innovative management competencies, required for today's complex and global workplace.

Syllabus

Definition, functions of a management, managerial skills and roles, basics of decision making process. Early contributors and their contributions to the field of management. Planning, Organizing, Staffing and HRD functions, Directing and Controlling form the core content of this course.

Expected Outcome

The students will be able to

i. understand management as a process
ii. critically analyse and evaluate management theories and practices
iii. plan and make decisions for organisations
iv. do staffing and related HRD functions
v. be aware about quality standards
vi. understand the marketing basics

References

1. Gary Dessler, Biju Varkkey, "Human Resourse Management", Pearson Education India, 14th Edition.
2. Harold Koontz and Heinz Weihrich, "Essentials of Management", McGraw Hill Education, 10th Edition (2015).
3. L M Prasad, "Principles of Management", Sultan Chand & Sons, 8th Edition (2010)
4. L M Prasad, "Principles of Management", Sultan Chand & Sons, 8th Edition (2010)
5. Peter F Drucker, "The Practice of Management", Butterworth-Heinemann publication, 2nd Edition (2007)
6. Philip Kotler, "Marketing Management", Pearson Education India, 15th Edition.
7. R N Gupta, "Principles of Management", S. Chand & Company Ltd., (2010)
8. Robbins and Coulter, Management, Pearson Education 13th Edition, 2016,
9. Tripathi, "Principles of Management", McGraw Hill Education, 5th Edition (2012)

Suggested MOOCs

1. Management Functions: http://nptel.ac.in/courses/122108038/
2. Leadership: http://nptel.ac.in/courses/110105033/33

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Introduction to Management**: Basic Managerial Concepts, Levels of management, Managerial Skills, Managerial roles Decision Making- Concept, types of decision, decision making process. Management functions- Planning, Organising, Staffing, Directing and Controlling.	7	15%
II	**Early Contributions in Management**: Management thought - Classical approach, scientific management, contributions of Taylor, Gilbreths, Fayol's 14 principles of management.	10	15%

	Human relation approach - contribution of Elton Mayo Systems approach - organization as an open system and Contingency approach.		
FIRST INTERNAL EXAMINATION			
III	**Planning:** Nature and importance of planning, types of plans - Steps in planning, Levels of planning - The Planning Process - MBO definition and process, SWOT Analysis, importance.	9	15%
IV	**Organising :** Nature of organizing, Departmentation - need and importance, span of control in management, factors affecting span of management. Organisation structure - Formal and informal, Types of organization structure line, line and staff, functional, divisional, project, matrix, free form, virtual. Delegation of authority, Steps in delegation and Principles of delegation	10	15%
V	**Staffing and related HRD Functions:** meaning, nature, staffing process, Job analysis and manpower planning, job description and job specification, Recruitment & selection, selection process, tests and interviews. Training and development - concept and methods, Performance appraisal- concept and methods.	10	20%
SECOND INTERNAL EXAMINATION			
VI	**Directing and Controlling:** Supervision, Motivation - significance, motivational theories - Maslow's need hierarchy. Basic control process - control as a feedback system. Quality engineering, quality control, control chart (basic concepts), Introduction to ISO 9000 and 14000 standards, TQM, Six Sigma concepts, Bench marking, Introduction to marketing, marketing mix, Product Life cycle.	10	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA109	**Digital Fundamentals**	**3-1-0-4**	**2016**

Course Objectives

- To introduce the foundations of computer hardware.
- To introduce digital electronics

Syllabus

Number Systems, Logic Gates and Boolean algebra, Combinational and Sequential circuits, Registers and Counters, Introduction to Computers.

Expected Outcome

The students will

i. get a thorough knowledge of Digital electronics
ii. be able to design simple logic circuits
iii. get an overall idea about single board computers like Arduino®, Raspberry Pi® etc.

References

1. Floyd, "Digital Fundamentals", Pearson Education, 10th Edition (2011).
2. Mano, "Digital Design : With an Introduction to Verilog HDL", Pearson Education, 5th Edition (2014)
3. Morris Mano, "Digital logic and Computer design", Pearson Education, 1st Edition (2004).
4. Morris Mano, "Logic and Computer Design Fundamentals",4th Edition (2013).
5. Nisan & Schocken, "The Elements of Computing Systems", MIT Press (2008)

Suggested MOOC

https://www.coursera.org/learn/build-a-computer

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction of number systems - Binary, Decimal and Hexadecimal- Conversions. Arithmetic operations on binary numbers, Representation of signed numbers - 1's compliment and 2s compliment - Representation of floating point numbers - BCD representation	10	15%
II	Logic gates and Boolean algebra - Basic gates - AND, OR, NOT, NAND, NOR, XOR - their symbols and truth tables. Boolean algebra - Basic laws and theorems - Boolean functions - truth table - minimization of Boolean function using K map method, Realization using logic gates and universal gates.	10	20%
FIRST INTERNAL EXAMINATION			
III	Combinational Circuits - Basic ideas about combinational circuits - Half adder - Full Adder, Parallel binary adder, Subtracter, Decoders, Encoders, Multiplexers, Demultiplexers, Parity bit generator.	11	20%
IV	Sequential circuit - Basic ideas about sequential logic, Clocking, Flip flops RS, JK D and T flip flops, edge triggering , level triggering.	8	15%
V	Registers and counters - Serial in serial out, Serial in Parallel out, Parallel in serial out, Parallel in Parallel out registers, Bidirectional shift registers, Synchronous and asynchronous counters, UP/DOWN counters, Modulo-N ; Counters.	8	20%
SECOND INTERNAL EXAMINATION			

VI	Introduction of Computers - Overview of PC architecture - Basic components of a computer - PC hardware – Motherboards - Expansion boards -Specifications of Personal computers. Introduction to single board computers - Arduino - architecture - Introduction to Arduino environment. Writing simple programs for blinking an LED, Input from an external switch, fading an LED, serial monitor and debugging. Raspberry pi : Introduction to Raspberry - Architecture, versions, Software installation and configuration. ***Note : The last module should be taught in a tutorial session. Students should be shown actual devices. A practical assignment about configuring a PC / arduino or raspberry pi should be given.***	9	10%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA131	**Programming Lab**	**0-0-4-1**	**2016**

Course Objectives

- Companion course of RLMCA101

Syllabus

Companion course of RLMCA101. Practical aspects of RLMCA101 to be covered in the laboratory Environment.

Expected Outcome

- The students will develop adequate programming skills

References

1. A. N. Kamthane, "Programming in C", Pearson Education, 3rd Edition (2015)
2. Brian W Kernighan & Dennis Ritchie, "The C programming language", 2nd Edition, Prentice Hall (2015)

Course Plan

Ex. No	Exercises/Experiments	Hours
1	Compilation and Executing programs Arithmetic operations Use of Symbolic constants Demonstrating the following gcc options -o, -c, -D, -l, -I, -g, -E Note : ***Algorithm of every program should be written. Properly document the programs using comments. Author name and date, purpose of each variable and constructs like loop and functions should be indicated/ documented.*** ***gcc or an equivalent compiler is assumed***.	50
2	Program to demonstrate the following Branching Nested Branching Looping Selection	
3	Using debugger Important Commands - break, run, next, print, display, help Functions Creating Header file for Function Prototype Compiling and storing Function Definition in Library (archive) file Calling the function Recursion Storage Classes Using register, extern and static	
4	Arrays 1D - Linear Search, Sort 2D - Matrix operations Strings, Structure, Union	
5	Pointers, Dynamic Memory Allocation Structure Pointer Array of Pointers, Ragged Arrays, Function pointer	
6	File Handling Low level programming Macros and Preprocessor	
END SEMESTER EXAM		

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA133	Applied Statistics Lab	0-0-4-1	2016

Course Objectives

- To introduce modern statistical tools
- To prepare students for big data analysis course

Syllabus

Companion course of RLMCA103, Practical aspects of RLMCA103 to be covered in the laboratory Environment

Expected Outcome

- The students will be able to apply statistical methods to real life problems

References

1. Dr. Mark Gardener, "Beginning R: The Statistical Programming Language", Wiley (2013)
2. Gnuu PSPP Team, "GNU PSPP Reference Manual", Samurai Media Limited (2015)
3. Jared P Lander, "R for everyone", Pearson education, 1st Edition (2014).

Web Resources

1. PSPP www.gnu.org/s/**pspp**/manual/**pspp**.pdf
2. Simple R http://www.math.csi.cuny.edu/Statistics/R/simpleR/

Suggested MOOCs

1. https://www.edx.org/course/analyzing-visualizing-data-excel-microsoft-dat206x-1
2. https://www.coursera.org/learn/analytics-excel
3. Instructors can also use the simulations material at http://wiki.stat.ucla.edu/socr/index.php/SOCR_EduMaterials

Course Plan

Ex. No	Exercises/Experiments
1	Visualizing Data Tables, charts and plots. Visualising Measures of Central Tendency, Variation, and Shape. Box plots, Pareto diagrams. How to find the mean median standard deviation and quantiles of a set of observations. Students may experiment with real as well as artificial data sets.
2	Probability Distributions. Set operations, simulation of various properties. Bays' rule. Generate and Visualize Discrete and continuous distributions using the statistical environment. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions. Students are expected to generate artificial data using the chosen statistical environment and explore various distribution and its properties. Various parameter changes may be studied.
3	Random samples. How to generate random numbers. Study how to select a random sample with replacement from normal and uniform distribution. Students can use the built in functions to explore random sample selection.

4	Study of binomial distribution. Plots of density and distribution functions. Normal approximation to the Binomial distribution. Central limit theorem
5	Study of confidence intervals. How to compute confidence intervals for the mean when the standard deviation is known.
6	How to perform tests of hypotheses about the mean when the variance is known. How to compute the p-value. Explore the connection between the critical region, the test statistic, and the p-value.
7	How to find quartiles of the t-distribution. How to perform a significance test for testing the mean of a population with unknown standard deviation.
8	Compare populations means from two Normal distributions with unknown variance Tests of Hypotheses for One Proportion Tests of Hypotheses for Comparing Two Proportions
9	How to calculate the correlation between two variables. How to make scatter plots. Use the scatterplot to investigate the relationship between two variables
10	Find the least-squares regression line. How to calculate and plot the residuals
	Note : This laboratory is to be conducted with a suitable statistical software. The colleges can choose the statistical software. Some of the suggested environments are R, SciPy, SPSS Excel, or any other statistical analysis software depending on availability. ***The students are expected to write code for statistical applications using the chosen environment. The instructor may choose a standard data set and ask the students to work with it.***
END SEMESTER EXAM	

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA102	Object Oriented Programming	3-1-0-4	2016

Course Objectives

- To understand the concepts of object-oriented programming paradigms and develop skills in these paradigms using Java.
- To provide an overview of characteristics of Java Applets, Exceptions, Multithreading, Streams, Networking etc

Syllabus

Introduction to Object Oriented concepts - Java Basics - Arrays and Strings -Inheritance – Polymorphism – Interface – Packages - Exception Handling -Multithreaded Programming – Streams-Applets –Networking.

Expected Outcome

The students will

i. Design the classes needed, given a problem specification.
ii. Implement the designed classes using the object oriented programming language.
iii. Learn how to test, verify, and debug object-oriented programs and create programs using object oriented principles.

References

1. C. Thomas Wu, "An introduction to Object-oriented programming with Java", Fourth Edition, Tata McGraw-Hill Publishing company Ltd.
2. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", Eighth Edition, Sun Microsystems Press.
3. Herbert Schildt, "Java The Complete Reference", Seventh Edition, Tata McGraw-Hill Edition
4. K. Arnold and J. Gosling, "The JAVA programming language", Third edition, Pearson Education.
5. Paul Deitel and Harvey Deitel, "Java, How to Program", Tenth Edition, Pearson Education
6. Rohit Khurana, "Programming with Java", Vikas Publishing, 2014.
7. Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education.
8. Y. Daniel Liang, "Introduction to Java programming", Seventh Edition, Pearson Education.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Need for OOP paradigm, Procedural approach vs. Object-Oriented approach. Object Oriented concepts Java Basics: History of Java, Java features, data types, variables, operators, expressions, control statements, type conversion and casting, Concepts of - classes, objects, constructors, Access Specifiers (public, private, protected, friendly), Access Modifiers (static, final, abstract, native, synchronized), overloading methods, recursion, nested and inner classes	9	20%
II	Inheritance: Generalizations vs. Specialization, Inheriting data members and methods, Single and Multilevel inheritance, use of super and this keywords. Polymorphism- method overriding, dynamic method dispatch, abstract and final classes	10	20%
FIRST INTERNAL EXAMINATION			

III	Arrays and Strings: One dimensional arrays, Multidimensional arrays, exploring String class and methods, String Buffer class. Interface: creation and implementation of an Interface. Packages - creating and accessing a package, importing packages, creating user defined packages	8	15%
IV	Exception Handling: benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built-in exceptions, creating own exception sub classes. Multithreaded Programming: thread life cycle, creating threads, thread priorities, synchronizing threads, Inter Thread Communication.	9	15%
V	Exploring Java I/O, Streams, Byte Streams, Character Streams, Random Access Files, Object Streams.	10	15%
SECOND INTERNAL EXAMINATION			
VI	Applets – Applets and Applications, life cycle of an applet, passing parameters to an applet, HTML tags. Working with Graphics, Colors. Networking: client-server model, Sockets, Inlet Address, TCP sockets – Server Socket and Socket classes, UDP Sockets – Datagram Socket, Datagram Packets.	10	15%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA104	**Data Structures**	**3-1-0-4**	**2016**

Course Objectives

- To provide an insight into data structures such as arrays linked lists, stacks, queues, trees and graphs.
- To provide an understanding of searching and sorting methods.

Syllabus

Data structures: Definitions, Concept and Overview of data structures - Analysis of Algorithm- Asymptotic Complexity of an algorithm.

Arrays, Operations on Arrays, Applications - Linked List, Applications of Linked Lists, Stacks and Queues: Stack Operations, Applications of Stacks, Queues - Operations on Queues, Different Types of Queues, Applications of Queues - Trees, Binary Trees, Traversals, BST, Introduction to AVL trees.

Graphs: Traversals, Minimum Spanning Trees and shortest path algorithms

Internal and External sorting techniques – selection, bubble, insertion, merge sorting, partition exchange sorting, heap sort, Counting Sort, Searching - External sorting – sorting with disks, sorting with tapes

Expected Outcome

- The students will be able to choose appropriate data structure for solving problems considering resource constraints such as time and space.

References

1. A N Kamthane , "Introduction to Data Structures in C", Pearson Education (2005)
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman "Data structures and Algorithms", Fourth Edition, Pearson Education (2009)
3. G A V Pai , "Data Structures and Algorithms: Concepts, Techniques and Applications", 2nd Edition, Tata McGraw-Hill (2008)
4. J. P. Tremblay , P. G. Sorenson, "An Introduction to Data Structures with applications", 2nd Edn, McGraw Hill, Inc. New York, NY, USA.
5. Samanta, "Classic Data Structures", 2nd Edition, PHI.
6. Seymour Lipschutz, "Data Structures", 6th Edition, 9th Reprint 2008, Tata McGraw-Hill
7. Thomas H. Corman, Charles E. Leiserson and Ronald L. Rivest., "Introduction to Algorithms", 3rd Edition, Prentice Hall of India.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Data structures: Definitions, Overview of data structures- Analysis of Algorithm-Asymptotic Complexity of an algorithm. Arrays: Definition, Terminology, One dimensional Array, Two dimensional array, Multidimensional array, Representation of Arrays in Memory, Operations on Arrays, Applications of Arrays, Sparse Matrices Manipulation.	7	10%
II	Stack-Introduction, Representation of a Stack, Operations on Stacks, Applications of Stacks - Evaluation of Arithmetic expressions – Recursion and Iteration	9	15%
FIRST INTERNAL EXAMINATION			

III	Queues-Introduction, Representation of a queue -Operations on Queues, Circular Queues, Deque, Priority Queue, Applications of Queues.	9	15%
IV	Linked List - Singly Linked Lists, Circular Linked Lists, Doubly Linked Lists - Applications of Linked Lists- Polynomial Representation-Linked stacks and Queues.	10	20%
V	Trees, Binary Trees, Representation and Traversals, BST and operations –Introduction to AVL trees. Graphs: Definitions and Basic Terminologies, Representations of Graphs, Traversals, Minimum Spanning Tree and shortest path algorithms	10	20%
SECOND INTERNAL EXAMINATION			
VI	Internal sorting – selection, bubble, insertion, merge sorting, and partition exchange sorting, heap sort, Counting Sort. Time Complexities- comparisons. Searching – linear search, binary search.	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA106	**Operating Systems**	**3-1-0-4**	**2016**

Course Objectives

- To introduce you to Operating Systems concepts, to make you a more effective programmer.
- To cover important concepts like process management, memory management, I/O management, file system management and protection.
- To design and implement operating systems.

Syllabus

Introduction to Operating Systems – Evolution- OS structure- Operating system services – Process management – Threads - Inter process communication- Process Co-ordination- Dead locks – Memory management- Virtual memory concepts- Storage management- Protection – Secondary storage structure – disk scheduling.

Expected Outcome

- The students will understand Operating System concepts and design Operating Systems

References

1. A. Silberchatz et.al., "Operating System Concepts", 9th Edition Wiley (2015)
2. Andrew S.Tanenbaum , Albert S.Woodhull, "The Minix Book- Operating Systems Design and Implementation", 3rd Edition Pearson(2016).
3. D. M. Dhamdhare, "Operating System, A Concept based approach", 2nd Ed, Tata McGraw-Hill
4. Deitel. H.M., "Operating system principles", 3rd Ed, Pearson.
5. SibsankarHaldar ,Alex a Aravind, "Operating Systems", Pearson Education India, Second impression.
6. Tanenbaum, " Modern Operating System", Pearson 3rd Edition

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction Basic concepts – user view & system view – Computer System organization - OS structure – batch processing - multiprogramming - time sharing - OS operations. Distributed systems - Multiprocessor system - real time - embedded systems. Operating system services – User OS interface, System calls – types, System programs, OS structure – simple – layered.	7	10%
II	Process management – process concept – states – PCB – threads introduction – process scheduling – queues – schedulers – long, short & medium – context switch. Operations on processes – process creation and termination. Process scheduling – pre-emptive and non-pre-emptive – scheduling criteria – scheduling algorithms – different types - algorithm evaluation - deterministic modelling only. *Programming assignments using fork, execv, thread creation, join etc to be given to introduce students to system calls, process creation concepts, process loading concept on threads.*	9	20%
FIRST INTERNAL EXAMINATION			

III	Inter process communication – shared memory – message passing. Process Co-ordination - Synchronization - the critical section problem – Petersons solution – Synchronization hardware – Semaphores – usage and implementation – the bounded buffer problem. *Programming assignments using pipes and semaphores to be given to introduce students to process communication and synchronization.*	7	15%
IV	Dead locks – system model & characterization – methods for handling deadlocks - prevention - avoidance - bankers algorithm - detection - Recovery from dead lock. Memory management - Preliminaries – address binding – logical and physical address space - Swapping - Contiguous memory allocation – fragmentation - paging – with TLB – protection – hierarchical page table structure – segmentation hardware.	11	20%
V	Virtual memory concepts - demand paging - page replacement – different types – frame allocation – algorithms – thrashing. Secondary storage structure – Overview – disk structure - disk scheduling - FCFS, SST, CSCAN - selecting a disk scheduling algorithm.	11	20%
SECOND INTERNAL EXAMINATION			
VI	Storage management - File concepts – attributes – operations – types – structure – access methods. Directory and disc structure –overview – directory schemes – single level – two level – tree structured – acyclic and general graph directories. File system mounting. Protection – types of access – access control. File system – structure and implementation. Directory implementation – File allocation methods – Free space management using link list only. *Programming assignments using create, open, read, write and close system calls to be given to introduce students to file system calls. Students can be asked to code system programs using the above system calls.*	11	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA108	OPERATIONS RESEARCH	3-1-0-4	2016

Course Objectives

- To introduce Operations research as a tool used to solve decision making problems in a wide range of areas.
- To impart different modeling techniques of real world problems and the various optimization techniques for solving these models.

Syllabus

Linear Programming model and various methods for solving the models- The transportation and assignment problems - Probabilistic models - game theory and queuing theory. Simulation models - the virtual running of a real world problem.

Expected Outcome

The students will be able to

i. Construct a mathematical model of a real world problem which has many alternative solutions which makes the decision maker unable to take a decision.
ii. Learn about various optimization methods that are employed to solve these mathematical models to find a solution which is in the best interest of the decision maker.

References

1. Hamdy A.Taha, "Operations Research-An Introduction", Prentice Hall of India
2. Kanti Swarup, P.K.Gupta and Man Mohan "Operations Research", Sultan Chand (2010).
3. Ravindran, Philips and Solberg, Wiley., "Operations Research", Second edition (2007), Wiley.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to O.R-Modeling in O.R -Solution methods for O.R- Methodology of O.R Linear Programming Problem-Formulation-Graphical method-Simplex method-Big M method-Two phase method.	8	15%
II	Duality in LPP-Statement of Duality theorems-Statement of complementary slackness theorem Solving LPP using duality-Dual simplex method.	9	15%
	FIRST INTERNAL EXAMINATION		
III	Transportation problem-Methods to find initial basic feasible solution-Northwest corner rule-Matrix minima method-Vogel's Approximation method. Solving a TP -MODI method –Degeneracy in TP-Unbalanced TP-Maximization in TP Assignment problem-Hungarian method of assignment-Maximization in assignment problem.	9	15%
IV	Game Theory-Two person zero sum game-Basic notions-saddle point-Maximin-Minimax principle. Games without saddle point-Mixed strategies-Algebraic method for solving two person zero sum game-Graphical method for 2xn and mx2 games-Dominance principle-Solving mxn game -using dominance-LPP method.	9	15%

V	Queuing theory-Elements of a queuing system-Kendall's notation-Operating characteristics-Poisson process-Exponential distribution-mean and variance-Birth and death process. Queuing models based on Poisson process-Single server models with finite and infinite capacity-Multi server models with finite and infinite capacity.	11	20%
SECOND INTERNAL EXAMINATION			
VI	Simulation-Methodology of Simulation-Simulation models-Event type simulation-Generation of Random numbers. Multiplication congruence algorithm-Inverse transformation method-Monte-Carlo simulation-Simulation of a queuing system.	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA112	**Computer Organization & Architectures**	**3-1-0-4**	**2016**

Course Objectives

- To introduce computer architecture and organization, with a special focus on the basic principles underlying micro-processor design.
- To explore the interaction of hardware and software, and consider the efficient use of hardware to achieve high performance.

Syllabus

Basic Structure of digital computer, Instructions and instruction sequencing, addressing modes. Basic I/O operations, stacks, subroutines. Basic processing unit – sequencing of control signals – Hardwired control and microprogrammed control. Pipelining – basic concepts only. I/O organization – Interrupts, DMA. Interface circuits. Memory organization – Cache memory. Virtual memory – paging and segmentation. RAID, Introduction to HDL.

Expected Outcome

- The students will acquire knowledge about the design and organization of components in computing systems**.**

References

1. Hamachar, Vranesic & Zaky, "Computer Organization" (5th Ed), McGraw Hill.
2. **http://ece.umd.edu/~manoj/350/notes/book.pdf**
3. J. Hennessy and D. Patterson, "Computer Architecture, A quantitative approach", 5th Edition, Elsevier
4. Miles Murdocca, Vincent Heuring, "Computer Architecture and Organization, an integrated approach", (2007 Ed), Wiley**.**
5. Nisan & Schocken, "The Elements of Computing Systems" MIT Press (2008)
6. P. Pal Chaudhuri, "Computer Organization and Design", (2008 Ed) PHI**.**
7. Sameer Palnitkar, "Verilog HDL", 2nd Edition (2003), Prentice Hall.
8. Tanen Baum and Austin, "Structured Computer Organisation", 6th Edition, Pearson.
9. William Stallings, "Computer Organisation and Architecture, Designing for performance", Pearson Education (9th Edition or 2014 Indian Sub continent Edition).

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Basic Structure of digital computer - functional units - basic operational concepts – bus structures - software. Memory locations and addresses – Instructions and instruction sequencing – basic instruction types – Instruction execution and straight line sequencing – branching.	10	15%
II	Addressing modes, assembly language. Basic I/O operations, stacks, subroutines – nesting and processor stack – parameter passing.	10	15%
FIRST INTERNAL EXAMINATION			
III	Basic processing unit – fundamental concepts - execution of a complete instruction – multiple bus organization - sequencing of control signals – Hardwired control and microprogrammed control.	10	20%
IV	Pipelining – basic concepts only. I/O organization – Accessing I/O devices, Interrupts – handling - use of interrupts in operating systems, DMA. Interface circuits – parallel port – serial port. Standard I/O interfaces – PCI – SCSI and USB in brief.	8	15%

V	Memory organization – basic concepts, semiconductor RAM memories - memory system considerations – semiconductor ROM memories - speed, size and cost. Memory design using decoders.	8	15%
SECOND INTERNAL EXAMINATION			
VI	Cache memory – mapping functions – replacement algorithms, multiple module memories and interleaving. Virtual memory – paging and segmentation, RAID. *Programming assignments may be given in any HDL like Verilog or VHDL to create gate level OR Dataflow OR Behavioral level models of gates, multiplexer, adders, flip-flops, registers, latches, etc. Open source Verilog HDL like iverilog can be used. The Purpose of the assignment is to introduce the students to HDL for VLSI Design including Processor design. No detailed teaching of HDL is necessary. The students can be given a basic tutorial write up on gate level modelling.*	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA132	**Object Oriented Programming Lab**	**0-0-4-1**	**2016**

Course Objectives

- To understand the concepts of object-oriented programming.
- To develop skills using these paradigms using Java.
- To learn Java and practice to implement OOP concepts using Java.

Syllabus

This course is to implement the concepts learned in the course **RLMCA102** - Object Oriented Programming.

Expected Outcome

- The students will be able to develop programs using object oriented programming concepts.

Exercises/Experiments

Students are expected to write programs demonstrating the use of

- Classes and Objects.
- Constructors, Method Overloading.
- Arrays and Strings.
- Inheritance.
- Method overriding, Abstract classes
- Interfaces and Packages.
- Exceptions
- Multithreading
- Applets
- Graphics
- Files
    - Faculty can assign suitable programming exercises to cover the topics in RLMCA102

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA134	**Data Structure Lab**	**0-0-4-1**	**2016**

Course Objectives

- Companion course of RLMCA104. The students will develop adequate programming skills to implement various data structures and operations using them

Syllabus

Companion course of RLMCA104. Practical aspects of **RLMCA104** to be covered in the laboratory Environment.

Expected Outcome

- The students will be able to solve applications using appropriate data structures

Exercises/Experiments

Preparation of programs demonstrating the use of following data structures

- Arrays
  - Store, retrieve and delete element
  - Shift and insert, delete and Shift
  - Merge two sorted arrays and store in a third array
- Stack operations
- Stack Applications
  - Infix to Postfix expression
  - Evaluation of expressions
  - Recursion
- Queue operations
- Circular Queue
- Singly linked list
  - Insertion , Deletion and Search
  - Sorting
  - Priority Queue
  - Linked stacks and Queues
  - Polynomial addition using linked list
- Doubly linked list
  - Insertion, Deletion, Search
- Search
  - Linear search, Binary search
- Binary trees
  - Creation and traversals
- Binary search trees
  - Search, Insertion and Deletion
- Graph traversals
  - DFS, BFS, Spanning tree
- Sort
  - Insertion, Merge, Quick, Heap

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA201	**Computer Networks**	**3-1-0-4**	**2016**

Course Objectives

- To introduce students to modern computer networks
- To lay foundation for internet technologies and related topics

Syllabus

Basic communications model - Protocol layers and service models - Transport Layer Protocols - Network Layer Protocols - Link layer and Physical Layer – Wireless and mobile networks – Threats and attacks – VPNs -Network management.

Expected Outcome

- The students will gain proficiency in various network protocols and models.

References

1. Behrouz A Forouzan, Firouz Mosharraf, "Computer Networks: A top down Approach", McGraw Hill Education, 1st Edition (2011).
2. James F Kurose and Keith W Ross, "Computer Networking: A Top - Down Approach", Pearson Education; 5th Edition (2012).
3. Kevin R. Fall, W. Richard Stevens, "TCP/IP Illustrated, Volume 1 -The Protocols", Pearson Education, 2nd Edition (2014).
4. Larry Peterson, Bruce Davie, "Computer Networks, A systems Approach", Morgan Kaufmann Publishers, 5th Edition (2011).
5. Uyless Black, "Computer Networks: Protocols, Standards and Interface", Prentice Hall India Learning Private Limited, 8th Edition (2015).
6. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", Pearson Education, 1st Edition (2016).

Suggested MOOC

1. https://lagunita.stanford.edu/courses/Engineering/Networking-SP/SelfPaced/info
   (Students can be asked to take this self-paced course as an assignment)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Basic communications model - Protocol layers and service models - Basic definitions - OSI model - Internet protocols, the role of standards organizations, History of Internet, Security in the Internet, concept of Quality of Service (QoS).	9	15%
II	Application layer protocols - Client-server as a key model - Network application architecture, Web, HTTP, FTP, SMTP, POP3, and DNS, Peer-to-peer file sharing networks, Introduction to Sockets programming.	9	15%
FIRST INTERNAL EXAMINATION			
III	Transport Layer Protocols: Introduction to transport layer, Multiplexing and demultiplexing, Principles of Reliable data transfer - Stop-and-wait and Go-back- N design and evaluation, Connection oriented transport TCP, Connection less transport UDP, Principles of congestion control - efficiency and fairness.	9	15%

IV	Network Layer Protocols: Virtual circuits and datagrams, Principles of routing, internet protocol Ipv4 and Ipv6, Routing algorithms: Link-state and distance vector routing, Routing on the internet RIP OSPF and BGP, Multicast routing.	9	15%
V	Link layer and Physical Layer: Introduction to link layer - Error detection (parity, checksum, and CRC), Multiple access protocols (collision and token based), IEEE 802.3 Ethernet, Switching and bridging, Media, Signal strength and interference. Data encoding.	10	20%
SECOND INTERNAL EXAMINATION			
VI	IEEE 802.11 Wi-Fi, Bluetooth, and cellular networks, Threats and attacks, Firewalls, VPNs, Introduction to network management, SNMP, Overview of tools and troubleshooting, Traffic analysis tools and Configuration management. ***Note: Introduction to network tools like Wireshark, Snort etc. may be given as assignments/tutorials.***	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA203	**Software Engineering**	**3-1-0-4**	**2016**

Course Objectives

- To assist the student in understanding the basic theory of software engineering, and to apply these basic theoretical principles to a software development project.

Syllabus

Introduction to Software Engineering, Fundamentals of Agile Development, Scrum Framework, Industry Trends.

Expected Outcome

At the end of the course, students will

i. Learn the theory and foundations of software engineering.
ii. Learn the different process models and choose the best model for their project
iii. Be able to construct requirement models
iv. Be able to Understand the different development practices and its advantages
v. Be able to create test cases and implement different testing strategies
vi. Understand the environment and work culture in a software organization

References

1. Alistair Cockburn, "Agile Software Development: The Cooperative Game", Addison Wesley, 2nd Edition (2006).
2. Andrew Hunt, David Thomas, "The Pragmatic Programmer: From Journeyman to Master", Pearson India, 1st Edition (2008).
3. Ken Schwaber, Mike Beedle, "Agile Software Development with Scrum", Pearson (2008).
4. Lisa Crispin, Janet Gregory, "Agile Testing: A Practical Guide for Testers and Agile Teams", Addison Wesley Professional, 1st Edition (2008).
5. Mike Cohn, "User Stories Applied: For Agile Software Dvelopment", Addison Wesley, 1st Edition, (2004).
6. Pressman, R.S., "Software Engineering: A Practitioner's Approach", McGraw Hill SE, 7th Edition, (2010).
7. Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", Prentice Hall Imprint, Pearson Education, 2nd Edition (2002).
8. Rod Stephens, "Beginning Software Engineering", Wrox Series, Wiley India Pvt Ltd (2015).
9. RyPress "Ry's Git Tutorial" (Free e-book)

Suggested MOOC

- Introduction to DevOps (https://www.edx.org/course/introduction-devops-microsoft-dev212x)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Software Engineering - What is Software Engineering - Why is software engineering important, Details around requirements gathering, Software design, Development, Testing, Deployment, Maintenance. Planning phase – project planning objective, software scope, empirical estimation, models, COCOMO, staffing and personal planning.	9	15%
II	Software Engineering models - Predictive software engineering models and its application - Model Approaches – Prerequisites - predictive and adaptive waterfall - waterfall with feedback - Sashimi - incremental waterfall - V model -	8	20%

	System development life cycle - Iterative vs Predictive – prototypes - Spiral - unified process - Cleanroom - Rapid Application development principles – risk management.		
FIRST INTERNAL EXAMINATION			
III	Fundamentals of Agile Development - Introduction to agility, Agile Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management. Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools - Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques. The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), JUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.	11	20%
IV	Scrum Framework - Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective Daily scrum, Scrum roles - Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management	8	15%
V	Pragmatic Programming in Software Engineering - Essential pragmatism in software engineering - Code maintainability - design by contract - assertive programming - Writing maintainable code - Ruthless testing – pride.	9	15%
SECOND INTERNAL EXAMINATION			
VI	Industry Trends - Introduction to DevOps - A unified process between development and operations - Continuous Integration (CI), continuous testing, and continuous deployment - Configuration management, release management, and monitoring and learning	8	15%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA205	**Database Management Systems**	**3-1-0-4**	**2016**

Course Objectives

- To develop and manage efficient and effective database applications that requires understanding the fundamentals of database management systems, techniques for the design of databases, and principles of database administration.

Syllabus

Introduction of database systems - Data modeling using Entity Relationship Model - Extended E-R features - The Relational model -Relational Query Languages. Introduction to SQL - Intermediate SQL - Advanced SQL - Database Design - Functional Dependencies - Foundations of Database Transaction Processing - Concurrency Control in databases - Overview of Data Mining and Data Warehousing Concepts.

Expected outcome

The students will

i. Understand the fundamentals of relational, object-oriented, and distributed database systems including: data models, database architectures, and database manipulations.

ii. Understand the theories and techniques in developing database applications and be able to demonstrate the ability to build databases

References

1. Abraham Silberschatz ,Henry F. Korth ,S. Sudarshan, ”Database System Concepts”, McGraw Hill Education, 6th Edition (2013) - (for Modules 1,2,3).
2. Ashutosh Kumar Dubay, “Database Management Concepts”, S.K. Kataria & Sons, 1st Edition (2012).
3. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, McGraw Hill, 3rd Edition (2014).
4. Ramez Elmasri, Shamkant B.Navathe, “Database Systems “, Pearson Education, 6th Edition (2013) (for Modules 4,5,6).
5. Thomas M Connolly and Carolyn E Begg, “Database systems”, Pearson Education, 4th Edition (2009) - (for Module 4).

Suggested MOOC

1. Data Manipulation at Scale: Systems and Algorithms (https://www.coursera.org/learn/data-manipulation)
2. Introduction to Databases (Coursera) (https://class.stanford.edu/courses/DB/2014/SelfPlaced/about)
3. Database Management Essentials (Coursera) (https://www.coursera.org/learn/database-management)
4. SQL(Stanford University) (https://lagunita.stanford.edu/courses/DB/SQL/SelfPaced/courseware)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Purpose of database systems - View of data - Data models, schemas and instances - Database Languages - Database Users and Administrators. Data modeling using Entity Relationship Model - Entity sets, Relationship sets, attributes, Constraints – Keys – Entity - Relationship Diagrams - Weak Entity Sets. Extended E-R features - Specialization and Generalization - Constraints on Specialization and Generalization.	9	15%

II	The Relational model: Relational model concepts - Relational model constraints - Relational Databases and Relational Database Schemas. Relational Query Languages :The Relational Algebra - Examples of Queries in Relational Algebra.	9	15%
FIRST INTERNAL EXAMINATION			
III	Introduction to SQL: SQL Data Definition, Basic structure of SQL Queries, Additional Basic Operations, Set Operations, Null values, Aggregate functions, Nested Subqueries, Modifications of database Intermediate SQL: JOIN Expressions, Views, Transactions, Integrity Constraints, SQL Data types and schemas, Authorisation. Advanced SQL: Declaring and Invoking SQL Functions and Procedures, Triggers - Need for triggers, Triggers in SQL	11	20%
IV	Database Design: Functional Dependencies - Normal Forms: First Normal Form, Second Normal Form, Third Normal Form, Boyce Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Inference Rules for Functional Dependencies, Minimal Sets of Functional Dependencies, Properties of Relational Decompositions.	9	20%
V	Foundations of Database Transaction Processing: Transactions, Database Items, Read and Write Operations and DBMS buffers, Transaction states, Desirable states of Transactions, Transactions and Schedules - Characterising Schedules based on Recoverability, Schedules of Transactions, Characterising Schedules Based on Recoverability, Characterising Schedules Based on Serializability, Serial, Non serial , and Conflict-Serializable Schedules, Testing for Conflict Serializability of a Schedule, View Equivalence and View Serializability. Concurrency Control in databases: Two - Phase Locking Techniques, Guaranteeing Serializability by Two-Phase Locking, Dealing with Deadlock and Starvation, Concurrency Control Based on Timestamp Ordering	9	20%
SECOND INTERNAL EXAMINATION			
VI	Overview of Data Mining and Data Warehousing Concepts - Data mining Technology, Association rules, Classifications, Clustering, Introduction of Data Warehousing - Characteristics of Data Warehouses, Data Modeling for Data Warehouses.	7	10%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA207	**Design and Analysis of Algorithms**	**3-1-0-4**	**2016**

Course Objectives

- To familiarize with algorithm design strategies.
- To learn to analyse and measure the performance of algorithms

Syllabus

Introduction to Algorithm Analysis, Divide and Conquer Method, Greedy Strategy, Dynamic Programming, Algorithm Design by State Space Trees – Backtracking - Branch and Bound, Introduction to Computational Complexity.

Expected Outcome

i. Given a problem, the student will be able to design algorithms.
ii. Given an algorithm, he/she will be able to analyse it and produce an estimate of its time and space requirements.

References

1. A. Levitin, "Introduction to the Design & Analysis of Algorithms", Pearson Education, 3rd Edition (2008).
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Orient Longman, Universities Press, 2nd Edition (2008)
3. Harsh Bhasin, "Algorithms Design and Analysis", Oxford University Press, 1st Edition (2015).
4. Rajesh K.Shukla, "Analysis and Design of Algorithms, A Beginner's Approach", Wiley (2015)
5. Richard Neapolitan , Kumarss Naimipour, "Foundations Of Algorithms ",Jones and Bartlett Publishers, Inc, 4th Edition (2011).
6. Sara Baase , Allen Van Gelder , "Computer Algorithms: Introduction to Design and Analysis", Pearson India, 3rd Edition (2002).
7. Thomas H. Cormen, et al., "Introduction to Algorithms", Prentice Hall, 3rd Edition (2010)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Algorithm Analysis : Algorithm and its properties - Apriory and Aposterior analysis of algorithms - Time and Space Complexity- Elementary Operation and Complexity Estimation of Simple Algorithms - Asymptotic notations and their properties - Common Complexity functions - Recurrence Relations - Solution of Recurrence Relations - Iteration Method - Recurrence Tree Method - Master's Theorem (Proof not required)	10	15%
II	Divide and Conquer Method : Control Abstraction for Divide and Conquer- 2- way Merge Sort , Quick sort, Binary Search, Finding Maximum and minimum, Divide and Conquer Matrix Multiplication.	9	15%
FIRST INTERNAL EXAMINATION			
III	Greedy Strategy: - Control Abstraction for Greedy Strategy - The Fractional Knapsack Problem - Prims' and Kruskal's Algorithms for Minimal Spanning Tree - Job Sequencing Problem.	8	15%
IV	Dynamic Programming : Control Abstraction for Dynamic Programming - The Principle of Optimal Substructure - All Pair	8	15%

	Shortest Path Problem - Travelling Sales Person Problem, Divide and Conquer vs Dynamic Programming.		
V	Algorithm Design by State Space Trees: State Space - Bounding Functions – Examples. Backtracking: Control Abstraction for Backtracking - The N-Queen's Problem, Sum of Subset Problem. Branch and Bound: Depth First, Breadth First and Best First Branch and Bound strategies and their control abstractions - The N^2-1 Puzzle Problem	10	25%
SECOND INTERNAL EXAMINATION			
VI	Introduction to Computational Complexity: Tractable and Intractable Problems - Complexity Classes- P and NP Classes - SAT and 3-SAT Problems - NP-Hard and NP-Complete Classes – Study of NP complete problems - Travelling Sales Person Problem - Knapsack Problem - Clique Problem, Vertex Cover Problem. ***Note: Only general concepts required to be covered. No proof required. Only elementary treatment is required.***	10	15%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA209	**Web Programming**	**3-1-0-4**	**2016**

Course Objectives

- To understand the concepts of the World Wide Web
- To understand and practice markup languages
- To understand and practice embedded dynamic scripting on client side Internet Programming
- To understand and practice web development techniques on client-side
- To understand and practice server-side scripting

Syllabus

Introduction To Web - Internetworking - Working with TCP/IP - Client/Server concepts - World Wide Web - Components of Web Application - Types of Web Content - Application Servers - Web Security.

UI DESIGN - Markup Language: Introduction to HTML5 - Cascading Style Sheet: Introduction to CSS3.

Client - Scripting using JAVASCRIPT - Introduction to Javascript - Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Browser Management and Media Management - Object-Oriented Techniques in JavaScript - JQuery.

Server – Scripting using PHP - Introduction to PHP - Programming basics - Reading Data in Web Pages - Embedding PHP within HTML - Establishing connectivity with MySQL database.

Expected Outcome

The students will

i. Acquire knowledge about functionalities of world wide web
ii. Explore markup languages features and create interactive web pages using them
iii. Learn and design Client side validation using scripting languages
iv. Acquire knowledge about Open source JavaScript libraries
v. Be able to design front end web page and connect to the back end databases
vi. Be able to do Client-side & Server-side scripting

References

1. David Flanagan, "JavaScript: The Definitive Guide", 6th Edition", O'Reilly Media
2. Douglas E Comer, "The Internet Book: Everything You Need to Know About Computer Networking and How the Internet Works", 4th Edition, Prentice Hall
3. Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", 5th Edition, Pearson Education
4. Steve Suehring, Tim Converse, and Joyce Park, "PHP6 and MySQL Bible", Wiley India Pvt Ltd (2009)
5. Steven Holzner, "PHP-The Complete Reference", Tata McGraw Hill, 1st Edition (2007)
6. Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference", 3rd Edition, Tata McGraw Hill

Web resource

1. http://php.net/manual/

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to web - Internet Standards – Introduction to WWW – WWW Architecture – SMTP – POP3 – File Transfer Protocol - Overview of HTTP, HTTP request – response — Generation of dynamic web pages	9	15%

II	Markup Language (HTML): Introduction to HTML and HTML5 - Formatting and Fonts –Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – Frames - HTML Forms.	8	15%
FIRST INTERNAL EXAMINATION			
III	Cascading Style Sheet (CSS): The need for CSS, Introduction to CSS – Basic syntax and structure - Inline Styles – Embedding Style Sheets - Linking External Style Sheets – Backgrounds – Manipulating text - Margins and Padding - Positioning using CSS.	8	15%
IV	Client Side Scripting using JavaScript: Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements - Functions - Objects - Array, Date and Math related Objects - Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Form handling and validations.	9	15%
V	Advanced JavaScript: Browser Management and Media Management – Classes – Constructors – Object-Oriented Techniques in JavaScript – Object constructor and Prototyping - Sub classes and Super classes – JSON - JQuery and AJAX.	9	20%
SECOND INTERNAL EXAMINATION			
VI	Server Side Scripting using PHP: Introduction - How web works - Setting up the environment (Example - XAMP server) – PHP Programming basics - Print/echo - Variables and constants – Strings and Arrays – Operators, Control structures and looping structures – Functions – Reading Data in Web Pages - Embedding PHP within HTML – Establishing connectivity with database.	10	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA231	**Database Lab**	**0-0-4-1**	**2016**

Course Objectives

- To familiarise the functionality and support provided by commercially popular RDBMS
- To know its use in meeting data storage and organization requirements.

Syllabus

This is a companion Course for the 'RLMCA303 Database Management Systems' theory course.

Expected Outcome

The student will be able to:

i. Understand, appreciate and effectively explain the underlying concepts of database technologies.
ii. Design and implement a database schema for a given problem-domain.
iii. Normalize a database.
iv. Populate and query a database using SQL DML/DDL commands.
v. Use any popular RDBMS for data access and updating.

References

1. Text Books prescribed for theory course 'RMCA303 Database Management Systems'
2. Nilesh Shah, " Database Systems using Oracle – A simplified guide to SQL and PL/SQL", Pearson Education, 2nd Edition.
3. Benjamin Rosenzweig, Elena Silvestrova, "ORACLE PL/SQL by example", Pearson Education , 3rd Edition.

Web Resources

1. mySQL (http://dev.mysql.com/doc/refman/5.7/en/tutorial.html)
2. MongoDB (https://university.mongodb.com/courses/M101P/about)
3. Hadoop
4. HBase-(https://hbase.apache.org/book.html#shell, followed by https://hbase.apache.org/book.html#shell_exercises)
5. Apache Hive (https://cwiki.apache.org/confluence/display/Hive/Tutorial)
6. Pig (https://pig.apache.org/docs/r0.7.0/tutorial.html)

Suggested MOOC

1. SQL(Stanford University) (https://lagunita.stanford.edu/courses/DB/SQL/SelfPaced/courseware)
2. Databases (Stanford OpenEdX) (https://online.stanford.edu/course/databases-self-paced)

Exercises

The Students can do their practical in the following areas in any of the DBMS like MySql, Oracle, MongoDB etc..

1. Table Design- Using foreign key and Normalization

2. Practice SQL Data Definition Language(DDL) commands
   a. Table creation and alteration (include integrity constraints such as primary key, referential integrity constraints, check, unique and null constraints both column and table level

3. Practice SQL Data Manipulation Language (DML) commands
   a. Row insertion, deletion and updating
   b. Retrieval of data
      I. Simple select query
      II. Sub query (returning single row, multiple rows, more than one column
      III. Joining tables

4. Practice Transaction Control Language (TCL) commands (Grant, revoke, commit, rollback and save point options)

5. Development of sample applications using Oracle/ MySql / MongDB as back end. Sample applications may include
   I. Payroll Information
   II. Student Information System
   III. Bank Transaction
   IV. Library Information System etc.

6. Develop programs using Triggers, Stored procedures

END SEMESTER EXAM

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA233	**Web Programming Lab**	**0-0-4-1**	**2016**

Course Objectives

- To practice the concepts & syntax learned in the course RL1MCA305.
- To understand and practice markup languages.
- To understand and practice embedded dynamic scripting on client side Internet Programming.
- To understand and practice web development techniques on client-side
- To understand and practice server-side scripting.

Syllabus

This is a companion Course for the 'RLMCA305 Web Programming'

Expected Outcome

The students will be able to:

i. Explore markup languages features and create interactive web pages using them.
ii. Learn and design Client side validation using scripting languages.
iii. Acquire knowledge about Open source JavaScript libraries.
iv. Design front end web page and connect to the back end databases.
v. Do Client-side & Server-side scripting
vi. Develop Web Applications

References

1. Text Books prescribed for theory course 'RLMCA305 Web Programming'

Web resources

1. http://php.net/manual/

Experiments/Exercises

1. Create a web page with the following using HTML5
   (i) To embed an image map in a web page
   (ii) To fix the hot spots
   (iii) Show all the related information when the hot spots are clicked.
2. Create a web page with all types of Cascading style sheets.
3. Implement Client Side Scripts for Validating Web Form Controls using JavaScript.
4. Designing Quiz Application Personal Information System using JavaScript
5. Develop PHP program using Arrays, control structures, looping structures and Form Handling
6. Implement Web applications using HTML and JSP/PHP/ASP and deploy.
7. Using PHP and MySQL, develop a program to accept book information viz. Accession number, title, authors, edition and publisher from a web page and store the information in a database and to search for a book with the title specified by the user and to display the search results with proper headings.
7. Develop a web application for Airline Reservation System using PHP

8. Programs for creating dynamic and interactive web pages using forms.

9. Test the application on an Application Server.

Note : Students can be given a group micro project, so that they learn to work in a team environment. They can also be trained on project management tools.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA202	**Application Development and Maintenance**	**3-1-0-4**	**2016**

Course Objectives

- To impart the practical aspects of Application Development and Maintenance
- To emphasizes the pragmatic and practical aspects of building industry ready applications
- To understand and adhere to best practices while developing applications
- To understand the basics of continuous development and focus on industry practices around continuous integration and continuous development

Syllabus

Principles of Software Delivery, Configuration Management, Continuous Integration, Implementing a Testing Strategy, Build and Deployment Scripting, The Commit Stage, Automated Acceptance Testing, Testing Nonfunctional Requirements, Deploying and Releasing Applications, Application Development Guidelines.

Expected Outcome

The students will be

i. Able to work in a continuous integration environment
ii. Understand to follow coding best practices, and to follow the same in academic projects

References

1. Andrew Hunt, David Thomas, "The Pragmatic Programmer: From Journeyman to Master", Addison-Wesley Professional, 1999
2. Jez Humble, David Farley, "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation", Addison-Wesley Professional, 2010
3. Travis Swicegood, "Pragmatic Guide to Git", Pragmatic Bookshelf, 2010

Suggested MOOC

1. https://www.udemy.com/short-and-sweet-get-started-with-git-and-github-right-now/
2. https://www.coursera.org/learn/software-processes-and-agile-practices
3. https://www.coursera.org/specializations/agile-development

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Principles of Software Delivery – Configuration Management – Introduction to Continuous Integration - Implementing a Testing Strategy **Reference:** Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation (Part I, Chapters 1, 2, 3,4)	9	15%
II	Using Git for version Control – Leveraging Github.com repositories for projects/Assignments – Getting Started with Git – Working with Git- Organizing Your Repository with Branches and Tags – Working in a team – Branches and Merging – Git History - Fixing Commits **Reference:** Pragmatic Guide to Git: (Part I, 2, 3,4,5,6,7)	11	20%
FIRST INTERNAL EXAMINATION			
III	Introduction to the Deployment Pipeline – Different Stages of Deployment Pipeline – Scripting for Deployment stages –	9	15%

	Details of Commit Stage **Reference:** Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation (Part II, Chapters 5, 6,7)		
IV	Automated Testing – Testing for Non Functional Requirements – Deploying and releasing applications **Reference:** Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation (Part II, Chapters 8,9,10)	9	20%
V	Best practices for Software Development –Practical Approach in Software development- The Basic Tools **Reference:** i) The Pragmatic Programmer: From Journeyman to Master (Chapter I, 2, 3, 4)	9	15%
SECOND INTERNAL EXAMINATION			
VI	Best practices and principles in Application Development – Dealing with requirements – Pragmatic Projects **Reference:** The Pragmatic Programmer: From Journeyman to Master (Chapter 5, 6, 7, 8)	9	15%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA204	**Big Data Technologies**	**3-1-0-4**	**2016**

Course Objectives

- To understand the concept of Big data
- To understand HADOOP
- To understand the Big Data concerns: Storage and Analysis

Syllabus

Introduction to Big Data Platform, Big Data Storage Concepts, Big Data Processing Concepts, Introduction to Hadoop Ecosystem, Understanding Map Reduce Fundamentals, Big Data Storage Technology, Big Data Analysis Techniques

Expected Outcome

The students will

i. Be able to work with big data platform.
ii. Understand Hadoop and develop its applications on Big Data.

References

1. Chandrakant Naikodi, "Managing Big Data", Vikas Publishing, 2015
2. DreamTech Editorial Services, "Big Data", Dreamtech Press, 2015 Edition.
3. Michael Frampton, "Big Data Made Easy: A Working Guide to the Complete Hadoop Toolset", Apress, 2014
4. Michael Manoochehri, "Data Just Right", Pearson education, 2015.
5. Thomas Erl ,"Big Data Fundamentals Concepts, Drivers and Techniques", Pearson Education First Edition,2016
6. Vijay Srinivas Agneeswaran, "Big Data Analytics beyond HADOOP", Pearson Education(2015)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Big Data Platform – History of Data Management- Structuring Big data - Elements of Big Data, Big data stack - Big data Analytics - Introducing Technologies for handling Big Data: Distributed and Parallel Computing for Big Data - Cloud Computing and Big Data	8	15%
II	Big Data Storage Concepts- Clusters - File Systems and Distributed File Systems- NoSQL – Sharding – Replication – Sharding and Replication – CAP Theorem – ACID – BASE Big Data Processing Concepts- Parallel Data Processing – Distributed Data Processing – Hadoop – Processing in Batch Mode – Processing in Real time Mode	8	20%
FIRST INTERNAL EXAMINATION			
III	Introduction to Hadoop Ecosystem - Hadoop Distributed File System-HDFS Architecture - Features of HDFS - Map Reduce- Features of Map Reduce- Hadoop Yarn - HBase- Hive – Sqoop – ZooKeeper – Flume – Oozie. ***Note : Lab Assignments and hands on training to be given in labs.***	10	15%
IV	Understanding Map Reduce Fundamentals- Map Reduce Framework- Exploring Features of Map Reduce- Working of Map Reduce- Exploring Map and Reduce Functions- Techniques	9	15%

	to optimize Map Reduce- Hardware/ Network Topology- Synchronization- File System- Uses of Map Reduce ***Note: provide practical assignments on familiarizing HADOOP environment.***		
V	Big Data Storage Technology – On-Disk Storage Devices – Distributed File Systems, RDBMS Databases, NoSQL Databases, NewSQL Databases – In-Memory Storage Devices: In-Memory Data Grids, In-Memory Databases.	9	20%
SECOND INTERNAL EXAMINATION			
VI	Introduction to Big Data Analysis Techniques- Quantitative Analysis – Qualitative Analysis – Data Mining - Statistical Analysis - Machine Learning – Semantic Analysis – Visual Analysis	9	15%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA206	**Mobile Computing**	**3-1-0-4**	**2016**

Course Objectives

- To learn the concepts of Mobile Communication and Computing Technologies
- To learn mobile OS concepts.
- To develop and deploy effective mobile applications.

Syllabus

Introduction to Communication technologies -Mobile Computing: Mobile Computing Technologies - Operating Systems for Mobile Computing: Survey of Mobile OS - Mobile Applications Development and Protocols - HDML -WAP – J2ME – Android SDK – – Android Studio- Creating an Android application-Android User Interface – Introduction to SQLite database

Expected Outcome

- The students will be able to design and develop mobile applications

References

1. Bill Phillips, Chris Stewart, Brian Hardy, Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide" , Publisher: Big Nerd Ranch Guides , July 24, 2015– (Modules 4,5,6)
2. Joseph Annuzzi Jr, Lauren Darcey, Shane Condor, "Advanced Android Application Development, Developers Library", Pearson Education, 4th Edition (2015)
3. Joseph Annuzzi Jr, Lauren Darcey, Shane Condor, "Android Application Development, Android Essentials", Pearson Education, 5th Edition (2016) – (Modules 4,5,6)
4. Lauren Darcey, Shane Condor, "Android, Wireless Application Development", Pearson Education, 3rd Edition.
5. Paul Deitel, Harvey Deitel, Alexander Wald, "Android 6 for programmers, An App-Driven Approach", Pearson Education
6. Pradeep Kothari, "Android Application Development Black Book", Dreamtech Press(2015)
7. Prasanna Kumar Dixit, "Android", Vikas Publishing, 2014 Edition.
8. Prasanth Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing "Second Edition , PHI (2012) – (Modules 1,2,3).
9. Raj Kamal, "Mobile Computing", Second Edition, Oxford University Press,2013 – (Modules 1,2,3).
10. https://developer.android.com/index.html

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Communication technologies -Mobile handsets, wireless communications and server applications - Components of a wireless Communication systems - Architecture of a Mobile telecommunication system – Wireless Standards-Wireless Local Area Networks (WLAN s) -Bluetooth Technology - Bluetooth low energy (BLE), NFC.	8	15%
II	Mobile Computing: Mobile Computing vs Wireless Networking – Mobile Computing Applications – Characteristics of Mobile Computing – Cellular Mobile Communication – Global System for Mobile Communication (GSM) – Services, Architecture and Security - General Packet Radio Service (GPRS) -Services, Architecture, 3G, 4G LTE.	10	20%
FIRST INTERNAL EXAMINATION			

III	Operating Systems for Mobile Computing: OS Responsibilities in mobile devices – Concepts of Mobile OS – Special Constraints and requirements of Mobile OS - Survey of Mobile OS- Windows Mobile, iOS and Android OS - Comparative study	10	20%
IV	Mobile Applications Development and Protocols - Mobile devices as web clients – HDML -WAP – J2ME – Android SDK – Android SDK Environment – Features of SDK – Android Application Components – Android Software Stack Structure.	8	15%
V	Android Development Environment-: Android SDK, ADT, AVDs, Emulators, DVM- Difference between JVM and DVM - Development Environment: Eclipse, DDMS, Command-line tools – Android Studio- Creating an Android application	8	15%
SECOND INTERNAL EXAMINATION			
VI	Android User Interface – Designing user interface with view - Activity-Intent-Activity life cycle - Broadcast receivers-service - Features of service- Service life cycle- Introduction to SQLite database	8	15%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA208	**Introduction to Machine Learning**	**3-1-0-4**	**2016**

Course Objectives

- To introduce the basic concepts and techniques of Machine Learning.
- To develop skills for using machine learning algorithms for solving practical problems.
- To develop skills for using standard machine learning libraries.

  Note: The course should be taught from a programmer's perspective. Mathematical rigor is not expected.

Syllabus

Introduction to Machine Learning - Lazy Learning - Probabilistic Learning - Classification Using Decision Trees and Rules-Regression Methods - Understanding regression - Neural Networks - Unsupervised Learning - Support Vector Machines.

Expected Outcome

The students will be able

- To recognize machine learning problems and apply suitable algorithms.
- To use machine learning libraries on various platforms

References

1. Brett Lantz, "Machine Learning with R", Packt Publishing, 2nd Edition.
2. Tom Micheal, "Machine Learning", Mcgraw Hill (1997)
3. Vinod Chandra S S, Anand Hareendran S., "Artificial Intelligence and Machine Learning", Prentice Hall (2014)
4. Simon Rogers, Mark Girolami, "A First course in Machine Learning", CRC Press, First Indian reprint, 2015.
5. N P Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 1st Edition.
6. E. Alpayidin, "Introduction to Machine Learning", Prentice Hall of India (2005)
7. T. Hastie, RT Ibrashiran and J. Friedman, "The Elements of Statistical Learning", Springer 2001
8. Toby Segaran, "Programming Collective Intelligence: Building Smart Web 2.0 Applications", O'Reilly Media; 1 edition (16 August 2007).
9. Drew Conway, John Myles White, "Machine Learning for Hackers: Case Studies and Algorithms to Get You Started", O'Reilly Media; 1 edition (13 February 2012)
10. Christopher Bishop, "Pattern Recognition and Machine Learning (Information Science and Statistics)", Springer 2011 edition (15 February 2010)
11. Machine Learning - Course Materials @ http://cs229.stanford.edu/materials.html

Suggested MOOC

1. https://www.coursera.org/learn/machine-learning

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Machine Learning - How do machines learn - Selecting the right features, Understanding data:- numeric variables – mean, median, mode, Measuring spread. Review of distributions: Uniform and normal. Categorical variables. Dimensionality Reduction - Principal Component Analysis	8	10%
II	Lazy Learning - Classification Using k-Nearest Neighbor algorithm. Measuring similarity. Choice of k.	10	10%

	Probabilistic Learning - Naive Bays' classifier. Review of probability - Joint probability, Conditional probability and Bay's theorem, Naive Bayes algorithm.		
FIRST INTERNAL EXAMINATION			
III	Classification Using Decision Trees and Rules - Divide and conquer strategy. Decision tree algorithm. Regression Methods - Simple linear regression - Ordinary least squares estimation Correlations - Multiple linear regression	8	20%
IV	Neural Networks: Biological motivation - Perceptron - Activation functions - Network Models - Cost Function - Back-propagation algorithm. Introduction to deep learning.	10	20%
V	Support Vector Machines - Review of finite dimensional vector spaces - Hyper planes - Support Vector Classifier. Kernel methods - Gaussian kernel, Multi class SVM.	10	20%
SECOND INTERNAL EXAMINATION			
VI	Evaluating Model Performance: Precision and recall, Confusion matrix, Cross validation Bootstrap sampling, Improving model performance with ensemble learning, Bagging and Boosting. Introduction to random forest. ***Assignments*** ***The assignments for this course can be given in R, Python or any other suitable platform. At least two programming assignments should be given. Each of them should explore the practical aspects of implementing a machine learning system in the chosen platform.***	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA262	**Functional Programming**	**3-1-0-4**	**2016**

Course Objectives

- To introduce the basic principles of functional programming
- To make aware why, what and how that underlies pure functional programming
- To get familiar with Haskell.

Syllabus

Functional Programming: Introduction, Data structures in functional languages, Imperative and functional languages, Functions, Lists, New Types, Programming with Haskell

Expected Outcome

The students will

- Understand the principles of functional programming
- Be able to write purely functional programs, using recursion, pattern matching, and higher-order functions
- Be able to design immutable data structures
- Understand generic types for functional programs
- Be able to write programs using Haskell

References

1. Greg Michaelson, "An introduction to functional programming through lambda calculus", Dover Publications, 2011.
2. Miran Lipovača, "Learn You a Haskell for Great Good!: A Beginner's Guide", No Starch Press, 1st Edition (15 March 2011).
3. Simon Peyton Jones , "The Implementation of Functional Programming Languages" , Prentice Hall.

Suggested MOOC

1. https://www.haskell.org/
2. http://learnyouahaskell.com/
3. https://www.edx.org/course/introduction-functional-programming-delftx-fp101x-0#!

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Review of recursion - Functional Programming: Introduction, Expressions and values, Basic Data Types , Names and values in programming- Data structures in functional languages	8	15%
II	Names and values in imperative and functional languages- Execution order in imperative and functional languages- Repetition in imperative and functional languages- Functions as values	6	5%
FIRST INTERNAL EXAMINATION			
III	Functions: Functions and definitions, Functional composition, Operators, Inverse functions, Strict and non-strict functions,	10	20%
IV	Lists: List notation, List comprehensions, Operations on lists, Map and filter, List patterns, Recursion and Induction: Over natural numbers, Over lists. Operations on lists	10	20%
V	New Types : Enumerated types , Composite types , Recursive types , Abstract types , Trees: Binary trees , Binary search trees	10	20%
SECOND INTERNAL EXAMINATION			
VI	Programming with Haskell: Introduction to Haskell, Defining functions: guards, pattern matching and recursion, Lists, strings	10	20%

	and tuples, Types and polymorphism, Higher order functions on lists: map, filter, list comprehension, User defined data types: lists, queues, trees		

END SEMESTER EXAM

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA264	**Design and Analysis of Parallel Algorithms**	**3-1-0-4**	**2016**

Course Objectives

- To understand the need for parallel algorithms
- To expose different models of parallel computation, parallel sorting and searching algorithms.
- To apply parallel algorithms to different types of problems
- To analyze parallel algorithms

Syllabus

Parallel Algorithms- Properties, Models, Parallel Selection-Searching-Merging- Sorting- Matrix Operations- Numerical Problems- Graph Theory.

Expected Outcome

The students will be able to

- Identify the need for parallel algorithms.
- Discuss the classification of parallel architectures and identify suitable programming models.
- Develop and analyze algorithms for different applications like matrix multiplication, shortest path, connected components.

References

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar ", Introduction to Parallel Computing", Second Edition, Addison Wesley, 2003. ISBN: 0-201-64865.
2. F.T.Leighton, "Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes", MK Publishers, San Mateo California, 1992.
3. Michael J. Quinn, "Parallel computer theory and practice", McGraw Hill, Second Edition, 1994.
4. Selim G. Akl, “The Design and Analysis of Parallel Algorithms”, Prentice Hall, New Jersey, 1989.
5. Wilkinson, M.Allen,"Parallel Programming Techniques and Applications using networked workstations and parallel computers", Prentice Hall,1999.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Parallel Algorithms – Models of Computation – Analyzing Algorithms. Expressing Algorithms.	8	10%
II	Selection : The Problem and a Lower Bound, A Sequential Algorithm, Desirable Properties for Parallel Algorithm, Two Useful Procedures, Parallel Algorithm for Selection- Searching : Searching a Sorted Sequence(EREW, CREW, CRCW) - Searching a Random Sequence - Searching on SM SIMD Computers(EREW, ERCW, CREW, CRCW).	10	20%
FIRST INTERNAL EXAMINATION			
III	Merging : A Network for Merging, Merging on the CREW Model, Merging on the EREW Model, A better Algorithm for the EREW Model- Sorting: A network for Sorting, Sorting on a Linear Array, Sorting on the CRCW Model, Sorting on the CREW Model, Sorting on the EREW Model.	10	20%
IV	Matrix Operations: Transposition, Matrix-by-Matrix Multiplication, Matrix-by-Vector Multiplication.	10	20%
V	Numerical Problems: Solving Systems of Linear Equations,	8	10%

	Finding Roots of Nonlinear Equations, Solving Partial Differential Equations, Computing Eigenvalues.		
SECOND INTERNAL EXAMINATION			
VI	Graph Theory: Definitions, Computing the Connectivity Matrix, Finding Connected Components, All-Pairs Shortest Path Algorithm, Computing the Minimum Spanning Tree.	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA266	**Advanced Database Systems**	**3-1-0-4**	**2016**

Course Objectives

- To introduce the basic concepts and terminology related to DBMS and Relational Database Design
- To design and implement Distributed Databases.
- To understand advanced DBMS techniques to write effective queries, forms, and reports.
- To introduce students to New Generation databases – MongoDB.

Syllabus

Storage and File Structure, RAID, Indexing & Hashing, Query Processing, Object Oriented Database and XML, Distributed Database, New Generation databases – MongoDB.

Expected Outcome

The students will be able to

i. Explain the roles that databases play in organizations.
ii. Gain knowhow of the file organization, query Optimization, transaction management, and database administration techniques.
iii. Understand the basics of advanced topics such as database performance tuning, distributed databases, Object Oriented Databases.

References

1. Abraham Silberschatz, Henry F Korth & S Sudarshan, "Database System Concepts", Fourth Edition, Tata McGraw-Hill, 2002.
2. Alex Berson, Stephen J Smith; "Data Warehousing, Data Mining, and OLAP"; Tata McGraw-Hill Publishing Company Limited, 1997, ISBN 0-07-058741-8
3. Elmasri, Navathe,Somayajulu & Gupta,"Fundamentals of Database Systems", Fourth Edition, Pearson Education,2008
4. Guy Harrison, "Next Generation Databases: NoSQL, NewSQL, and Big Data", Apress, 1st Edition (14 December 2015)- Refer Chapters 8, Chapters 9 for Module VI
5. J. L. Harrington; "Object Oriented Database Design Clearly Explained"; Morgan Kaufmann Publishers, 2001, ISBN 0-12-326428-6.
6. M Tamer Ozsu, P Valduriez; "Principles of Distributed Database Systems"; Pearson Education Pvt. Ltd., 2005, ISBN 81-7808-375-2.
7. S Ceri, G Pelagatti; ""Distributed Databases: Principles and Systems"; Tata McGraw-Hill Publishing Company Limited, ISBN 0-07-066215-0

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Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Storage and File Structure: Magnetic Disk, RAID- RAID Levels, File Organization- Organization of Records in File, Heap-Sequential- Hashing File Organizations.	8	10%
II	Indexing & Hashing: Basic Concept, Ordered Indices, Dense & Sparse Indices, Multilevel Indices, Secondary Indices, B+-Tree Index Files- Structure, Queries on B+ Trees, Updates on B+ Trees.	10	10%
FIRST INTERNAL EXAMINATION			
III	Query Processing : Overview, Measures of Query Cost, Selection Operation, Sorting- External Sort-Merge Algorithm	9	20%

IV	Object Oriented Database and XML: OO Paradigm, OO Data Models: Object Identifiers, Relationship and Integrity, ER Diagramming Model For OO Relationships, Object Relational Data Models, XML.	9	20%
V	Distributed Database: Distributed Database Architecture, Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Distributed Query Processing	8	20%
SECOND INTERNAL EXAMINATION			
VI	Next Generation Databases - Distributed Database Patterns - Introduction to MongoDB - Introduction to Hbase/Cassandra - Consistency Models- CAP Theorem - ACID vs BASE in Databases.	10	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA268	**Computational Science**	**3-1-0-4**	**2016**

Course Objectives

- To impart theoretical and practical knowledge concerning numerical methods for scientific and engineering computations

Syllabus

Numerical Calculations- Numerical Solution Of Non Linear Equations- Gauss Elimination Method- Lagrange's Interpolation Polynomial- Mathematical Formulation Of Linear Programming problem- Standard Form of LPP- Transportation Problem-Network Scheduling

Expected Outcome

The students will be

i. Able to describe and interpret basic field problems and explain how they can be solved numerically.
ii. Able to compare and contrast different time stepping schemes for time dependent problems.

References

1. Erwin Kreyszig, Advanced Engineering Mathematics, New Age International (p) Limited
2. Froberg, Introduction to Numerical Analysis-Second Edition , Addition Wesley
3. Kanthi Swarup, P.K.Gupta,Man Mohan, "Operations research ," Sultan Chand & Sons. 5th Edition
4. R Panneerselvam – Operations research, 2nd edition, PHI
5. Sastry S.S., "Numerical Analysis, Prentice"-Hall India, 4th edition.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Errors In Numerical Calculations - Errors and their computation. Solution of algebraic and Transcendental Equations - Bisection Method -Regula Falsi Method - Iteration Method -Acceleration of convergence-Newton Raphson Method.	10	20%
II	Solution of linear systems – Introduction - Direct methods - Gauss Elimination Method -Gauss Jordan Method, Iterative Method -Jacobian Method - Gauss Seidel Method.	10	15%
	FIRST INTERNAL EXAMINATION		
III	Polynomial Interpolation-Introduction –Errors - Finite Difference - Difference Operators- Newtons Forward and Backward Difference Interpolation - Central Difference Interpolation Formulae - Gauss Interpolation Formulae. Interpolation with unevenly spaced points - Lagrange's Interpolation - Divided Differences - Newton's Divided Difference Interpolation	12	20%
IV	Mathematical Formulation Of Linear Programming problem- Formulation Of LPP-Graphical Solution Of LPP – Canonical And Standard Form of LPP- Simplex Method-Big M Method- Two Phase Method- Principle Of duality- Dual Simplex Method..	8	15%
V	Transportation type Problem- Initial Basic Feasible Solution- North West Corner Rule-Vogel's Approximation Method – Tests For Optimality- Unbalanced Transportation Problem- Assignment Problem.	8	15%

SECOND INTERNAL EXAMINATION			
VI	Travelling Salesman Problem-Network Scheduling-Rules of Network Construction – Critical Path Method-PERT.	8	15%

END SEMESTER EXAM

QUESTION PAPER PATTERN

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA272	**Advanced Java Programming**	**3-1-0-4**	**2016**

Course Objectives

- To understand the architecture of JVM
- To know the advancements in Java Language
- To introduce Enterprise Java

Syllabus

Networking using Sockets, Java Beans, Java 8 Features, Servlets, Spring frameworks

Expected Outcome

The students will

i. Get knowledge about JVM architecture
ii. Be able to write advanced Java Programs
iii. Be able to develop Spring based applications

References

1. Cay S. Horstmann, Gary Cornell, "Core Java, Volume II" - Advanced Features, Pearson, 9th Edition
2. Craig Walls , "Spring in Action" - Manning Publications, 4th Edition (2014).
3. H. M.Deitel, P. J. Deitel, S. E. Santry, "Advanced Java 2 Platform HOW TO PROGRAM" – Prentice Hall.
4. Jim Smith, Ravi Nair, "Virtual Machines", Morgan Kaufmann, Chapter 6
5. Raoul-Gabriel Urma, Mario Fusco, and Alan Mycroft , "Java 8 in Action: Lambdas, Streams, and functional-style programming", Manning Publications, 1st Edition (2014).
6. Uttam K.Roy, "Advanced Java Programming", Oxford University Press (2015)

Suggested MOOC

1. https://prod-edx-mktg-edit.edx.org/course/advanced-software-construction-java-mitx-6-005-2x
2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-01sc-introduction-to-electrical-engineering-and-computer-science-i-spring-2011/

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	JVM Architecture - Class Loader Subsystem - Runtime data Area - Method Area - Heap Area - Stack Area - Native Method Stack - Execution Engine - Garbage Collection. **Collections :** Collection Interfaces, Collection Classes, Collection Algorithms	7	10%
II	Java Beans: Introduction, Properties, Bean Builder, Advantages, BDK Introspection, Beaninfo interface, Persistence, Customizer, Javabeans API	7	10%
FIRST INTERNAL EXAMINATION			
III	Java 8 features: Iterable Interfaces, Functional Interface and Lambda Expressions, Parallel Operations, JVM JavaScript Engine, Date and Time APIs, Concurrent Accumulators, Collection API Improvements, Java IO Improvements	10	20%
IV	Servlets: Server-side java, Advantages over Applets, Servlet Alternatives, Servlet strengths,Architecture,lifecycle,GenericServlet,httpservlet,Passing and retrieving parameters, server-side Include, Cookies, Filters, Security issues. Java Server Pages – Introduction	10	20%

V	Spring Framework- Introduction, Dependency Injection and IoC , Spring Container and its life cycle, Aspect Oriented Programming, Data Access Framework, Transaction Management Framework, Messaging (JMS), REST and Unit Testing	12	20%
SECOND INTERNAL EXAMINATION			
VI	Create Spring MVC Applications, Create and configure a Spring application using Spring Boot, REST Web Services with Spring Boot, Data Access with Spring Boot, Spring Security, JMS support of Spring.	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA274	**Business Intelligence and its Applications**	**3-1-0-4**	**2016**

Course Objectives

- To understand Business Intelligence (BI) systems.
- To impart knowledge on design of BI solutions for different BI targets and users.
- To learn the role that software tools/applications play in BI with emphasis on industrial case studies and practical applications

Syllabus

Decision support and business intelligence, Computerised decision support, Decision support systems concepts, methodologies and technologies, Modelling and analysis, Data mining for business intelligence, Artificial neural networks for data mining, Text and web mining, Data warehousing

Expected Outcome

The students will be able to

i. Differentiate between Transaction Processing and Analytical applications and describe the need for Business Intelligence.
ii. Demonstrate understanding of technology and processes associated with Business Intelligence Framework.
iii. Select appropriate DM tools and methods to manipulate and achieve data.
iv. Demonstrate understanding of Data Warehouse implementation methodology and project life cycle.
v. Identify the metrics, indicators and make recommendations to achieve the business goal for given business scenario.

References

1. Bert Brijs, Business Analysis for Business Intelligence, CRC press.
2. Efraim Turban, Ramesh Sharda, Dursun Delen, Decision Support and Business Intelligence Systems, 9th edition Pearson Education, 2014.
3. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Decision support and business intelligence – introduction, changing business environments, managing decision making, computerized support for decision making, an early framework, work system view, major tools and techniques, plan.	8	10%
II	Computerized decision support – introduction and definitions, models, phases of decision making processes, intelligence phase, design phase, choice phase, implementation phase.	8	10%
FIRST INTERNAL EXAMINATION			
III	Decision support systems concepts, methodologies and technologies – decision support system configurations, description, characteristics and capabilities, classifications, components of decision support systems, data management subsystem, model management subsystem, user interface subsystem, knowledge based management subsystem.	10	20%
IV	Modelling and analysis- management support systems modelling, certainty, uncertainty, risk, decision analysis with decision tables and decision. Data mining for business intelligence- data mining	10	20%

	concepts and applications, data mining applications, data mining process, data mining methods, data mining software tools.		
V	Artificial neural networks for data mining- basic concepts of neural networks, learning in artificial neural networks. Text and web mining – text mining concepts and definitions, natural language processing, text mining applications, text mining process, text mining tools, web mining overview, web content mining and web structure mining.	9	20%
SECOND INTERNAL EXAMINATION			
VI	Data warehousing – data warehousing concepts and definitions, data warehousing process overview, data warehousing architecture, data warehouse development, real-time data warehousing, data warehouse administration and security issues, OLTP Vs OLAP .	9	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.		

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA232	**System Design Lab**	**0-0-4-1**	**2016**

Course Objectives

- To Introduce Shell Scripting.
- To sensitize the need for Version control
- To do network programming using Socket Programs.

Syllabus

Shell Scripts – GIT – Socket Programming

Expected Outcome

The students will be able to

i. Develop Shell Programs for system administration
ii. Use GIT and gain knowledge in using version control
iii. Develop programs for client- server communications using various network protocols(TCP/UDP)

References

1. B. M. Harwani, Unix and Shell programming", Oxford University Press(2013)
2. James F Kurose and Keith W Ross, "Computer Networking: A Top - Down Approach", Pearson Education; 5 th Edition (2012).
3. Richard Stevens, "UNIX Network Programming : Inter process Communications", Prentice Hall, Second Edition
4. Richard Stevens, "UNIX Network Programming,: Networking APIs: Sockets and XTI", Prentice Hall, Second Edition.
5. Travis Swicegood, " Pragmatic Guide to Git", Pragmatic Bookshelf. Pub. Date: November 15, 2010

Experiments/Exercises

Administration Level

Introduction to Shell scripting – Experiment with shell scripts mainly for administrative tasks like user creation in bulk, changing file permissions recursively, creating files in bulk, deleting folders and sub folders etc…

1. Commands
    1. echo, read
    2. more, less
    3. man
    4. chmod, chown
    5. cd, mkdir, pwd, ls, find
    6. cat, mv, cp, rm
    7. wc, cut, paste
    8. head, tail, grep, expr
    9. Redirections & Piping
    10. useradd, usermod, userdel, passwd
    11. tar
2. Scripting
    1. Environment variables
    2. If statement
    3. For statement
    4. While statement
3. Remote access
    1. ssh, scp, ssh-keygen, ssh-copy-id
4. Scheduling Using cron and at

Experiments to supplement RLMCA202 - Application Development and Maintenance

GIT

1. git init - Initializing an empty git repository
   git init --bare
2. git status - Knowing the status of your repository
3. git add <artifact> Staging/Adding artifacts(files) to repository
   {3.1 git status}*
4. git commit -m "Message for the commit" - Details on how to commit changes to the local repository
5. git add <pattern> - Bulk adding/staging artifacts to repository
   {5.1 git commit -m "Commit the changes"}*
6. git log - Git Activity logs
7. git remote add <origin_name> <remote repository URL> - Attaching a remote repository <remote repository URL> - username@127.0.0.1:/path/to/repository
8. git push -u <origin_name> <branch> (git push -u origin master) -Pushing to the master
9. git pull origin master - Pulling from a master
10. git diff options
11. resetting a staged/added file.
12. git checkout
13. git branch <branch_name> - Creating the branches
14. git checkout <branch_name> - switching between branches
15. git rm 'pattern' - removing the files/artifacts
    {15.1 commit to the branch}*
    {15.2 Switch back to the master}*
16. git merge <branch_name> - Merging the contents.
17. git branch -d <branch_name> - Removing a branch
18. git push - Syncing with the remote repository
19. git stash - Park your changes in directory.
20. git stash apply - Applying the changes back (git stash options)
21. git rebase - Reapply commits on top of another base tip

**** Steps that are repeated for completing the exercise***

Students should be encouraged to do all the subsequent experiments in a GIT repository.

Network Programming (Java/C)

1. Implement Bidirectional Client-Server communication using TCP.
2. Implement Echo Server using TCP
3. Implement Chat Server using UDP.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA234	**Mobile Application Development Lab**	**0-0-4-1**	**2016**

Course Objectives

- To execute mobile application development programming in android platform.
- To create a simple application that runs under the android operative system.

Syllabus

This is a companion course of RLMCA206 - Mobile Computing.

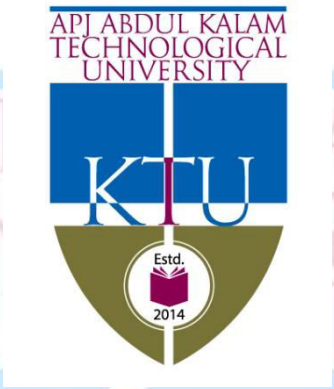
Expected Outcome

- The students will be able to develop android applications and test it on emulators and phones.

References

1. Joseph Annuzzi Jr, Lauren Darcey, Shane Condor, "Advanced Android Application Development, Developers Library", Pearson Education, 4th Edition (2015)
2. Joseph Annuzzi Jr, Lauren Darcey, Shane Condor, "Android Application Development, Android Essentials", 5th Edition (2016)
3. Lauren Darcey, Shane Condor, "Android, Wireless Application Development", Pearson Education, 3rd Edition.
4. Paul Deitel, Harvey Deitel, Alexander Wald, "Android 6 for programmers, An App-Driven Approach", Pearson Education

Sl No.	Experiments/Exercises
1	**Fundamentals**: Basic Building blocks – Activities, Services, Broadcast Receivers and Content providers, UI Components - Views and notifications Components for communication -Intents and Intent Filters
2	**Application Structure**:- AndroidManifest.xml , user-permission - sdk , Resources and R.java , Assets, Layouts and Drawable Resources, Activities and Activity lifecycle.
3	**Emulator-Android Virtual Device**:- Launching emulator, Editing emulator settings, Emulator shortcuts, Logcat usage, Introduction to DDMS
4	**Basic UI design**:- Form widgets , Text Fields , Layouts , [dip, dp, sip, sp] versus px
5	**Preferences**:- Shared Preferences, Preferences from xml
6	**Menu** : Option menu , Context menu, menu from xml, menu via code
7	**Intents** : Explicit Intents, Implicit intents
8	**UI design**: Time and Date, Images and media , Composite , Alert Dialogs and Toast, Popup
9	**Tabs and Tab Activity** **Styles and Themes**: styles.xml , drawable resources for shapes, gradients (selectors) , style attribute in layout file, Applying themes via code and manifest file
10	**Content Providers**: SQLite Programming , SQLite Open Helper, SQLite Database, Cursor, Reading and updating Contacts, Reading bookmarks



APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

CET Campus, Thiruvananthapuram, Kerala-695016

SYLLABUS
For

MASTER OF COMPUTER APPLICATIONS
(REGULAR)

Semester 5 and 6

SEMESTER 5

	Regular Master of Computer Applications (Regular)	Hours / week			IA Marks	ESE Marks	Total	Credits	Exam Slot
Course No	**Course**	**L**	**T**	**P**					
RLMCA301	Web Data Mining	3	1	-	40	60	100	4	A
RLMCA303	E-Commerce	3	-	-	40	60	100	3	B
RLMCA305	Cryptography and Cyber Security	3	1	-	40	60	100	4	C
RLMCA3--	Elective II	3	1	-	40	60	100	4	D
RLMCA3--	Elective III	3	1	-	40	60	100	4	E
RLMCA341	Seminar	-		2	50	-	50	2	S
RLMCA351	Mini Project	-		8	150	-	150	2	T
		15	**4**	**10**	**400**	**300**	**700**	**23**	

ELECTIVE-II		**ELECTIVE-III**	
RLMCA361	Compiler Construction	RLMCA381	Cloud Computing
RLMCA363	IPR and Cyber Law	RLMCA383	Human Computer Interaction
RLMCA365	Cyber Forensics	RLMCA385	Bioinformatics
RLMCA367	Internet of Things	RLMCA387	Computer Graphics
RLMCA369	Python Programming	RLMCA389	Parallel and Distributed Computing
RLMCA371	Social Network Analysis	RLMCA391	Artificial Intelligence

SEMESTER 6

	Regular Master of Computer Applications	Hours / week			Sessional	ESE Marks	Total	Credits	Exam Slot
Course No	**Course**	**L**	**T**	**P**					
RLMCA352	Project and Viva Voce			30	70	30	100	12	S
		Cumulative Total					**3600**	**123**	

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA301	**Web Data Mining**	**3-1-0-4**	**2016**

Course Objectives

- Provide data mining concepts, principles and methods
- To develop understanding of problems and potentials of current Information Retrieval (IR) Systems.
- Understand how effective information source and retrieval are inter- related

Syllabus

Web Data Mining - Basic Concepts of Association Rules - Supervised Learning - Unsupervised Learning - Information Retrieval and Web Search - Web Usage Mining.

Expected Outcome

At the end of the course, students will be able to

- Understand theoretical and practical aspects of information and data mining
- Understand the quantitative evaluation methods for the IR systemsand data mining techniques

References

1. Bing Liu, “Web Data Mining - Exploring Hyperlinks, Contents and Usage Data”, Second edition, Springer 2011.
2. Matthew A Russell, “Mining the social web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub and more”, Second Edition, O’Reilly October 2013.
3. Jiawei Han and Micheline Kamber, “Data Mining Concepts & Techniques”, Second Edition, Elsevier.
4. Alex Berson and Stephen J Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw –Hill Edition, Tenth Reprint 2007.
5. Pang Ning Tan, Michael Steinbach and Vipin Kumar, “ Introduction To Data Mining”, Pearson Education, 2007.

Suggested MOOC

1. https://ocw.mit.edu/courses/sloan-school-of-management/15-062-data-mining-spring-2003/lecture-notes/
2. http://www.cs.virginia.edu/~hw5x/Course/CS6501-Text-Mining/_site/lectures/

Course Plan

Module	Contents	Hours Allotted	% of marks in End-Semester Examination
I	Introduction - World Wide Web - Web Data Mining - Data Mining - Web Mining - Data Mining Foundations - Basic Concepts of Association Rules - Apriori Algorithm - Data Formats for Association Rule Mining - Basic Concepts of Sequential Patterns - Mining Sequential Patterns based on Generalised Sequential Pattern (GSP) Algorithm *Text : 1*	8	15
II	Supervised Learning - Basic Concepts - Decision Tree Induction - Classifier Evaluation - Rule Induction - Classification based on Associations - Support Vector Machines - Linear SVM - Separable Case -Non Separable Case - Unsupervised Learning - Basic Concepts - K-Means Clustering - Representation of Clusters - Hierarchical Clustering *Text : 1*	12	25
FIRST INTERNAL EXAM			
III	Information Retrieval and Web Search - Basic Concepts of IR - IR Models - Boolean Model, Vector model, Statistical Language Model - Evaluation Measures *Text : 1*	8	15
IV	Text and Web Page Pre-Processing - Stopword Removal, Stemming, Other Pre-Processing Tasks for Text, Web Page Pre-Processing, Duplicate Detection - Inverted Index and its Compression - Latent Semantic Indexing *Text : 1*	8	15
V	WebSearch - Metasearch: Combining Multiple Rankings - Web Spamming - Web Crawling - A Basic Crawler Algorithm - Implementation Issues *Text : 1*	8	15
SECOND INTERNAL EXAM			
VI	Web Usage Mining - Data Collection and Preprocessing - Data Modelling for Web Users Mining - Discovery and Analysis of Web Usage Patterns - Recommender Systems and Collaborative Filtering *Text : 1*	8	15
END SEMESTER EXAM			

QUESTION PAPER PATTERN			
	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA303	**E-Commerce**	**3-1-0-4**	**2016**

Course Objectives

- Define E-commerce and describe how it differs from e-business.
- Describe major business models of E-Commerce
- Describe how Internet and Web features support E-Commerce
- Understand the key dimensions of E-Security
- Understand the features of E- Payment systems
- Understand the concepts and technologies of E- marketing systems

Syllabus

Introduction to e-Commerce, Business Models and Concepts, Technology Infrastructure for E-Commerce, E-Security , E-Payment and E-Marketing

Expected Outcome

At the end of the course,

- The students are expected to realise the problems involved in designing and building e-commerce systems.
- Understand the need to design E-Commerce systems that fully meet the requirements of the intended users.

References

1. Kenneth C. Laundon, Carol Guercio Traver, “E-Commerce”, Pearson India, 2016
2. P T Joseph, S.J., “E-Commerce An Indian Perspective”, PHI, Fifth edition ,2015
3. Whiteley,”e-Commerce Strategies, Technologies and Applications”, McGraw Hill, 2014
4. Tharam Dillon, Henry Chan, “E-Commerce Fundamentals and Applications”, John Wiley & Sons Ltd, 2014

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Introduction to e-Commerce- e-Commerce v/s e-Business, Types of E-Commerce, E-commerce Infrastructure ***Text : 1***	6	15
II	Business Models and Concepts - B2C, B2B, C2C, C2B -Brokerage Model, Aggregator Model, Info-mediary Model, Community Model, Value Chain Model, Manufacturer Model, Advertising Model, Subscription Model, Affiliate Model *Text: 2*	10	20
FIRST INTERNAL EXAM			
III	E-Security:E-Commerce Security Environment, Security Threats, Technology Solutions, SSL, Protecting Networks- Firewalls, Proxy-Servers *Text :1*	8	15
IV	E-Payment: Types of Payment Systems, Credit card E-Commerce Transactions- How an Online Card Transaction works - Credit Card E-Commerce Enablers - Limitations of Online Credit Card Payment Systems, Secure Electronic Transaction Protocol *Text :1*	8	15
V	E-Commerce digital payment systems in B2C-Digital Wallets- Digital Cash -Online stored Value Systems -Digital Credit Card Payment systems - Digital Checking Payment systems - B2B Payment systems *Text :1*	10	20
SECOND INTERNAL EXAM			
VI	E-Marketing: Basic Marketing Concepts, Internet Marketing Technologies, B2C and B2B-Commerce, Marketing and Branding Strategies, Online Market Research *Text :1*	8	15
END SEMESTER EXAM			
QUESTION PAPER PATTERN			

	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLMCA305	**Cryptography and Cyber Security**	**3-1-0-4**	**2016**

Course Objectives

- Provide basic mathematical concepts used in Cryptography.
- Provide basic understanding of various cryptographic algorithms.
- Provide basic understanding of Hashing techniques, Digital Signature schemes and key management techniques.
- Provide basic understanding of crypto currencies and bitcoins
- Provide an understanding of network security implementation at application layer, transport layer, and network layer and the protocols used.

Syllabus

Introduction to Cryptography, Security architecture and classical encryption schemes, Number theory basics, Conventional symmetric key encryption techniques, Public key cryptography, Digital signatures, Message Authentication codes and Hash functions, Crypto currencies and bitcoins, Cyber Security, Email Security, IP Security and Web Security.

Expected Outcome

At the end of the course, students will be able to

1. *Build cryptosystems using various Symmetric and Asymmetric encryption techniques.*
2. *Apply the concepts of different message authentication and digital signature techniques to applications for ensuring secure transactions.*
3. *Apply security services to applications at Application, Transport and Network layer.*

References

1. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013.
2. Behrouz A. Forouzan, “Cryptography and Network Security”, Tata McGraw-Hill Publishing(2e 2011)
3. Charlie Kaufman, Radia Perlman and Mike Speciner, “Network Security”, Prentice Hall of India, 2002.
4. Manuel Mogollon, “Cryptography and Security Services – Mechanisms and Applications”,Cybertech Publishing.
5. William R. Cheswick, Steven M. Bellovin, Aviel D. Rubin, “Firewalls and Internet Security” Addison-Wesley

6. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, "Bitcoin and Cryptocurrency technologies", Princeton University Press

Suggested MOOC

1. **https://www.coursera.org/learn/crypto**
2. **https://www.coursera.org/learn/cryptocurrency**
3. **https://www.coursera.org/learn/crypto2**

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	**Introduction to Cryptography**: Services, Mechanisms and attacks-Phishing, ransomware, DoS attack, OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).	8	15%
II	**Mathematical Background:Elementary number theory:** Prime numbers, Fermat's and Euler's theorems, Testing for primality, **Modular Arithmetic**: Congruences, Chinese remainder theorem. F**inite fields**: Review of groups, rings and fields; Finite fields of the form GF(p), Polynomial Arithmetic, Finite fields of the form GF(2").Discrete logarithms Euclidean Algorithms.	12	15%
FIRST INTERNAL EXAM			
III	**Conventional Symmetric Key Encryption:Block** ciphers and Stream Ciphers, Modes of operation (ECB, CBC, CFB, OFB), multiple encryption, Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES. **Public key cryptography:** Principles of public key cryptosystems-The RSA algorithm-Key management – Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.	8	20%
IV	**Hash Functions and MAC**: Properties of hash functions, birthday attack, hash-cash, Message Authentication Code Algorithms, MAC protocols, HMAC, CBC-MAC. **Digital Signatures:** Classification of signature schemes, RSA signature, Digital Signature Standard, one time signature schemes, attacks on Digital Signatures, Blind Signatures.	8	15%
V	**Cryptocurrencies and Bitcoins**: **A Simple Cryptocurrency**: GoofyCoin, ScroogeCoin, **How Bitcoin Achieves Decentralization:** Centralization vs. Decentralization, Distributed consensus, Consensus without identity. **Mechanics of Bitcoin**: Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, **How to Store and Use Bitcoins**: Simple Local Storage, Hot and Cold Storage, Splitting and	8	15%

	Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets		
SECOND INTERNAL EXAM			
VI	**Introduction to Cyber Security, E-mail Security:** Security Services for E-mail-attacks possible through E-mail – establishing keys privacy-authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy-S/MIME. **IPSecurity:** Overview of IPSec – IPv4 and IPv6-Authentication Header-Encapsulation Security Payload (ESP)-Internet Key Exchange. **Web Security:** SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSL Attacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET).	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA361	Elective II- Compiler Construction	3-0-1-4	2016

Course Objectives

- To introduce the major concept areas of language translation and compiler design.
- To enrich the knowledge in various phases of compiler and its use, token generation, parsing, creating intermediate codes, code optimization techniques, machine code generation, and use of symbol table.
- To provide practical programming skills necessary for constructing a compiler.

Syllabus

Introduction to compilers and interpreters – Overview of compilation, Issues in compilation – structure of a compiler – compiler writing tools – bootstrapping – notations and concepts for languages and grammars – regular expressions – context free grammar, derivations and parse trees, BNF notations.

Context of a lexical analyzer – construction of lexical analyzer, deterministic and non-deterministic finite automata. Compile time error handling, error detection, reporting, recovery and repair.

Basic parsing techniques – Top down parsing – recursive descent parser, predictive parser simple LL(1) grammar. Bottom up parsers, operator precedence parser, LR grammar, LR(0), SLR(1) parsers.

Syntax directed translation schemes, syntax-directed definitions - S-attributed definitions - L-attributed definitions - bottom-up and top-down translation - type checking - type systems - specification of a type checker - run-time environments - source language issues - storage organization – storage allocation strategies - access to non-local names - parameter passing - symbol tables.

Intermediate codes, translation of assignments, translation of array reference, Boolean expressions, case statements, back patching.
Code optimization, loop optimization and global optimization, sources of sample code generation.

Expected Outcome

At the end of the course, students will be able to

- Develop lexical rules and grammars for a programming language
- Develop Parser for a programming language.
- Identify and develop code optimization techniques to improve the performance of a program in terms of speed & space.
- Design a compiler for a concise programming language.

References

1. Alfred V Aho and Jeffery D Ullman , Principles of Compiler Design - Techniques and Tools, Pearson Edn, 2nd edn, 2009
2. V Raghavan- Principles of Compiler Design – TMH, 2nd ed,2011
3. Jean Paul Tremblay and Sorenson., The Theory and Practice of Compiler Writing McGraw Hill
4. Principles of compiler design, 2nd ed, Nandini Prasad, Elsevier
5. Kenneth C.Louden, Compiler Construction-Principles and Practice, 2nd Edition, Cengage, 2010.
6. Keith Cooper and Linda Torczon, "Engineering a Compiler", 2nd Edition, Elsevier, 2011
7. Principles of Compiler, A new approach to Compilers including the algebraic methods, Su, Yunlin, Yan, Song Y., SPRINGER

Suggested MOOC

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-035-computer-language-engineering-spring-2010/lecture-notes/
2. http://nptel.ac.in/courses/106108113/

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Compilers – Analysis of the source program – Phases of a compiler – Interpreters –Compiler construction tools– bootstrapping – Compile time error handling, Notations and concepts for languages and grammars – regular expressions – Context of a lexical analyzer –deterministic and non-deterministic finite automata-construction of lexical analyzer. Introduction to Lex //Assignments on Lex programs	9	20
II	Role of the parser –Writing Grammars - Context free grammar, derivations and parse trees, BNF notations. Top Down parsing – Recursive Descent Parsing – Predictive Parsing	8	20
FIRST INTERNAL EXAM			
III	Bottom-up parsing – Shift Reduce Parsing – Operator Precedence Parsing – LR Parsers – SLR Parser. Introduction to Yacc //Assignments on Yacc programs	8	15
IV	Syntax Directed Translation, Intermediate Codes-Syntax Tree- Three Address Codes-Quadruple-Triples- Indirect Triples-comparisons	8	15
V	Translation of Assignment Statements, Translation of Boolean Expressions, Translation of Control flow statements-Backpatching-Symbol Tables-Data Structures	8	15
SECOND INTERNAL EXAM			
VI	Code Optimization- Sources-Loop Optimization-DAG representation-Construction-Global data Flow analysis Issues in the design of code generator – A simple Code Generator	9	20
END SEMESTER EXAM			
QUESTION PAPER PATTERN			

	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA363	Elective II- IPR and Cyber Law	3-0-1-4	2016

Course Objectives

- To understand various intellectual property rights
- To understand the procedure for applying copyright,patents.
- Learn the legalities of intellectual property to avoid plagiarism and other IPR related crimes like copyright infringements.
- To understand various cybercrimes.
- To understand the information technology act.
- To understand various penalties related to cybercrimes.

Syllabus

Fundamentals of IPR - Patents - Trademarks - Copyright - Industrial Designs - Geographic Indications - Trade Secret and software copyright - cyber law - Information Technology Acts and Punishments

Expected Outcome

At the end of the course, students will be able to

- Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IPs.
- Recognize the crucial role of IPs in organizations of different industrial sectors for the purposes of product and technology development.
- Identify activities which constitute IP infringements and the remedies available to the IPs owner and describe the steps to be taken to prevent infringement of proprietary rights in products and technology development.
- Evaluate the effectiveness of cyber-security, cyber-laws and other countermeasures against cybercrime and cyber warfare.
- Analyse and assess the impact of cybercrime.
- Understand the structure, mechanics and evolution of the Internet in the context of emerging crime threats and technological and other trends in cyberspace.

References

1. Dr. R. Radhakrishnan and Dr. S. Balasubramanian, " Intellectual Property Rights: Text and Cases", Excel Books
2. Harish Chander, " Cyber Law and IT Protection", PHI Learning Pvt.Ltd
3. D.Bainbridge, "Introduction to Computer Law", Pearson Education
4. RohasNagpal, "Cyber Crime & Corporate Liability", CCH, 2008

Suggested MOOC

1. http://www.ficciipcourse.in/index.php
2. https://onlinecourses.nptel.ac.in/noc16_hs08/preview

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	**Fundamentals of IPR-** Introduction – Intellectual property – Need for protection of intellectual property – WIPO – Intellectual property rights and development – Rationale of protection – TRIPS Agreement – **Patents –** Introduction **–** Patentable and Non-patentable Invention – Types of patent applications – Guidelines for registration of patent – patent filing – grant of patent – types of patent documents *Text :1*	8	15
II	**Trademarks** – Introduction – Guidelines for registration – Requirements for filing trademarks – Trademark Infringement – Protection of trademarks – **Copyright –** Introduction – Rights conferred by copyright – registration – ownerships – terms – transfer of copyrights – copyright infringement – databases and copyright *Text :1*	8	20
FIRST INTERNAL EXAM			
III	**Industrial Designs** – Introduction – Need for protection of design – requirements for registration of designs – Design Act,2000 – Duration of registration of design – application procedure – **Geographic Indications –** Introduction **–** Filing – Granting – Protection of geographic indications *Text :1*	8	15
IV	**Trade Secret –** definition – discovering and protecting of trade secret – **Software Copyright** –Introduction – Need of software copyright – classification of software according to copyright – software auditing – copyright notice – transfer of copyright *Text :1*	8	15
V	Cyber law - Need for cyber laws - Historical perspective - cyberspace - deception by squatting in cyberspace - protection of copyright on cyberspace - infringement of copyright on cyberspace - linking, hyperlinking and framing - ISP in cyberspace - cyberspace and protection of patents in India. *Text :2*	8	15
SECOND INTERNAL EXAM			

VI	Information Technology Act and Punishments- Introduction to IT Act 2000- Amendments on IT Act - Violation of the right of privacy in cyberspace/internet-punishment for violation of privacy, breach of confidentiality and privacy under IT act- Terrorism on cyberspace- overview of cybercrimes-offences by intermediaries- offences related to protected system- offences of misrepresentation-punishment for Abetment and Attempt to commit offences under the IT act. *Text :2*	10	20
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA365	Elective II- Cyber Forensics	3-1-0-4	2016

Course Objectives

- To understand the fundamentals of computer forensics
- To introduce computer security administrators to computer forensics.
- To understand about computer forensics tools.
- To understand about data acquisition.
- To perform computer forensic analysis, e-mail investigations, image file recovery.
- To perform cloud forensics.

Syllabus

Computer forensics fundamentals - Types of computer forensics technology - Data recovery - Evidence collection and data seizure - Computer image verification and authentication - Reconstructing past events

Expected Outcome

- Identify and need for computer forensics
- Describe the computer forensic technology
- Illustrate the process of data recovery
- Determine various aspects of collecting and preserving computer evidence
- Assess the authenticity of evidences and forensic identification.
- Estimate various ways to handle files, evidence related data and network forensics scenarios.

References

1. John R Vacca,"Computer Forensics computer crime scene investigation ", Firewall Media, 2009 Edition Reprint 2012.
2. Bill Nelson, Amelia Phillips, Christopher Steuart , "Guide to Computer Forensics and Investigations", Cengage Learning, Fifth Edition 2010.
3. Marjie T. Britz, "Computer Forensics and Cyber Crime", Pearson Third Edition 2013.
4. Marie - Helen Maras "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning, Second Edition 2015.

Suggested MOOC

1. **http://www.open.edu/openlearn/futurelearn/cyber-security**
2. **http://www.cyberdegrees.org/resources/free-onlinecourses/.**

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	**Computer forensics fundamentals:** Introduction: What is computer forensics? - Use of computer forensics in law enforcement - Computer forensics assistance to human resources /employment proceedings - Computer forensics services - Benefits of professional forensics methodology - Steps taken by computer forensics specialists.	8	15
II	**Types of computer forensics technology:** Types of military computer forensics technology, Types of law enforcement in Computer forensic technology, Types of business computer forensic technology. Occurrence of cyber crime - Cyber detectives - Computer forensics investigative services. *//Lab exercises may be given for (use any open source tools):* *1. Investigating NTFS Drive using DiskExplorer.* *2. Viewing contents of a forensic image*	8	15
FIRST INTERNAL EXAM			
III	**Data recovery:** Introduction of Data recovery - Data back-up and recovery - The role of back- up in data recovery - The data-recovery solution. *//Lab exercises may be given for (use any open source tools):* *1. File Recovery.* *2. Data Recovery.*	8	15
IV	**Evidence collection and data seizure**: Why collect evidence?, Collection options - Obstacles - Types of evidence - The rules of evidence - Volatile evidence - General procedure - Collection and archiving - Methods of collection - Artifact - Collection steps. Preserving the digital crime scene - Computer evidence processing scene - Legal aspects of collecting forensic evidence. *// Lab Exercises may be given for (use any open source tools):* *1. Gathering evidences* *2. Viewing files of various formats*	10	20

V	**Computer image verification and authentication:** Special needs of evidential authentication - Practical consideration - Practical implementation. Electronic document discovery :a powerful new litigation tool. Forensics identification and Analysis of technical surveillance devices. *// Lab Exercise may be given for (use any open source tools):* *1. Identifying image file format.* *2. Analyzing images for hidden messages.*	8	15
SECOND INTERNAL EXAM			
VI	**Reconstructing past events:** How to become a digital detective - Useable file formats - Unusable file formats - Converting files. Network forensics scenario - A technical approach - Destruction of e-mail - Damaging computer evidence. *// Lab Exercises may be given for (use any open source tools):* *1. Cracking password using any password recovery tool.* *2. Recovering deleted emails using the recover my email utility* *Note : Students may be introduced to penetration testing tools like metasploit, Penetration Testing DistributionKali linux, network protocol analyzers like wiresharketc as part of the course.*	10	20
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2.The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA367	Elective II- Internet of Things	3-1-0-4	2016

Course Objectives

- Understand the main concepts and features of the IoT paradigm
- Describe different architectures for managing IoT platforms
- Insight on trust, security, and privacy in IoT environments
- Describe data management techniques applied to the IoT environment
- Understand the key enablers and solutions to enable practical IoT systems

Syllabus

IoT ecosystem concepts and architectures - IoT enablers and solutions - IoT data and knowledge management - IoT reliability, security, and privacy - IoT applications

Expected Outcome

- At the end of the course, students should be able to understand the concepts and features of IoT Paradigm with a good understanding on different IoT architectures and how it is practically managed.

References

1. RajkumarBuyya; Amir VahidDastjerdi , “Internet of Things”, Morgan Kaufmann, 2016
2. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015
3. S. SitharamaIyengar; NandanParameshwaran; Vir V. Phoha; N. Balakrishnan; Chuka D. Okoye, “Fundamentals of Sensor Network Programming: Applications and Technology”, Wiley, December 14, 2010
4. Robert Stackowiak (Author), Art Licht (Author), VenuMantha (Author), Louis Nagode (Author), “Big Data and The Internet of Things: Enterprise Information Architecture for A New Age” , Apress, 2015

Suggested MOOC

1. https://www.coursera.org/specializations/internet-of-things
2. http://web.mit.edu/professional/digital-programs/courses/IoT

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Overview of Internet of Things - Open source semantic web infrastructure for managing IoT resources in the Cloud - Device/Cloud collaboration framework for intelligence applications	10	20
II	Introduction to Fog Computing: principles, architectures, and applications - TinyOS - NesC	6	15
FIRST INTERNAL EXAM			
III	Programming frameworks for Internet of Things - Virtualization on embedded boards as enabling technology for the Cloud of Things - Micro Virtual Machines (MicroVMs) for Cloud-assisted Cyber-Physical Systems (CPS)	8	15
IV	Stream processing in IoT: foundations, state-of-the-art, and future directions - A framework for distributed data analysis for IoT	8	15
V	Security and privacy in the Internet of Things- Internet of Things—robustness and reliability - Governing Internet of Things: issues, approaches, and new paradigm - TinyTO: two-way authentication for constrained devices in the Internet of Things - Obfuscation and diversification for securing the internet of things (IoT)	10	20
SECOND INTERNAL EXAM			
VI	Applied Internet of Things - Internet of Vehicles and applications - Cloud-Based Smart-Facilities Management Creating a simple sensor project - Preparing Raspberry Pi - Interfacing the hardware - Internal representation of sensor values- Persisting data -Creating the actuator project - Creating a controller	8	15
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper - Part A and Part B. Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in Part B to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus**.**		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA369	Elective II- Python Programming	3-1-0-4	2016

Course Objectives

- To develop proficiency in the Python Programming Language.
- To be able to understand the various data structures available in Python programming
- To be able to do testing and debugging of code written in Python.
- To implement OOPs concept using Python
- To be able to develop web based applications using Python

Syllabus

Introduction to Python, Data Types and Operations, Decision Making, Functions, Modules & Packages, File Handling, Object Oriented Programming, Exception Handling and Regular Expressions, Database Programming, GUI Programming, Web Development and Web Frameworks.

Expected Outcome

- Ability to design algorithmic solution to problems.
- Ability to convert algorithms to Python programs.
- Ability to design modular Python programs using functions.

References

1. Wesley J. Chun, “Core Python Applications Programming”, 3rd Edition , Pearson Education, 2016
2. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley, 2015
3. Jeeva Jose &P.SojanLal, “Introduction to Computing and Problem Solving with PYTHON”, Khanna Publishers, New Delhi, 2016
4. Downey, A. et al., "How to think like a Computer Scientist: Learning with Python", John Wiley, 2015

Suggested MOOC

1. **https://archive.org/details/MIT6.00SCS11**
2. **https://www.coursera.org/course/pythonlearn**
3. **http://www.learnerstv.com/Free-Computer-Science-Video-lectures-ltv163-Page1.htm**
4. **https://www.coursera.org/learn/python-databases**

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Introduction to Python: Features of Python, How to Run Python, Identifiers, Reserved Keywords, Variables, Input, Output and Import Functions, Operators Data Types: Numbers, Strings, List, Tuple, Set, Dictionary, Data Type Conversions. Decision Making, Loops, Nested Loops, Control Statements, Types of Loops	8	15%
II	Function Definition, Function calling, Function arguments, Lambda Functions, Recursive Functions Modules & Packages: Creating Modules, import Statement, Locating Modules, Namespaces and Scope, Packages, Date and Time Modules. Exception Handling: Built-in Exceptions, Handling Exceptions, Exception with arguments, Raising an Exception, User-defined Exception, Assertions in Python.	9	15%
FIRST INTERNAL EXAM			
III	File Handling, Object Oriented Programming: Class definition, Creating objects, Encapsulation, Data hiding, Inheritance, Method overriding, Polymorphism.	8	20%
IV	Regular expressions: Introduction, match() function, search() function, search and replace, regular expression modifiers, regular expression patterns, Character classes, special character classes, repetition cases, findall() method, compile() method. Database Programming: Connecting to a database, Creating Tables, INSERT, UPDATE, DELETE and READ operations, Transaction Control, Disconnecting from a database, Exception Handling in Databases	9	20%
V	GUI Programming: Tkinter introduction, Tkinter and Python Programming, Tk Widgets, Tkinter examples Web Development: Python Web clients tools, Web Clients, Web Servers, Web Services.	8	15%
SECOND INTERNAL EXAM			

VI	Web Frameworks : Introduction to Django, Projects and Apps in Django, The Python Application Shell, The Django Administration App, Creating an App using Django. Introduction to SciPy (https://www.scipy.org), NumPy (http://www.numpy.org), matplotlib (https://matplotlib.org). A micro project/programming assignment should be given as part of the course. Assignments may be given in machine learning using resources available at scikit-learn.org. Note : Python may be taught effectively using ***IPython*** (https://ipython.org) using Jupiter notebook, which provides an interactive web based platform for programming.	9	15%
	END SEMESTER EXAM		
	QUESTION PAPER PATTERN		
	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA371	Elective II- Social Network Analysis	3-1-0-4	2016

Course Objectives

- To provide students with essential knowledge of network analysis applicable to real world data, with examples from today's most popular social networks.

Syllabus

Introduction to Social Network Analysis - Social Media Examples - Electronic Sources for Network Analysis - Mathematical Representations of Social Networks - Modelling and Aggregating Social Network Data - Semantic based Social Network Analysis - Case Studies

Expected Outcome

At the end of the course, students will be able to :

- Understand the importance of social media and networks
- Enhance analytical skills for analyzing social media and networking data
- Create real - life case studies using social media data

References

1. Peter Mika, "Social Networks and the Semantic Web", Springer, 2007
2. Hansen, Derek, Ben Shneiderman, Marc Smith, "Analyzing Social Media Networks with NodeXL: Insights from a Connected World", Morgan Kaufmann, 2011
3. Stanley Wasserman and Katherine Faust. "Social Network Analysis. Methods and Applications." Cambridge University Press, 1994
4. Christina Prell, "Social Network Analysis: History, Theory and Methodology", SAGE Publications Ltd, 2012

Suggested MOOC

1. http://nptel.ac.in/courses/106106146
2. https://www.politaktiv.org/documents/10157/29141/SocNet_TheoryApp.pdf
3. https://www.mooc-list.com/course/social-network-analysis-coursera

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Introduction to Social Network Analysis - Network Analysis - Key Concepts and Measures in Network Analysis - Global Structure of Networks, Macro Structure of Social Networks, Personal Networks Relevant Portions from Text 1	8	15
II	Social Media Examples: Asynchronous Threaded Conversation - Synchronous Conversation - World Wide Web - Collaborative Authoring - Blogs and Podcast - Social Sharing - Electronic sources for network analysis - Electronic discussion networks - Blogs and online communities - Web based networks. Text 2 and Text 1	10	20
FIRST INTERNAL EXAM			
III	Mathematical Representations of Social Networks - Notations for Social data - Graph Theoretic Notation, Sociometric Notation, Algebraic Notation - Sets of Actors Text 1	8	15
IV	Modelling and Aggregating Social Network Data : Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Representing identity - Determining equality - Reasoning with instance equality- Evaluating Smushing Text 1	10	20
V	Developing social-semantic applications : Building Semantic Web applications with social network features - The generic architecture of Semantic Web applications - Sesame - Elmo - Flink : the social networks of the Semantic Web community - Features of Flink. Text 1	10	15
SECOND INTERNAL EXAM			
VI	Social Media Network Analysis Case Studies - Email - Twitter - Visualizing and Interpreting Facebook Networks - YouTube: Contrasting Patterns of Interaction and Prominence. Text 2	8	15
END SEMESTER EXAM			

QUESTION PAPER PATTERN			
	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA381	**Elective III- Cloud Computing**	**3-1-0-4**	**2016**

Course Objectives

- Understand the main concepts and features of Cloud Computing
- Understand when enterprises should choose Cloud Services
- Understand current cloud providers and the offerings
- Understand cloud services and its applications

Syllabus

Introduction to Cloud Computing - The Value Proposition of Cloud computing - Using Cloud Platforms - Exploring Cloud Infrastructures - Details of Cloud Services and its Applications - Using the Mobile Cloud

Expected Outcome

- At the end of the course, students should be able to understand the basics of Cloud computing and be able to would be able to understand different cloud offering and its applications.

Text Book

1. Peter Waher, “Cloud Computing Bible”, John Wiley & Sons Publishing, 2011

Reference Books

1. Michael Kavis, "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", John Wiley & Sons Publishing, 2014
2. Jothy Rosenberg; Arthur Mateos, “The Cloud at Your Service: The when, how, and why of enterprise cloud computing”, Manning Publications , 2010

Suggested MOOC

1. https://www.coursera.org/specializations/cloud-computing
2. http://ocw.mit.edu/courses/sloan-school-ofmanagement/15-768-management-of-services-conceptsdesign-and-delivery-fall-2010/lecture-notes/

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Defining Cloud Computing - Cloud Types- Characteristics of Cloud Computing - Open Standards - Value of Cloud for Enterprises - Understanding Cloud Architectures - Understanding Services and Applications by Type - IaaS vs. PaaS vs. SaaS	8	15
II	Virtualization Technologies - Load Balancing and Virtualization- Hypervisors - Machine Imaging - Porting Applications- Capacity Planning - Baselines and Metrics - Network Capacity - Scaling - Exploring Platform as a Service - Using Google Web Services	8	15
FIRST INTERNAL EXAM			
III	Using the prominent cloud services - Google Cloud Services - Amazon Web Services - Microsoft Cloud Services - Google Cloud Services - Demonstration/Tutorial on exploring cloud services on either Amazon/Azure/Google Cloud platform	8	15
IV	Managing the Cloud - Cloud Management Products - Industry Standards - Understanding Cloud Security - Securing the Cloud - Establishing Identity and Presence	8	20
V	Understanding Service Oriented Architecture - Moving Applications to the Cloud - Working with Cloud-Based Storage - Working with Productivity Software - Using Webmail Services - Communicating with the Cloud - Using Media and Streaming	10	20
SECOND INTERNAL EXAM			
VI	Working with Mobile Devices - Smartphones accessing cloud services - Cloud Mobile Web Service - Service Types - Service Discovery - Microservice architecture	8	15
END SEMESTER EXAM			

QUESTION PAPER PATTERN			
	There will be two parts in the Question paper - Part A and Part B. Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in Part B to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA383	Elective III- Human Computer Interaction	3-1-0-4	2016

Course Objectives

- Acquire the knowledge and skills needed to create highly usable software systems.
- Obtain the objective of the basics of human and computational abilities and limitations.

Syllabus

Usability Engineering Concepts - Interaction basics - Interaction Designs - Socio - Organizational Issues and Stakeholder Requirements - Modelling Rich Interaction

Expected Outcome

- Understand basic concepts of Usability Engineering
- Understand the fundamental aspects of interaction and designing the interaction
- Understand basic concepts of Dialog Designing aspects in Human Computer Interaction
- Understand the aspect of Rich Context Modelling

References

1. Alan Dix,Janet Finlay, ”Human Computer Interaction” ,Third Edition,Pearson Education
2. Preece J. , Rogers Y, Sharp H.,”Human Computer Interaction, Addison - Wesley,1994.
3. Martin.G.Helander,Thomas .k .Landauer, “Handbook of Human Computer Interaction”,Second Edition , Elsevier 1997
4. B.Shneiderman, “ Designing The User Interface” Addison Wesley 2000

Suggested MOOC

1. http://nptel.ac.in/courses/106103115/3

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Introduction- User-Centered System Design , Human Computer Interaction (HCI) - HCI as Process - Relationship Between the HCI and Human Dialogue - Goals of HCI - Purpose of HCI - Interaction and Interactivity - Factors in HCI Design.	8	15
II	Usability - Concepts of Usability - Usability Criteria - Usability Specifications – Conclusion.	8	15
FIRST INTERNAL EXAM			
III	The interaction - Introduction - Models of interaction - Frameworks and ERGONOMICS - Interaction Styles - Interactivity - The Context of the Interaction - Experience , Engagement and Fun	10	20
IV	Interaction Design Basics - Introduction- The process of Design - User Focus- Scenarios - Navigation Design - Iteration and prototyping	10	20
V	Socio - Organizational Issues and Stakeholder Requirements - Capturing Requirements,Dialog- Dialog Design Notations - Diagrammatic Notations	8	15
SECOND INTERNAL EXAM			
VI	Modelling Rich Interaction-Introduction - Status Event Analysis - Rich Contexts - Rich Contexts	8	15
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper - Part A and Part B. Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in Part B to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA385	**Elective III- Bioinformatics**	**3-1-0-4**	**2016**

Course Objectives

- To enable the students to understand scope of Bioinformatics
- To understand popular bioinformatics database
- To learn Fundamentals of Databases and Sequence alignment
- To learn Genomics and Gene Recognition
- To study predictive methods using DNA and Protein Sequences

Syllabus

Introduction to bioinformatics and molecular biology: Databases tools and their uses, Data searches and Pairwise Alignments, Molecular Phylogenetic, Genomics and Gene Recognition, Protein and RNA structure Prediction

Expected Outcome

- At the end of the course,Students will be comfortable to formulate solutions to problems in the field of bioinformatics.

References

1. Dan. E. Krane and M. L. Raymer, “Fundamental Concepts of Bioinformatics”, Pearson Education, 2003.
2. Attwood T. K. and D. J. Parry-Smith, “Introduction to Bioinformatics “, Pearson Education, 2003.
3. Neil C Jones and Pavel A Pevzner,” An Introduction to Bioinformatics Algorithms”, MIT Press, 2004.
4. David W Mount, “Bioinformatics- Sequence and Genome Analysis “, 2/e, Cold Spring Harbor Laboratory Press, New York, 2004.
5. Jean-Michel and Cedric Notredame, “Bioinformatics – A beginners guide”, Wiley India, 2010
6. Bryan Bergeron, M.D, “Bioinformatics Computing”, Pearson Education, 2015.

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	**Introduction to bioinformatics and molecular biology:** What is Bioinformatics? Why is Bioinformatics important?Central Dogma of Molecular Biology: Proteins- Structure, Protein Folding and Protein functions, DNA and RNA structure – Nucleic Acid structure and function, Genetic Code, Genes and Evolution	8	15
II	**Biological Databases and DNA sequence data repositories** Importance of databases -Biological databases-primary sequence databases, Composite protein sequence databases- Secondary databases- nucleic acid sequence databases -Composite Protein pattern databases - structure classification databases – DNA sequence databases - specialized genomic resources- analysis packages	8	15
FIRST INTERNAL EXAM			
III	**Data searches and Pairwise Alignments:** Dot plots, Simple Alignments, Gaps, Scoring Matrices Dynamic Programming: The Needleman and Wunsch Algorithm, Global and Local Alignments- Semi global alignments- The Smith-Waterman algorithm , Database Searches, Multiple sequence alignments	10	20
IV	**Molecular Phylogenetic:** Introduction, Advantages, Phylogenetic Trees, Distance Matrix methods, Maximum likelihood approaches, Multiple sequence alignments **Molecular visualization tools:** Sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol) and Anatomical visualization tools. //Tutorials may be given to familiarize the tools like Rasmol, Chime etc	10	20
V	**Genomics and Gene Recognition:** General introduction to Gene expression in prokaryotes and eukaryotes-Prokaryotic Genomes – Gene structure, GC content, Gene Density, Eukaryotic Genomes- Gene structure, GC content, Gene Density - Gene Expression, Transposition	8	15
SECOND INTERNAL EXAM			

VI	**Protein and RNA structure Prediction:** Amino Acids, Polypeptide Composition, Protein Structures, Algorithms for protein folding, Structure prediction, Predicting RNA secondary structures	8	15
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper - Part A and Part B. Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in Part B to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA387	Elective III- Computer Graphics	3-1-0-4	2016

Course Objectives

- Provide a comprehensive introduction to the basic hardware and software elements of computer graphics.
- Provide a thorough explanation of computer graphics techniques such as geometric transformation, projections, hidden surface elimination, illumination models and 3D rendering.
- Provide an insight into graphics applications and multimedia components.

Syllabus

Introduction: What is Computer Graphics? Basic Raster Graphics: Scan conversion, filling, and clipping Geometric Manipulation: Transformations, Matrices, Homogeneous Coordinates. Elementary 3D Graphics: Plane projections, Vanishing points, Specification of a 3D view. Visibility: Image and object precision, z-buffer algorithms, area based algorithms. Rendering: Lighting, Radiosity, Raytracing

Expected Outcome

At the end of the course, Students will be able to

1. Describe underlying graphic hardware, architecture, graphic primitives and their attributes and apply algorithms for implementing (drawing) these primitives.
2. Develop applications applying mathematical concepts of geometric transformations, polygon filling and clipping in 2 dimensions.
3. Compare the different types of projections of 3D objects and the methods to identify visible surfaces of those projected images, rendering them using illumination models.

References

1. Donald Hearn and M. Pauline Baker, "Computer Graphics – C Version", Pearson Education, 2nd Edition
2. Sinha, Udai, "Computer Graphics", TMH, 2010
3. David F. Rogers, "Procedural Elements for Computer Graphics", McGraw Hill
4. F.S. Hill., "Computer Graphics Using Open GL", Prentice Hall, 2001
5. S. Feiner, J. Foley, A. Van Dam, R. Hughes, "Computer Graphics, Principles and Practice", Addison Wesley, 1990.
4. John F. Koegel Buford, "Multimedia systems", Pearson Education/Addison Wesley.
5. Tay Vaughan, "Multimedia making it works", TMH, 6th Ed.2004
6. William M. Newman and Robert F. Sproull, "Principles of Interactive Computer Graphics", McGraw Hill
7. Desai**, "Computer Graphics", PHI**

Suggested MOOC

1. http://nptel.ac.in/courses/106106090
2. http://www.learnerstv.com/Free-Computer-Science-Video-lectures-ltv046-Page1.htm

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Basic concepts in Computer Graphics - Types of Graphic Devices - Video Display Devices-Graphic monitors and Workstations, Interactive Graphic inputs-Hard Copy Devices-Graphic Software - Basic Raster Scan - Random Scan Systems - Line Drawing Algorithms - Circle Generation Algorithms - Scan Conversion - solid area scan conversion - polygon filling.	**9**	**20**
II	Two dimensional transformations - Homogeneous coordinate systems - matrix formulation and concatenation of transformations - Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; window -to-viewport coordinate transformation; clipping operations – point, line, and polygon clipping algorithms	**9**	**20**
FIRST INTERNAL EXAM			
III	Introduction to graphics in three dimension, Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations – Polygon meshes- Curved Lines and surfaces- Quadric surfaces- Blobby objects.	**8**	**15**
IV	Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Vanishing points, Clipping-Graphical User Interfaces. Introduction to multimedia systems.	**8**	**15**
V	Spline representations – introduction to Bezier curves and surfaces -B-Spline curves and surfaces - 3D transformations - Translation, Rotation, Scaling, composite transformations**.**	**8**	**15**

SECOND INTERNAL EXAM			
VI	Hidden surface elimination- z-buffer algorithms, area based algorithms. Light sources – basic illumination models -Properties of light-Lighting, Radiosity, Raytracing-Shading	**8**	**15**
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper - Part A and Part B. Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in Part B to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA389	**Elective III- Parallel and Distributed Computing**	**3-1-0-4**	**2016**

Course Objectives

- To learn Parallel and Distributed Computing from a programmer's perspective
- To understand the difference among various parallel programming models
- To study the process of ranking the super computers**.**

Syllabus

Introduction, Shared memory model (Thread based) - OpenMP, Shared memory model (Thread based) - CUDA, Shared memory model (Process based) : System V, Distributed Model - MPI, Hybrid Model : OpenMP + MPI, Data Parallel Model (PGAS) : UPC, Measuring the Performance, The Linpack Benchmark

Expected Outcome

- Analyse a problem, find out the scope of parallelising it and to write parallel programs
- The ability to convert existing serial programs to parallel ones, if possible
- Applying various programming models in solving the problems

References

1. Advanced Computer Architecture: Parallelism, Scalability, Programmability (Second Edition) Tata McGraw-Hill Education Pvt. Ltd., 2010 By Kai Hwang,Naresh Jotwani
2. Distributed and Cloud Computing - From Parallel Processing to the Internet of Things 1st Edition By Kai Hwang, Jack Dongarra and Geoffrey Fox
3. UPC: Distributed Shared Memory Programming By Tarek El-Ghazawi, William Carlson, Thomas Sterling, Katherine Yelick

Suggested MOOC

1. https://computing.llnl.gov/tutorials/parallel_comp/
2. http://www.openmp.org/wp-content/uploads/OpenMP3.1.pdf
3. http://docs.nvidia.com/cuda/cuda-c-programming-guide/
4. https://docs.oracle.com/cd/E19683-01/816-5042/svipc-41256/index.html
5. http://mpi-forum.org/docs/mpi-3.0/mpi30-report.pdf
6. http://upc.lbl.gov/publications/upc-lang-spec-1.3.pdf
7. http://www.gccupc.org/gnu-upc-info/binary-release
8. https://www.top500.org/lists/2016/11/download/TOP500_201611.xls
9. https://www.top500.org/green500/

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	**Introduction:** Need for Parallelism, Speedup - Amdahl's law, Gustafson's law *Classifications*: a) Flynn's classification b) Classification based on Memory Architectures - Shared Memory - UMA, NUMA, Distributed Memory, Hybrid. c) Classification based on Programming models - Shared (Thread based and Process based), Distributed, Hybrid model, Data Parallel model(PGAS)	6	15
FIRST INTERNAL EXAM			
II	***Shared memory model (Thread based)* - OpenMP** Important Directives - parallel, for, sections, single, parallel for, parallel sections, master, critical, barrier, atomic, ordered. Runtime Library Routines: omp_set_num_threads, omp_get_num_threads, omp_get_thread_num, omp_get_num_procs, omp_set_nested, omp_get_nested, omp_set_schedule, omp_get_wtime, omp_get_wtick. Clauses: default, shared, private, firstprivate, lastprivate, copyin, copyprivate. Writing an OpenMP program to find mean deviation of an array. Compiling with gcc -fopenmp.	10	20
III	***Shared memory model (Thread based)* - CUDA** Kernels and host-device communication. Shared and constant memory Library routines and constructs: cudaMemcpy ,cudaMalloc, cudaFree , atomicAdd, cudaGetDeviceCount, cudaSetDevice,__syncthreads, __shared__, dim3,CUDA_SUCCESS. Programs to compute square and cube, synchronicity and performance. GPU coding restrictions	10	15

	Shared memory model (Process based) : **System V** shm functions **-** shmget,shmat,shmctl,shmdt		
IV	***Distributed Model*** **- MPI** Message Data, Message Envelope Basic MPI Functions: MPI_Init, MP_Comm_rank and MPI_Finalize Point-to-Point Communication: Blocking Send and Receive, Non Blocking Communication - Communication Initiation, Communication Completion Collective Communication: MPI_Barrier, MPI_Bcast, MPI_Scatter, MPI_Gather, MPI_Reduce, MPI_Scan, MPI_Allgather, MPI_Alltoall, MPI_Allreduce Writing an MPI program to find mean deviation, Compiling and executing with mpicc and mpirun (Use openmpi/mpich) ***Hybrid Model :*****OpenMP + MPI -** Writing a MPI-OpenMP program to find mean deviation. Compiling with mpicc -fopenmp and executing with mpirun	10	20
V	***Data Parallel Model (PGAS) :*** **UPC** Basic Concepts: Thread, Shared object, Private object, affinity, shared access, local access, collective, phase Translation environment - Threads environment, Execution environment - Program startup, Program termination, Program execution Predefined identifiers - THREADS, MYTHREAD Declarations - Type qualifiers - The shared and reference type qualifiers, layout qualifier, Array Declarators Important statements: Barrier statements - upc_notify, upc_wait, upc_barrier, upc_fence,Collective Iteration - upc_forall Writing a UPC program to find mean deviation. Using gnu UPC compiler.	10	15
SECOND INTERNAL EXAM			

VI	**Measuring the Performance:** FLOPS, Calculating Theoretical peak of a Microprocessor, Interconnection networks - Gigabit Ethernet and Infiniband (comparison only). **The Linpack Benchmark** - Solving Linear Equations, LU Decomposition, Ranking from top500.org, Important fields - Rmax, Rpeak, Nmax, Nhalf, MFlops/Watt, Energy efficient ranking - green500.	8	15
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper - Part A and Part B. Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in Part B to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA391	**Elective III- Artificial Intelligence**	**3-1-0-4**	**2016**

Course Objectives

- Study the techniques of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concept of Expert Systems.

Syllabus

Introduction to AI and Production Systems, Search Strategies, Game playing, Knowledge Representation Structures, Knowledge representation using Logic, Planning, Learning, Expert systems, Fuzzy Logic

Expected Outcome

- Ability to design Algorithms using AI techniques to solve problems that are otherwise intractable.
- Ability to design and develop expert systems

Text Books

1. Kevin Night and Elaine Rich,"Artificial Intelligence (SIE)", Mc Graw Hill-2008.
2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.

References

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.

Suggested MOOC

1. **https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/**
2. **http://nptel.ac.in/courses/106105077/**

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	*Introduction to AI and Production Systems:-* AI-Problem formulation, Problem Definition -Production systems, Control strategies, Problem characteristics, Production system characteristics , Example AI Problems (8 Puzzle problem, Missionary Cannibals Problem, Crypt arithmetic Problems, block world Problem)	8	15
II	*Search Strategies :* - Blind search strategies -Depth First Search, Breadth First Search, Best First Search, Iterative Deepening Search, Heuristic Search strategies- Admissible Heuristics and examples - Simple Hill Climbing and Steepest Ascending Hill Climbing, Simulated Annealing , A* algorithm	8	15
FIRST INTERNAL EXAM			
III	*Game playing :* Two Player Zero Sum Games, Modelling Two Player Zero Sum Games as search problems, Min-Max Algorithm, Optimising Min Max Algorithm using $\alpha - \beta$ cut off *Knowledge Representation Structures :*Frames, Sematic Networks and Conceptual Dependencies, Graph Databases.	8	15
IV	*Knowledge representation* using Logic : - First Order Predicate Logic (FOPL), Well Formed Formula(WFF) in FOPL,Inference rules for FOPL, The Clause Form and conversion of WFFs to Clause Form, Resolution-Refutation – Example problems	8	15
V	*Planning :-* Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. *Learning :*-Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning	10	20
SECOND INTERNAL EXAM			

VI	*Expert systems :*–Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells. *Fuzzy Logic:* - Fuzzy Variables ,Fuzzy Sets and Fuzzy Set Operations, Typical Examples using Fuzzy Sets	10	20
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
	There will be two parts in the Question paper - Part A and Part B. Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in Part B to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLMCA341	**SEMINAR**	**0-0-2-2**	**2016**

Course Objectives

To enable the students to gain knowledge in any of the technically relevant current topics on computer science/information technology/research, and acquire the confidence in presenting the topic and preparing a report.

Syllabus

Guidelines

The student shall undertake detailed study on a technically relevant current topic in computer science/information technology under the supervision of a faculty member, by referring articles published in reputed journals/conference proceedings. Each student has to submit a seminar report, based on these papers; the report must not be reproduction of any original paper. The topic shall be presented in the class taking a duration of 15-20 minutes.
The report and slides for presentation shall be prepared using free typesetting software such as LATEX. A committee consisting of three/four faculty members shall evaluate
the seminar presentation.

Following guidelines shall be used for the assessment of Seminar.

Scope and relevance of topic	– 20%
Quality of presentation slides	– 10%
Presentation skills	– 30%
Knowledge in the topic	– 20%
Report	– 20%

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLMCA351	MINI PROJECT	0-0-8-2	2016

Course Objectives

- To apply the software engineering principles on a real software project
- Develop a software product using the Agile methodology.

References

1. Alistair Cockburn, “Agile Software Development: The Cooperative Game”, Addison Wesley, 2nd Edition (2006).
2. Andrew Hunt, David Thomas, “The Pragmatic Programmer: From Journeyman to Master”, Pearson India, 1st Edition (2008).
3. Ken Schwaber, Mike Beedle, “Agile Software Development with Scrum”, Pearson (2008).
4. Lisa Crispin, Janet Gregory, “Agile Testing: A Practical Guide for Testers and Agile Teams”, Addison Wesley Professional, 1st Edition (2008).
5. Mike Cohn, “User Stories Applied: For Agile Software Development”, Addison Wesley, 1st Edition, (2004).
6. Pressman, R.S., “Software Engineering: A Practitioner's Approach”, McGraw Hill SE, 7th Edition, (2010).
7. Robert C. Martin, “Agile Software Development, Principles, Patterns and Practices”, Prentice Hall Imprint, Pearson Education, 2nd Edition (2002).
8. Rod Stephens, “Beginning Software Engineering”, Wrox Series, Wiley India Pvt Ltd (2015).
9. RyPress “Ry's Git Tutorial” (Free e-book)

Suggested MOOC

1. Introduction to DevOps(https://www.edx.org/course/introduction-devops-microsoft-dev212x)

Week	Schedule
I	Familiarisation with build tools. Familiarisation with an IDE (Eclipse, NetBeans,...), that support build tools and git. Selection of Topic, Formation of Development Team, Feasibility analysis.
II	Topic Approval, Meeting of Development Team including Scrum Master with Product Owner. Informal, preliminary discussions of requirements. Creating user stories in the rough record. Commencement of the Project.
III	Identifying modules, Initial Design of Database & UI. Starting Test Driven Development. Creating an empty git repository by Scrum Master / one member of the Development team.Setting permission to other members. Pushing the first version of the Project along with a Readme file containing contact details of team members. Using Branch for individual members. Merging with Master.
IV	First Scrum Review. (Here onwards, the Scrum reviews are conducted on every other week)
VII	Project Presentation - Interim Evaluation to be based on Git History
XIII	Project Presentation - Final Evaluation to be based on Git History
XIV	Submission of Project Report, with Rough Record

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLMCA352	**PROJECT AND VIVA-VOCE**	**0-0-30-12**	**2016**

Course Objectives

- To apply the software engineering principles on a real software project
- Develop a software product using the Agile methodology.

Note:

Identify Real projects - Any project useful to the Society. The project must be done inhouse. The student has to spent the time in the lab for project work. Attendance as per MCA regulations is applicable for appearing for the final viva-voce. However the evaluation committee can give consent to students in exceptional cases to do their project in Industry which has real live projects. Local industries and training Institutes which offer live projects should not be permitted.

Students, individually have to do a project approved by their faculty Supervisor.Project evaluation weights shall be as follows:-For convenience the marks are allotted as follows.

Project Progress evaluation details

- *Total Marks for the Final Project: 100*
- *Project evaluation by the supervisor/s : 30 Marks*
- *Presentation & evaluation by the Committee : 40 Marks*
- *Evaluation by the External expert : 30 Marks*

The project assessment board shall consist of the following members.

- *Chairman: Head of the Department*
- *Members: Project supervisor/s of the student*
- *One faculty member from the Department*
- *One faculty member from a sister Department*
- *An external expert, either from an academic/research institute or Industry*

A faculty/technical staff should act as the Scrum Master of each Project team.The Customer or a Senior faculty is the Product Owner.

Frequent meetings are highly encouraged, at the convenience of the Scrum Master. Should not exceed 15 minutes. Ensure meetings once in three days.A sprint is two weeks, so ensure biweekly reviews. A review should not exceed 30 minutes. A demo to the Product Owner is compulsory in each review.

Use git for Version control.

Follow Test Driven Development.Bugzilla or an equivalent tool may be used for bug tracking.

The student should keep a rough record. Divide it into 4 parts. Product Backlog, Database & UI Design, Testing & Validation and details of Versions. Make dated entries to the corresponding part, as the project progresses. The Corrections and comments from Product Owner/Scrum Master should be clearly indicated with the Date.

Project presentations may be conducted for Internal Assessment. They should also serve as supplement to Scrum reviews. The evaluation board may consist of other faculty members/technical staff. A maximum of 2 Presentations are allowed. Scrum reviews should not be sacrificed for presentations.

Students must be encouraged to publish their work in journals and due credit to be given to the students for this.

Latex or an equivalent tool should be used for preparing Presentations and Project Report.

Week	Schedule
I	Selection of Topic, Feasibility analysis.
II	Topic Approval, Meeting of student and Scrum Master with Product Owner. Informal, preliminary discussions of requirements. Creating user stories in the rough record. Commencement of the Project.
III	Identifying modules, Initial Design of Database & UI. Starting Test Driven Development. Creating an empty git repository by Scrum Master / Student. Pushing the first version of the Project along with a Readme file containing contact details of team members. Using Branch for individual members. Merging with Master.
IV	First Scrum Review. (Here onwards, the Scrum reviews are conducted on every other week)
VII	Project Presentation - Interim Evaluation to be based on Git History
XII	Project Presentation - Final Evaluation to be based on Git History
XIII	Submission of Project Report, with Rough Record