



Tripura University

(A Central University)

Suryamaninagar

West Tripura

Syllabus for Four Years Undergraduate Programme

Subject: B.Sc IT

(As per NEP-2020)

Year - 2023



Tripura University
(A Central University)

Course Structure of B.Sc in IT (UG Programme)
As per NEP-2020 under Tripura University

B.Sc in Information Technology (IT) MAJOR

Year	Semester	Paper	Credit	Mark	Practical
1 st	1st Semester ITS1101C Fundamentals of Information Technology	Paper-1A Theory	4	60 (IA=24 + ESE=36)	
		Paper-1B Practical		40 (IA=16 + ESE=24)	Based on Theory paper 1A
	1st Semester ITS1102C Numerical Analysis & Programming Language	Paper-2A Theory	4	60 (IA=24 + ESE=36)	
		Paper-2B Practical		40 (IA=16 + ESE=24)	Based on Theory paper2A
	2nd Semester ITS1201C Basic Electronics	Paper-3A Theory	4	60 (IA=24 + ESE=36)	
		Paper-3B Practical		40 (IA=16 + ESE=24)	Based on Theory paper 3A
	2nd Semester ITS1202C Operating System & System Software	Paper-4A Theory	4	60 (IA=24 + ESE=36)	
		Paper-4B Practical		40 (IA=16 + ESE=24)	Based on Theory paper 4A
2 nd	3rd Semester ITS2301C Data Structure & Algorithm	Paper-5A Theory	4	60 (IA=24 + ESE=36)	
		Paper-5B Practical		40 (IA=16 + ESE=24)	Based on theory paper 5A
	3rd Semester ITS2302C Computer Organization	Paper 6 Theory	4	100 (IA=40 + ESE=60)	
	4th Semester ITS2401C Computer Network	Paper-7A Theory	4	60 (IA=24 + ESE=36)	
		Paper-7B Practical		40 (IA=16 + ESE=24)	Based on theory paper 7A
	4th Semester ITS2402C Microprocessors	Paper-8A Theory	4	60 (IA=24 + ESE=36)	
		Paper-8B Practical		40 (IA=16 + ESE=24)	Based on theory paper 8A
	3 rd	5th Semester ITS3501C Database Management System	Paper-9A Theory	4	60 (IA=24 + ESE=36)
Paper-9B Practical			40 (IA=16 + ESE=24)		Based on theory paper 9A
5th Semester ITS3502C Software Engineering		Paper-10A Theory	4	60 (IA=24 + ESE=36)	
		Paper-10B Practical		40 (IA=16 + ESE=24)	Based on theory paper 10A
5th Semester ITS3503C Minor Project & Technical Writing		Paper-11 Practical	4	100 (IA=40 + ESE=60)	Based on minor Project works

	5th Semester ITS30XXE Departmental Optional Paper-I	Paper-12 Theory	4	100 (IA=40 + ESE=60)	
	6th Semester ITS3601C Object Oriented Programming	Paper-13A Theory	4	60 (IA=24 + ESE=36)	
		Paper-13B Practical		40 (IA=16 + ESE=24)	Based on theory paper 13A
	6th Semester ITS3602C Web Technology	Paper-14A Theory	4	60 (IA=24 + ESE=36)	
		Paper-14B Practical		40 (IA=16 + ESE=24)	Based on theory paper 14A
	6th Semester ITS3603C Major Project	Paper-15 Practical	4	100 (IA=40 + ESE=60)	Based on project works
	6th Semester ITS30XXE Departmental Optional Paper-II	Paper-16 Theory	4	100 (IA=40 + ESE=60)	
	7th Semester ITS4701C Introduction to AI & Machine Learning	Paper-17A Theory	4	60 (IA=24 + ESE=36)	
		Paper-17B Practical		40 (IA=16 + ESE=24)	Based on theory paper 17A
	7th Semester ITS4702C Discrete Mathematical Science	Paper-18 Theory	4	100 (IA=40 + ESE=60)	
	7th Semester ITS4703C Research Project/Dissertation Phase-I	Paper-19 Practical	4	100 (IA=40 + ESE=60)	Based on Project/Dissertation works
	7th Semester ITS40XXE Departmental Optional Paper-III	Paper-20 Theory	4	100 (IA=40 + ESE=60)	
	8th Semester ITS4801C Advanced Computer Architecture	Paper-21 Theory	4	100 (IA=40 + ESE=60)	
	8th Semester ITS4802C Research Project Phase-II	Paper-22 Practical	4	100 (IA=40 + ESE=60)	Based on Research Project works
	8th Semester ITS4803C Dissertation & Presentation	Paper-23 Practical	4	100 (IA=40 + ESE=60)	Based on Dissertation and Presentation works
	8th Semester ITS40XXE Departmental Optional Paper-IV	Paper-20 Theory	4	100 (IA=40 + ESE=60)	

*to be finalised later on...



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त्रिपुरा विश्वविद्यालय / TRIPURA UNIVERSITY

सूर्यमणिनगर / Suryamaninagar, त्रिपुरा / Tripura - 799022

B. Sc. in Information Technology (IT) Program 1st Year

Yr	Sem	Course Code	Course Title	Credits	Type
I	I	ITS1101C	Fundamentals of Information Technology	4(T+L)	Major-1
		ITS1102C	Numerical Analysis & Programming Language	4(T+L)	Major-2
			Minor/Elective-I	4	Minor/Elective-1
			Prerequisite Allied/MOOC-I	3	Interdisciplinary Course -I
			Prescribed Courses-I	3	Skill Enhancement/ Vocational-I
			Prescribed VAC Project/ Internship/ Survey-I	2*	Common Value-Added Courses
		Total Credits of Semester I		18+2*	
	II	ITS1201C	Basic Electronics	4(T+L)	Major-3
		ITS1202C	Operating System & System Software	4(T+L)	Major-4
			Minor/Elective-II	4	Minor/Elective-2
			Prescribed Courses-II	3	Skill Enhancement/ Vocational-II
			Qualifying Prescribed Course-I	3	Ability Enhancement Courses (language)
			Prescribed VAC Project/ Internship/ Survey-II	2*	Common Value-Added Courses
		Total Credits of Semester II		18+2*	

Total Credits after completion of 1st Year=36+4* =40 Credits

- 16 credits Major
- 8 Credits Minor
- 3 Credits Interdisciplinary Course (Prerequisite Allied/MOOC)
- 6 Credits Skill Enhancement/ Vocational
- 3 Credits Ability Enhancement Courses (language)
- 4* Credits Common Value-Added Courses (VAC Project/ Internship/ Survey)

Students Exiting the program after securing 40 Credits will be awarded UG CERTIFICATE IN INFORMATION TECHNOLOGY (IT) provided they secure 4* credits in skill based vocational courses offered during the 1st year summer term semester (exiting students need to undertake an internship of 4 credits additionally)



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B. Sc. in Information Technology (IT) Program 2ndYear

Yr	Sem	Course Code	Course Title	Credits	Type
II	III	ITS2301C	Data Structure & Algorithm	4(T+L)	Major-5
		ITS2302C	Computer Organization	4(T)	Major-6
			Minor/Elective-III	4	Minor/Elective-3
			Prerequisite Allied/MOOC-II	3	Interdisciplinary Course –II
			Prescribed Courses-III	3	Skill Enhancement/ Vocational-III
			Prescribed VAC Project/ Internship/ Survey-III	2*	Common Value-Added Courses
		Total Credits of Semester III		18+2*	
	IV	ITS2401C	Computer Network	4(T+L)	Major-7
		ITS2402C	Microprocessors	4(T+L)	Major-8
			Minor/Elective-IV	4	Minor/Elective-4
			Prerequisite Allied/MOOC-III	3	Interdisciplinary Course –III
			Qualifying Prescribed Course-II	3	Ability Enhancement Courses (language)
			Prescribed VAC Project/ Internship/ Survey-IV	2*	Common Value-Added Courses
		Total Credits of Semester IV		18+2*	

Total Cumulative Credits after completion of 2ndYear=72+8* =80 Credits

- 32 credits Major
- 16 Credits Minor
- 9 Credits Interdisciplinary Course (Prerequisite Allied/MOOC)
- 9 Credits Skill Enhancement/ Vocational
- 6 Credits Ability Enhancement Courses (language)
- 8* Credits Common Value-Added Courses (VAC Project/ Internship/ Survey)

Students Exiting the program after securing 80 Credits will be awarded UG DIPLOMA CERTIFICATE IN INFORMATION TECHNOLOGY (IT) provided they secure 8* credits in skill based vocational courses offered during the 1st year and 2nd year summer term semester (exiting students need to undertake an internship of 4 credits additionally in each year)



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B. Sc. in Information Technology (IT) Program 3rd Year

Yr	Sem	Course Code	Course Title	Credits	Type
III	V	ITS3501C	Database Management System	4(T+L)	Major-9
		ITS3502C	Software Engineering	4(T+L)	Major-10
		ITS3503C	Technical Writing with Minor Project	4(L)	Major-11
		ITS30XXE	Departmental Optional Paper-I	4(T)	Major-12
			Minor/Elective-V	4	Minor/Elective-5
			Qualifying Prescribed Course-III	2	Ability Enhancement Courses (language)
		Total Credits of Semester V		22	
	VI	ITS3601C	Object Oriented Programming	4(T+L)	Major-13
		ITS3602C	Web Technology	4(T+L)	Major-14
		ITS3603C	Major Project	4(L)	Major-15
		ITS30XXE	Departmental Optional Paper-II	4(T)	Major-16
			Minor/Elective-VI	4	Minor/Elective-6
		Total Credits of Semester VI		20	

Departmental Optional Papers I/II (Select any two)

Course Code	Course Title	Course Code	Course Title
ITS3001E	Cloud Computing	ITS3006E	Distributed Computing
ITS3002E	Computer Graphics	ITS3007E	E-Commerce
ITS3003E	Cyber Security & Cyber Law	ITS3008E	Formal Languages & Automata Theory
ITS3004E	Data Science	ITS3009E	Internet of Things
ITS3005E	Digital Marketing	IST3010E	Operation Research

Total Cumulative Credits after completion of 3rd Year=114+8* =122 Credits

- 64 credits Major
- 24 Credits Minor
- 9 Credits Interdisciplinary Course (Prerequisite Allied/MOOC)
- 9 Credits Skill Enhancement/ Vocational
- 8 Credits Ability Enhancement Courses (language)
- 8* Credits Common Value-Added Courses (VAC Project/ Internship/ Survey)

Students Exiting the program after securing above Credits will be awarded B. SC. IN INFORMATION TECHNOLOGY (IT)

N.B. 50% courses of minor stream must be from the relevant subject/discipline and remaining 50% from any discipline.



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B. Sc. in Information Technology (IT) Program 4thYear

Yr	Sem	Course Code	Course Title	Credits	Type
IV	VII	ITS4701C	Introduction to AI & Machine Learning	4(T+L)	Major-17
		ITS4702C	Discrete Mathematical Science	4(T)	Major-18
		ITS4703C	Research Project/Dissertation Phase-I	4(L)	Major-19
		ITS40XXE	Departmental Optional Paper-III	4(T)	Major-20
			Minor/Elective-VII	4	Minor/Elective-7
		Total Credits of Semester VII		20	
	VIII	ITS4801C	Advanced Computer Architecture	4(T)	Major-21
		ITS4802C	Research Project Phase-II	4(L)	Major-22
		ITS4803C	Dissertation & Presentation	4(L)	Major-23
		ITS40XXE	Departmental Optional Paper-IV	4(T)	Major-24
			Minor/Elective-VIII	4	Minor/Elective-8
		Total Credits of Semester VIII		20	

Departmental Optional Papers III/IV (Select any two)

Course Code	Course Title	Course Code	Course Title
ITS4001E	Adhoc & Sensor Network	ITS4005E	Information & System Security
ITS4002E	Advanced DBMS+	ITS4006E	Mobile Computing
ITS4003E	Deep Learning	ITS4007E	Numerical Methods
ITS4004E	Digital Signal Processing	ITS4008E	Soft Computing

Total Cumulative Credits after completion of 4thYear=154+8* =162 Credits

- 96 credits Major
- 32 Credits Minor
- 9 Credits Interdisciplinary Course (Prerequisite Allied/MOOC)
- 9 Credits Skill Enhancement/ Vocational
- 8 Credits Ability Enhancement Courses (language)
- 8* Credits Common Value-Added Courses (VAC Project/ Internship/ Survey)

Students Exiting the program after securing above Credits will be awarded B. SC. IN INFORMATION TECHNOLOGY (IT) WITH RESEARCH

N.B. 50% courses of minor stream must be from the relevant subject/discipline and remaining 50% from any discipline.



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PRE-REQUISITE COURSES FOR STUDENTS who are MIGRATING to B. Sc. in Information Technology
(IT) Program in 2nd Year for Admission

Yr	Sem	Course Code	Course Title	Credits	Type
I	I	ITS1100A	Introduction to Programming Methodology	4(T+L)	Pre-Requisite-I
	II	ITS1200A	Basics of IT & Electronics	4(T+L)	Pre-Requisite-II

PRE-REQUISITE COURSES FOR STUDENTS who are MIGRATING to B. Sc. in Information Technology
(IT) Program in 3rd Year for Admission

Yr	Sem	Course Code	Course Title	Credits	Type
II	III	ITS2300A	Basics of Computer Networking	4(T+L)	Pre-Requisite-III
	IV	ITS2400A	Computer Architecture & Microprocessor	4(T+L)	Pre-Requisite-IV

Students admitted in 2nd year/ 3rd year from other Program are required to complete the respective pre-requisite courses for admission.



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B. Sc. in Information Technology (IT) Program 1st Year

Yr	Sem	Course Code	Course Title	Credits	Type
I	I	ITS1101C	Fundamentals of Information Technology	4(T+L)	Major-1
		ITS1102C	Numerical Analysis & Programming Language	4(T+L)	Major-2
			Minor/Elective-I	4	Minor/Elective-1
			Prerequisite Allied/MOOC-I	3	Interdisciplinary Course -I
			Prescribed Courses-I	3	Skill Enhancement/ Vocational-I
			Prescribed VAC Project/ Internship/ Survey-I	2*	Common Value-Added Courses
		Total Credits of Semester I		18+2*	
	II	ITS1201C	Basic Electronics	4(T+L)	Major-3
		ITS1202C	Operating System & System Software	4(T+L)	Major-4
			Minor/Elective-II	4	Minor/Elective-2
			Prescribed Courses-II	3	Skill Enhancement/ Vocational-II
			Qualifying Prescribed Course-I	3	Ability Enhancement Courses (language)
			Prescribed VAC Project/ Internship/ Survey-II	2*	Common Value-Added Courses
		Total Credits of Semester II		18+2*	

Total Credits after completion of 1st Year=36+4* =40 Credits

- 16 credits Major
- 8 Credits Minor
- 3 Credits Interdisciplinary Course (Prerequisite Allied/MOOC)
- 6 Credits Skill Enhancement/ Vocational
- 3 Credits Ability Enhancement Courses (language)
- 4* Credits Common Value-Added Courses (VAC Project/ Internship/ Survey)

Students Exiting the program after securing 40 Credits will be awarded UG CERTIFICATE IN INFORMATION TECHNOLOGY (IT) provided they secure 4* credits in skill based vocational courses offered during the 1st year summer term semester (exiting students need to undertake an internship of 4 credits additionally)



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Fundamentals of Information Technology	ITS1101C
(T+L): 4 Credits	Prerequisites: <i>None</i>

UNIT I

Introduction: Characteristics of Computer, Generation of computer, Types of computer and features, Application of computer;

Software: Definition, Relationship between Software and Hardware, Software Categories, System Software, Application Software and other software's with example, Software Terminology;

Number Systems: Types of Number systems, Conversion between number bases, Binary arithmetic including 1's complement and 2's complement;

UNIT II

Block diagram of digital computer and function of each block; Introduction to computer memory, Types of Computer Memory: Input & Output Devices, Data & Information, Different data processing methods

UNIT III

Introduction to Computer Languages. Introduction, to Operating System: Types of Operating, System, Functions of Operating System, Modern Operating Systems with example, Difference between process and program. Processing function of an Operating System with example.

UNIT IV

Data Communication and Computer Network: Introduction, Data Transmission mode, Transmission Media, Types of Computer Network, Network Topologies, Communication Protocols, Network devices;

Internet Basics: Introduction, Basic Internet Terms (Website, Webpage, URL, Web Browser etc.), Internet Applications, Electronic Mail: Working principle, Search Engines, Intranet, Extranet, Data Security: Need of security, Basic principle of security.

Text Books:

- 1 P. K. Sinha, "Fundamental of Computers", B.P.B. Publications
2. Balaguruswamy, "Fundamental of Computers", TMH
3. V. Raja Raman, "Fundamental of Computers", PHI
4. Anita Goel, "Computer Fundamentals", Pearson

Information Technology Lab

UNIT I

Introduction to Basic Computer Structures, Assembling and De-Assembling of Computer, Installation of Operating System.

Introduction to software, Installation of different software, Licensing of software.

UNIT II

CUI based operating Systems: Introduction to MS-DOS, System files, Internal and External Commands: Syntax and examples, Batch processing.

GUI based operating Systems: Introduction to MS-DOS, File System, Start button and menus, Hide and Unhide properties of files and folders. Utilities of icons, Recycle bin, Task bar, Desktop background, Screen saver, working with control panel.



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UNIT III

Word Processor: Basic Concepts, Salient features, Utilities of Menu bar, Tool bar, Text, Font, Styles and background, Water mark, Table, Page border, Indentation, Page orientation, Equation Editor, Mail merge, Protection of the documents.

UNIT IV

Spread Sheet: Purpose, Salient features, usage, commands, Formulas, Validations, Basic functions and Chart.

Presentation: Purpose, Salient features, usage, Animation, Custom Animation, Slide Transaction, Mouse click presentation, Automatic presentation.

UNIT V

Basic Electronics:

To design a combinational logic system for a specified Truth Table.

To convert Boolean expression into logic circuit & design it using logic gate ICs.

To minimize a given logic circuit.

Half Adder and Full Adder.

Half Subtractor and Full Subtractor.

4-bit binary adder and adder-subtractor using Full adder IC.

To design a seven segment decoder.

Reference Books

1. Fundamental of Computers – By V.Rajaraman B.P.B. Publications
2. Fundamental of Computers – By P.K. Sinha
3. Computer Today- By Suresh Basandra
4. Computer Networks – By Tennenbum Tata MacGrow Hill Publication

Numerical Analysis & Programming Language	ITS1102C
(T+L): 4 Credits	Prerequisites: <i>None</i>

UNIT-I

Computer Programming Introduction to computer programming in C language. Arithmetic expressions, Simple programs. Concepts of variables, program statements and function calls from the library (printf for example) C data types, int, char, float etc. C expressions, arithmetic operations, relational and logic operations. C assignment statements, extension of assignment to the operations. C primitive input output using getchar and putchar, exposure to the scanf and printf functions. C statements, conditional execution using if, else. Optionally switch and break statements may be mentioned. Concepts of loops, example of loops in C using for, while and do-while.

UNIT-II

One dimensional arrays and example of iterative programs using arrays, 2-d arrays. Use in matrix computations. Concept of Sub-programming, functions. Example of functions. Argument passing mainly for the simple variables. Pointers, relationship between arrays and pointers. Argument passing using pointers. Array of pointers, Passing arrays as arguments. Strings and C string library. Structure and unions. Defining C structures, passing structures as arguments. Program examples. File I/O. Use of fopen, fscanf and fprintf routines.

UNIT-III

Numerical Analysis Approximations and round off errors, Truncation errors and Taylor Series, Determination of roots of polynomials and transcendental equations by Newton-Raphson, Secant and Bairstow's method. Solutions of linear simultaneous linear algebraic equations by Gauss Elimination and Gauss- Siedel iteration methods. Curve fitting- linear and nonlinear regression analysis.



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UNIT-IV

Backward, Forward and Central difference relations and their uses in Numerical differentiation and integration, Application of difference relations in the solution of partial differential equations. Numerical solution of ordinary differential equations by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method.

UNIT-V

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, Runge Kutta 2nd and 4th order, Stability analysis of above methods.

Text Books:

Shastri, S.S; Numerical Methods; Prentice Hall Inc., India, 1998.
Noble Ben; Numerical Methods; New York International Publications, New York, 1964.
Stanton Ralph G., ; Numerical Methods for Engineering; Englewood cliffs, N.J., Prentice Hall Inc., 1961. ;
Buckingham R.A., ; Numerical Methods, Sir Isaac Pitman Sons. Ltd., London, 1957. ;
Bakhvalov, N .S., ; Numerical Methods, Mir. Pub., Moscow, 1977. ;
Grewal, B.S., ; Numerical Methods, Khanna Pub., New Delhi, 1998. ;
Sudhit Kaicker, ; The Complete ANSI C, BPB Publications, New Delhi, 1996. ;
Kernighan, B. W. and D .M. Ritchie, ; The C Programming Language, Prentice Hall of India, 1998.
Byron, S. Gottfried, ; Programming with C, Tata McGraw Hill, 2nd edition 1998

Programming Language Lab

Course Objectives:

The course aims to provide the knowledge of computer programming to write the codes for the numerical methods learned in "Numerical Analysis" using C language and/or MATLAB.

Course Outcomes:

Upon successful completion of the course, students will be able to: 1. Write computer programs to solve engineering problems with MATLAB and/or C Language 2. Implement numerical methods in MATLAB /C Language. 3. Analyze the stability of algorithm. 4. Analyze and evaluate the accuracy of common numerical methods. 5. Ability to use approximation algorithm in real world problem.

Module

Contents

- | | |
|-----|---|
| I | Basic C Programming, Using Loops, Control Structure & Conditional Statement |
| II | Use of Array, Structure & Pointer, File Management |
| III | Gaussian elimination, Jacobi, Gauss Seidel methods. |
| IV | Bisection method, fixed point iteration scheme, Newton-Raphson method, secant method. |
| V | Lagrange's interpolation formula, Newton's divided difference formula. |
| VI | Trapezoidal rule, Simpson's 1/3, 3/8-rules. |
| VII | Euler's method modified Euler's method, Runge-Kutta method, Milne's method, Adams-predictor-corrector method. |

Numerical Methods Practical (Lab) using C programming

Numerical Methods Lab. Programming in C of the following set of problems:

- Bisection method.
- Regula Falsi method.
- Fixed-point method.



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- Newton-Raphson method.
 - Graffe's methods.
 - Lagrange interpolation.
 - Newton's forward and backward interpolation.
 - Hermite interpolation.
 - Richardson extrapolation (differentiation).
 - Trapezoidal and Simpson one-third rules.
 - Gauss Quadrature.
 - Gauss elimination method.
 - LU decomposition.
 - Gauss-Siedel method.
 - Jacobi's method (eigenvalue).
 - Power method (eigenvalue).
 - Euler's method.
 - Runge-Kutta's method.
 - Predictor-corrector method.
 - Fitting a polynomial function.

Reference Books:

1. Balaguruswamy, E., Programming in ANSI C, 2nd ed., Tata McGraw Hill.
2. Deitel, H. N., and Deitel, P. J., C How to Program, Prentice Hall.
3. Gottfried, Byron S., Theory and Problems of Programming with C, Tata McGraw Hill, 1998.
4. Hancock, Les, and Krieger, Morris, The C primer, McGraw Hill, 1998.
5. Kanetkar, Y., Let ui C, 3rd ed., BPB pub.
6. Kernighan, B. W., and Ritchie, D. M., The C Programming Language, 2nd ed., Prentice Hall, 1989.
7. Mullish, Henry, and Herbert, L., Spirit of C: An Introduction to Modern Programming, Jaico publishers.
8. Press, W. H., Teukolsky, S. A., Vetterling, W. T., and Flannery, B. P., Numerical Recipes in C, 2nd ed., Cambridge University Press.
9. Xavier, C, C Language and Numerical Methods, New Age International

Textbooks:

Essential Readings:

1. W. H. Press, B. P. Flannery, S. A. Teukolsky, W. T. Vetterling, "Numerical Recipes in C", Cambridge University Press, 1st edition, 1988.

Supplementary Readings:

1. M. Pal, Numerical Analysis for Scientists and Engineers: Theory and C Programs, Narosa, 2008.



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Basic Electronics	ITS1201C
(T+L): 4 Credits	Prerequisites: <i>None</i>

UNIT-I

Semiconductor Diodes and Applications (Text-1): p-n junction diode, Characteristics and Parameters, Diode approximations, DC load line analysis, Half-wave rectifier, Two-diode Full-wave rectifier, Bridge rectifier, Capacitor filter circuit (only qualitative approach), Zener diode voltage regulators: Regulator circuit with no load, Loaded Regulator.

Numerical examples as applicable, Bipolar Junction Transistors: BJT operation, BJT Voltages and Currents, BJT amplification, Common Base, Common Emitter and Common Collector Characteristics, Numerical examples as applicable.

UNIT-II

BJT Biasing (Text-1): DC Load line and Bias Point, Base Bias, Voltage divider Bias, Numerical examples as applicable. Introduction to Operational Amplifiers (Text-2): Ideal OPAMP, Inverting and Non Inverting OPAMP circuits, OPAMP applications: voltage follower, addition, subtraction, integration, differentiation; Numerical examples as applicable.

UNIT-III

Digital Electronics (Text-2): Introduction, Switching and Logic Levels, Digital Waveform (Sections 9.1 to 9.3). Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary, Converting Hexadecimal to Decimal, Converting Decimal to Hexadecimal, Octal Numbers: Binary to Octal Conversion. Complement of Binary Numbers. Boolean Algebra Theorems, De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, XOR Gate, NAND Gate, NOR Gate, X-NOR Gate. Algebraic Simplification, NAND and NOR Implementation (Sections 11.7 and 11.8): NAND. Implementation, NOR Implementation. Half adder, Full adder.

UNIT-IV

Flip-Flops (Text-2): Introduction to Flip-Flops (Section 12.1), NAND Gate Latch/ NOR Gate Latch, RS Flip-Flop, Gated Flip-Flops: Clocked RS Flip-Flop (Sections 12.3 to 12.5). Microcontrollers (Ref.1): Introduction to Microcontrollers, 8051 Microcontroller Architecture and an example of Microcontroller based stepper motor control system (only Block Diagram approach).

UNIT-V

Communication Systems (Text-2): Introduction, Elements of Communication Systems, Modulation: Amplitude Modulation, Spectrum Power, AM Detection (Demodulation), Frequency and Phase Modulation. Amplitude and Frequency Modulation: A comparison. Transducers (Text-2): Introduction, Passive Electrical Transducers, Resistive Transducers, Resistance Thermometers, Thermistor. Linear Variable Differential Transformer (LVDT). Active Electrical Transducers, Piezoelectric Transducer, Photoelectric Transducer.

Text Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
2. D.P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill Education (India) Private Limited, 2014.

Reference Books:



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1. MuhammadAli Mazidi, "The 8051 Microcontroller and Embedded. Systems. Using Assembly and C." Second Edition, 2011, Pearson India.

Basic Electronics Lab

At least 04 experiments each from section A, B and C

Section-A: Op-Amp. Circuits (Hardware)

1. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
2. Design
 - (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response
 - (b) To design non-inverting amplifier using Op-amp (741,351) & study frequency response
3. Design
 - (a) To add two dc voltages using Op-amp in inverting and non-inverting mode
 - (b) To study the zero-crossing detector and comparator.
4. To design a precision Differential amplifier of given I/O specification using Op-amp.
5. To investigate the use of an op-amp as an Integrator.
6. To investigate the use of an op-amp as a Differentiator.
7. To design a Wien bridge oscillator for given frequency using an op-amp.
8. Design a analog to digital (ADC) & digital to analog converter (DAC) of given specifications.

Section-B: Digital circuits (Hardware)

1. Design:
 - a. To design a combinational logic system for a specified Truth Table.
 - b. To convert Boolean expression into logic circuit & design it using logic gate ICs.
 - c. To minimize a given logic circuit.
2. Half Adder and Full Adder.
3. Half Subtractor and Full Subtractor.
4. 4-bit binary adder and adder-subtractor using Full adder IC.
5. To design a seven segment decoder.
6. To design an Astable Multivibrator of given specification using IC 555 Timer.
7. To design a Monostable Multivibrator of given specification using IC 555 Timer.
8. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
9. To build JK Master-slave flip-flop using Flip-Flop ICs
10. To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.
11. To make a Shift Register (serial-in and serial-out) using D-type/JK Flip-Flop ICs.

Section-C: SPICE/MULTISIM simulations for electronic circuits and devices

1. To verify the Thevenin and Norton Theorems.
2. Design and analyze the series and parallel LCR circuits
3. Design the inverting and non-inverting amplifier using an Op-Amp of given gain
4. Design and Verification of op-amp as integrator and differentiator
5. Design the 1st order active low pass and high pass filters of given cut-off frequency
6. Design clocked SR and JK Flip-Flop's using NAND Gates
7. Design 4-bit asynchronous counter using Flip-Flop ICs
8. Design the CE amplifier of a given gain and its frequency response.

Reference Books:

- Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw



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- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4 th edn., 2000, Prentice Hall
- R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
- Digital Electronics, S.K. Mandal, 2010, 1 st edition, McGraw Hill

Operating System & System Software	ITS1202C
(T+L): 4 Credits	Prerequisites: None

UNIT-I

Operating System Principles: Structuring methods (monolithic, layered, modular, microkernel models), processes, and resources, Concepts of APIs, Device organization, interrupts: methods and implementations, Concept of user/system state and protection, transition to kernel mode.

UNIT-II

Concurrency: Implementing synchronization primitives, Multiprocessor issues (spin locks, reentrancy).

Scheduling and Dispatch: Dispatching and context switching, Preemptive and non-preemptive scheduling, Schedulers and policies, Processes and threads.

UNIT-III

Memory Management: Review of physical memory and memory management hardware, Working sets and thrashing, Caching, Paging and virtual memory, Virtual file systems.

UNIT-IV

File Systems: Files: data, metadata, operations, organization, buffering, sequential, non-sequential, Directories: contents and structure, Naming, searching, access, backups, Journaling and log-structured file systems.

UNIT-V

Deadlock: Introduction, Analysis of conditions, Prevention & avoidance, Detection & recovery.

Security and Protection: Overview of system security, Security methods and devices, Protection, access control, and authentication.

UNIT-VI

System Software: Assemblers: General design procedures, Design of two pass assemblers, Cross Assemblers, Macro Processors – Features of a macro facility, (macro instruction arguments, conditional macro expansion, macro calls within macros),

Implementation of a restricted facility: A two pass algorithm; Macro Assemblers.

Loader schemes: Compile and go loaders, absolute loaders, relocating loader, Linking, Reallocation- static & dynamic linking, Direct linking loaders, Binders, **Overlays**, dynamic binders; Working principle of Editors, Debuggers.

Text Book:

1. Silberschatz A., Galvin B. P. and Gagne G., *Operating System Concepts*, John Wiley & Sons Inc (2013) 9th ed.
2. Stallings W., *Operating Systems Internals and Design Principles*, Prentice Hall (2018) 9th ed.
3. Sibsankar Halder and Alex A Aravind, "Operating Systems", Pearson Education
4. Harvey M Dietel, "An Introduction to Operating System", Pearson Education
5. D M Dhamdhare, "Operating Systems : A Concept based Approach", McGraw Hill.
6. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education".
7. Stuart E. Madnick & John J. Donovan, "Operating Systems", Tata McGraw Hill.

Reference Books (author, title, publisher and year):

- Bovet P. D., Cesati M., *Understanding the Linux Kernel*, O'Reilly Media (2006), 3rd ed.



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• Kifer M., Smolka A. S., *Introduction to Operating System Design and Implementation: The OSP 2 Approach*, Springer (2007).

Unix/Linux Lab

Laboratory work:

To explore different operating systems like Linux, Windows etc. To implement main algorithms related to key concepts in the operating systems.

1. Detailed architecture of Unix/Linux commands and flow of command execution.
2. Detailed commands related to basics of Unix/Linux, file handling, process management.
3. Shell program having sequential, decision and loop control constructs.
4. CPU Scheduling Algorithms
5. Threaded programming in Unix/Linux (Eg. POSIX threads in LINUX)



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PRE-REQUISITE COURSES FOR STUDENTS who are MIGRATING to B. Sc. in Information Technology

(IT) Program in 2nd Year for Admission

Yr	Sem	Course Code	Course Title	Credits	Type
I	I	ITS1100A	Introduction to Programming Methodology	4(T+L)	Pre-Requisite-I
	II	ITS1200A	Basics of IT & Electronics	4(T+L)	Pre-Requisite-II

Introduction to Programming Methodology	ITS1100A
(T+L): 4 Credits	

UNIT-I(Introduction to Problem Solving & Programming)

Introduction to programming-General Problem solving-

Algorithmic & Heuristic, Steps of problem solving, Problem solving using computer – programming; Basic programming concept – Input, Processing Data, Output Data; Data types-Variables and constants-Integer, Float, Character, Boolean, String etc.-Format of variable names; Types specific operations- arithmetic, logical, relational etc, Built-in functions for operation, Operator Precedence & Associativity, Expressions

The Program Development - Development Cycle; Program Design - Modular Programming, pseudo code, flowchart; Coding, Documenting & Testing - Programming Languages – Types, Examples, Translators – Assemblers, Interpreters & Compilers, Editors, Debuggers; Coding & Documenting - Testing & Errors; Commercial Programs – Testing & Documenting, Testing phases, External Documentation; Structured Programming, Flowchart- Creating flowchart, Control Structures, Programming Conventions.

Case Study:-

Data types and operations in various programming language Various Assemblers, Interpreters & Compilers

UNIT-II(Control Structures)

Introduction to Selection Structures - Single, dual, multiple alternative structures, Constructing flow charts with selection structure, ASCII Code, Revisit Logical & Relational Operators, Hierarchy of operators, Using IF structure - Simple IF, IF-Else, Nested IF & IF-ladder, Using Case - like structures, Applications of Selection Structures, Problem solving with selection structures – examples.

Case Study: Study of selection structures in various languages.

Introduction to Repetition (iteration) Structures-Basics of Loop-Types of loops, Pre-test and post-test loops - **while**, **repeat-until**, Constructing flowcharts with Loop structure, Counter controlled looping, **FOR** loop structure, Sentinel Controlled looping, Applications of repetition structures, Problem solving with repetition structures – examples,

Case Study:- Study of repetition structures in various languages, More on loops and decisions, Combining selection & loop structure, Early exit – eg. Break, skipping instructions – eg. Continue, Nested loops, Problem solving involving the above concepts

UNIT-III(Arrays)

Arrays in everyday world, One dimensional Arrays, Array Basics, Working with multiple arrays, Properties and Advantages of arrays, Searching and Sorting, Linear Searching, Bubble / Sink Sort, Strings as Array of characters, String operations, Two Dimensional Arrays, Introduction to two dimensional arrays, Using Nested loops to work with two dimensional arrays, Multi Dimensional Arrays, Problem solving with One, Two, Multi-Dimensional Arrays



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CaseStudy: -Definition&indexingofarraysinvariouslanguages

UNIT-IV(ModulesandSubprograms)

Need of Sub Programs - Problems requiring modules, Problem analysis, Design, and Data flow diagrams, Arguments and Parameters, Passing data between modules, Assigning type to parameters, Value & Reference parameters, Scope of Variables - Global, Local; Functions - Revisit built-in functions, User defined functions; Recursion- Recursive Process, Simple recursion examples, Problems solving involving subprograms.

CaseStudy: Study of subprograms (definition structure, parameter passing) in various programming languages.

Introduction to sequential files-File Basics, Creating, Reading & Writing into files

TextBook: -

1. Venit, S & Drake E., *Prelude to Programming: Concepts & Design*, 4th Ed., Addison-Wesley (Pearson)

References: -

2. Sprankle, Maureen., *Problem Solving and Programming Concepts*, 7th Ed., Pearson.
3. Juliff, Peter, *Program Design*, 4th Ed., Prentice-Hall India
4. Tremblay, J & Bunt, R.B., *Introduction to Computer Science: An Algorithmic Approach*, 2nd Ed., Tata-McGraw Hill
5. Balaguruswamy, E., *Programming in ANSI C*, 4th Ed., Tata-McGraw Hill
6. <http://docs.python.org/tutorial/>
7. <http://radianbytes.com/books/pdfs/pylatex.pdf>

LIST OF SAMPLE EXPERIMENTS FOR PRACTICE (Only indicative)

- Familiarization of compiled and interpreted programs.
- Demonstrates sample programs for the same
- Familiarization of data types, operators, input & output
- Program to read & print numerical, character data.
- Program to read temperature in Celsius scale and print its Fahrenheit equivalent whose equation is $F = 95C + 32$.
- Problems involving selection process - if, if-else, nested if, else-if ladder, case
- Program to evaluate quadratic expression.
- Program to calculate salary from the following data

Basic Pay (BP)	DA	HRA	PF
BP < 5000	30% of BP	500	150
5000 BP < 10000	25% of BP, Minimum 1800	10%	5%
BP > 10000	20% of BP, Minimum 3000	15%, Maximum 10000	5%, Maximum 5000

- Gross Salary = BP + DA + HRA
- Deduction = PF
- Net Salary = Gross Salary - Deductions
- Problems involving Repetition (looping) - while, do-while, for
- Program to find reverse of a number.
- Program to find factorial of a number.
- Program to check whether the given number is prime or not.



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- Program to find sum of a series
- Programs requiring one-dimensional arrays
- Implementing program to do string operations.
- Implementation of linear search.
- Implementation of bubble sort.
- Programs involving two-dimensional arrays
- Programs involving matrix operations.
- Modular programming using subprograms
- Check whether the given number is Prime or not.
- Depreciation of an item based on the cost of item & lifetime is calculated as depreciation = cost of item / lifetime and the book value of each year is calculated as book value = cost of item - depreciation. Implement program to calculate the depreciation table as using subprogram to calculate depreciation for each year.

Year	Depreciation	Book Value
0	0	250.00
1	50.00	200.00
2	40.00	160.00
3	32.00	128.00
4	25.60	102.40
5	20.48	81.92

Sum of n numbers using recursion

Generate Fibonacci series using recursion.

Program to read and write into a file.

Basics of IT & Electronics	ITS1200A
(T+L): 4 Credits	

UNIT I

Introduction: Characteristics of Computer, Generation of computer, Types of computer and features, Application of computer;

Software: Definition, Relationship between Software and Hardware, Software Categories, System Software, Application Software and other software's with example, Software Terminology;

Number Systems: Types of Number systems, Conversion between number bases, Binary arithmetic including 1's complement and 2's complement;

UNIT II

Block diagram of digital computer and function of each block; Introduction to computer memory, Types of Computer Memory: Input & Output Devices, Data & Information, Different data processing methods

UNIT III

Introduction to Computer Languages. Introduction, to Operating System: Types of Operating, System, Functions of Operating System, Modern Operating Systems with example, Difference between process and program. Processing function of an Operating System with example.



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Operating System Principles: Structuring methods (monolithic, layered, modular, microkernel models), processes, and resources, Concepts of APIs, Device organization, interrupts: methods and implementations, Concept of user/system state and protection, transition to kernel mode.

UNIT IV

Introduction to Electronics , Passive Components Introduction to electronics - applications of electronics - types of electronic components - active and passive - types of passive components - resistors, capacitors and inductors - resistors - definition of resistance, symbol, specifications - classification of resistors - fixed, variable - resistor colour coding - capacitors – definition of capacitance, symbol, specifications, classification - fixed and variable - inductors – definition of inductance, symbol, specifications, classification - fixed and variable inductors - transformers - working principle and application.

UNIT V

Semiconductors & PN junction Semiconductor diode P-N junction - concept of hole, majority and minority charge carriers - formation of depletion layer in P-N junction - barrier voltage - biasing the P-N junction - forward bias, reverse bias, P-N junction diode - symbol V-I characteristics - forward and reverse characteristics - ideal characteristics - static and dynamic resistance of a diode - knee voltage - diode specifications - forward voltage, peak inverse voltage, maximum forward current, reverse saturation current - types of diodes - zener diode - symbol, operating principle, V-I characteristics - zener breakdown voltage - zener as a voltage regulator - tunnel diode - symbol, operating principle, V-I characteristics, applications - varactor diode - symbol, operating principle, V-I characteristics, applications.

Text Books:

3. P. K. Sinha, “Fundamental of Computers”, B.P.B. Publications
4. Balaguruswamy, “Fundamental of Computers”, TMH
5. V. Raja Raman, “Fundamental of Computers”, PHI
6. Anita Goel, “*Computer Fundamentals*”, Pearson
7. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.
8. D.P. Kothari, I. J. Nagrath, “Basic Electronics”, McGraw Hill Education (India) Private Limited, 2014.

Reference Books:

1. MuhammadAli Mazidi, “The 8051 Microcontroller and Embedded. Systems. Using Assembly and C.” Second Edition, 2011, Pearson India.

Basics of IT & Electronics Lab

UNIT I

CUI based operating Systems: Introduction to MS-DOS, System files, Internal and External Commands: Syntax and examples, Batch processing.

GUI based operating Systems: Introduction to MS-DOS, File System, Start button and menus, Hide and Unhide properties of files and folders. Utilities of icons, Recycle bin, Task bar, Desktop background, Screen saver, working with control panel.

UNIT II

Word Processor: Basic Concepts, Salient features, Utilities of Menu bar, Tool bar, Text, Font, Styles and background, Water mark, Table, Page border, Indentation, Page orientation, Equation Editor, Mail merge, Protection of the documents.

UNIT III

Spread Sheet: Purpose, Salient features, usage, commands, Formulas, Validations, Basic functions and Chart.

Presentation: Purpose, Salient features, usage, Animation, Custom Animation, Slide Transaction, Mouse click presentation, Automatic presentation.



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UNIT IV

1. Basic Electronics:

- a. To design a combinational logic system for a specified Truth Table.
 - b. To convert Boolean expression into logic circuit & design it using logic gate ICs.
 - c. To minimize a given logic circuit.
2. Half Adder and Full Adder.
 3. Half Subtractor and Full Subtractor.
 4. 4-bit binary adder and adder-subtractor using Full adder IC.
 5. To design a seven segment decoder.



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B. Sc. in Information Technology (IT) Program 2ndYear

Yr	Sem	Course Code	Course Title	Credits	Type
II	III	ITS2301C	Data Structure & Algorithm	4(T+L)	Major-5
		ITS2302C	Computer Organization	4(T)	Major-6
			Minor/Elective-III	4	Minor/Elective-3
			Prerequisite Allied/MOOC-II	3	Interdisciplinary Course –II
			Prescribed Courses-III	3	Skill Enhancement/ Vocational-III
			Prescribed VAC Project/ Internship/ Survey-III	2*	Common Value-Added Courses
		Total Credits of Semester III		18+2*	
	IV	ITS2401C	Computer Network	4(T+L)	Major-7
		ITS2402C	Microprocessor	4(T+L)	Major-8
			Minor/Elective-IV	4	Minor/Elective-4
			Prerequisite Allied/MOOC-III	3	Interdisciplinary Course –III
			Qualifying Prescribed Course-II	3	Ability Enhancement Courses (language)
			Prescribed VAC Project/ Internship/ Survey-IV	2*	Common Value-Added Courses
		Total Credits of Semester IV		18+2*	

Total Cumulative Credits after completion of 2ndYear=72+8* =80 Credits

- 32 credits Major
- 16 Credits Minor
- 9 Credits Interdisciplinary Course (Prerequisite Allied/MOOC)
- 9 Credits Skill Enhancement/ Vocational
- 6 Credits Ability Enhancement Courses (language)
- 8* Credits Common Value-Added Courses (VAC Project/ Internship/ Survey)

Students Exiting the program after securing 80 Credits will be awarded **UG DIPLOMA CERTIFICATE IN INFORMATION TECHNOLOGY (IT)** provided they secure 8* credits in skill based vocational courses offered during the 1st year and 2nd year summer term semester (exiting students need to undertake an internship of 4 credits additionally in each year)



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Data Structure & Algorithm	ITS2301C
(T+L): 4 Credits	Prerequisites: None

UNIT I

Introduction to data structures: Introduction, Basic terminology; Elementary Data Organization, Data Structures, Data Structure Operations, Definition; Types of data structures - Primitive & Non-primitive, Linear and Non-linear; Operations on data structures. Dynamic memory allocation: Static & Dynamic memory allocation; Memory allocation and de-allocation functions - *malloc*, *calloc*, *realloc* and *free*. Algorithm Specification, Performance Analysis, Performance Measurement Recursion: Definition; Types of recursions; Recursion Technique Examples - GCD, Binomial coefficient nCr , Towers of Hanoi; Comparison between iterative and recursive functions.

Introduction to Algorithms, Preliminaries: Introduction, Algorithmic notations, Control structure.

UNIT II

Arrays: Basic Concepts – Definition, Declaration, Initialisation, Operations on arrays; Types of arrays; Arrays as abstract data types (ADT); Representation of Linear Arrays in memory; Traversing linear arrays; Inserting and deleting elements;

Sorting – Selection sort, Bubble sort, Quick sort, Merge sort, Heap sort, Insertion sort;

Searching - Sequential Search, Binary search; Iterative and Recursive searching; Multidimensional arrays; Representation of multidimensional arrays; Sparse matrices.

UNIT III

Linked list: Basic Concepts – Definition and Representation of linked list, Types of linked lists - Singly linked list, Doubly linked list, Header linked list, Circular linked list; Representation of Linked list in Memory; Operations on Singly linked lists – Traversing, Searching, Insertion, Deletion; Memory allocation; Garbage collection.

UNIT IV

Stacks: Basic Concepts – Definition and Representation of stacks; Operations on stacks; Applications of stacks; Infix, postfix and prefix notations; Conversion from infix to postfix using stack; Evaluation of postfix expression using stack; Application of stack in function calls.

Queues: Basic Concepts – Definition and Representation of queues; Types of queues - Simple queues, Circular queues, Double ended queues, Priority queues; Operations on Simple queues;

UNIT V

Trees: Definition; Tree terminologies – node, root node, parent node, ancestors of a node, siblings, terminal & non-terminal nodes, degree of a node, level, edge, path, depth; Binary tree: Type of binary trees - strict binary tree, complete binary tree, binary search tree and heap tree; Array representation of binary tree. Traversal of binary tree; preorder, inorder and postorder traversal;

Graphs: Basic terminology, Matrix representation of graphs, Traversal: BFS, DFS. Spanning Tree: Prim's, Kruskal Algorithm, Dijkstra's Algorithm.

Text Books:

1. Ellis Horowitz and Sartaj Sahni: Fundamentals of Data Structures
2. R. Venkatesan and S. Lovelyn Rose, Data Structures, First Edition: 2015, Wiley India Pvt.Ltd. Publications
3. Satraj Sahani: Fundamentals of Data Structures



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Reference Books:

1. Tanenbaum: Data structures using C (Pearson Education)
2. D. Samanta: Classic Data Structure
3. Bandopadhyay: Data Structure using C
4. Lipschutz: Data Structure
5. Kamathane: Introduction to Data structures (Pearson Education)
6. Y. Kanitkar: Data Structures Using C (BPB)
7. Kottur: Data Structure Using C
8. Padma Reddy: Data Structure Using C
9. Sudipa Mukherjee: Data Structures using C – 1000 Problems and Solutions (McGraw Hill Education, 2007))

Data Structure Lab

Programming Lab

Part A:

1. Program to find GCD using recursive function
2. Program to display Pascal Triangle using binomial function
3. Program to generate n Fibonacci numbers using recursive function.
4. Program to implement Towers of Hanoi.
5. Program to implement dynamic array, find smallest and largest element of the array.
6. Program to create two files to store even and odd numbers.
7. Program to create a file to store student records.
8. Program to read the names of cities and arrange them alphabetically.
9. Program to sort the given list using selection sort technique.
10. Program to sort the given list using bubble sort technique.
11. Program to sort the given list using insertion sort technique.
12. Program to sort the given list using bubble sort technique.
13. Program to search an element using linear search technique.
14. Program to search an element using binary search technique.
15. Program to implement Stack operations using arrays.
16. Program to implement Queue operations using arrays

Part B:

1. Program to sort the given list using insertion sort technique.
2. Program to sort the given list using quick sort technique.
3. Program to sort the given list using merge sort technique.
4. Program to search an element using linear search technique.
5. Program to search an element using recursive binary search technique.
6. Program to convert an infix expression to postfix.
7. Program to implement linear linked list.
8. Program to display traversal of a tree.
9. Program to implement circular queue using array
10. Program to implement Stack operations using linked list.
11. Program to implement Queue operations using linked list.
12. Program to evaluate postfix expression.
13. Program to perform insert node at the end, delete a given node and display contents of singly linked list.
14. Menu driven program for the following operations on Binary Search Tree (BST) of Integers
 - (a) Create a BST of N Integers
 - (b) Traverse the BST in Inorder, Preorder and Post Order



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सूर्यमणिनगर / Suryamaninagar, त्रिपुरा/ Tripura - 799022

Computer Organization	ITS2302C
T : 4 Credits	Prerequisites: None

UNIT-I

Data Representation and basic Computer Arithmetic: Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison.

UNIT-II

Logic gates and circuits: logic gates, boolean algebra, combinational circuits, circuit simplification, introduction to flip-flops and sequential circuits, decoders, multiplexers, registers, counters.

UNIT-III

Basic Computer Organization and Design: Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt.

UNIT-IV

Central Processing Unit: Register organization, arithmetic and logical micro-operations, stack organization, Hardwired vs. micro programmed control. Pipeline control: Instruction pipelines, pipeline performance, super scalar processing, Pipelining, RISC & CISC.

UNIT-V

Programming the Basic Computer: Instruction formats, addressing modes, instruction codes, assembly language.

UNIT-VI

Memory Organization: Memory device characteristics, random access memories, serial access memories, Multilevel memories, address translation, memory allocation, Main features, address mapping, structure versus performance.

UNIT-VII

Input-output Organization: Peripheral devices, I/O interface, Modes of data transfer: Programmed, Interrupt Driven and Direct Memory Access.

UNIT-VIII

Parallel processing: Processor-level parallelism, multiprocessor architecture

Text Books:

1. J. P. Hayes: Computer Architecture & Organization
2. Govind Rajalu: Computer Organization
3. Pal Chaudhury: Computer Architecture & Organization

References:

1. M. Mano, "Computer System Architecture", Pearson Education, New Jersey, 2017, Third Edition.
2. W. Stallings, "Computer Organization and Architecture Designing for Performance", Prentice Hall of India, 2015, Tenth Edition.
3. M. Mano, "Digital Design", Pearson Education, New Jersey, 2018, Sixth Edition.
4. Vranasic and Hamacher, Computer Organization, TMH"



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Computer Network	ITS2401C
(T+L): 4 Credits	Prerequisites: None

UNIT-I

Introduction to Signals Data and Information, Data communication, Characteristics of data communication, Components of data communication, Data Representation, Data Flow, Simplex, Half Duplex, Full Duplex, Analog and Digital Signals, Periodic and Aperiodic signals, Time and Frequency Domain, Composite Signals

Basic concepts of Networks: Components of data communication, standards and organizations, Network Classification, Network Topologies; network protocol; layered network architecture;

Network definition: Layered network architecture, OSI reference model, TCP/IP Model, Comparison between OSI and TCP/IP.

UNIT-II

Analog and digital signal, data-rate limits, digital to digital line encoding schemes, PCM, digital to analog modulation, multiplexing techniques FDM, TDM, transmission media,

Physical Layer: Cabling, Network Interface Card, Transmission Media Devices- Repeater, Hub, Bridge, Switch, Router, Gateway.

UNIT-III

Data Link Layer: Designing issues, Flow control, Framing and Data Link Control, Error detection schemes (parity, checksums, CRCs), Error correction schemes (Hamming codes, binary convolution codes), Data link layer protocols (Simplex, Stop & Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, Sliding Window), MAC sublayer (Ethernet, ALOHA, CSMA family, Contention-free access/Token Ring), Ethernet LANS, connecting LAN.

UNIT-IV

Network Layer: Design issues, Switching (Circuit switching, packet switching- connection-less datagram switching, connection-oriented virtual circuit switching), Routing algorithms (Shortest path, Link state, Flooding, Broadcast, Multicast), Distance vector routing and link state routing, Packet Scheduling, Internetworking, Internet Protocol (IPv4, IPv6), IP addressing, Internet Control Protocols (ICMP, ARP, DHCP), Mobile IP, dial-up modems, digital subscriber line, cable TV for data transfer.

UNIT-V

Transport Layer: Transport layer services, Connection establishment and teardown, TCP, UDP, Congestion Control, Quality of Service, Domain Name System, World Wide Web.

UNIT-VI

Application Layer: Application layer protocols and services – Domain Name System, HTTP, WWW, TELNET, FTP, SMTP

UNIT-VII

Network Security: Common Terms, Network security issues, Common threats, Security barriers in the network pathways, Official levels of computer security, Types of security controls, Approaches to network security, Ethical Hacking, Virtual Private Networks.

Firewalls: Need and features of firewalls, Types of firewall technology – network level and application level, IP packets filter screening routers, limitations of firewalls.

Cryptography: Encryptions and Decryption, Type of encryptions, encryption keys, Public/Private key encryption.

Text Books:



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1. B. A. Forouzan: Data Communications and Networking
2. Tannenbaum: Computer Networks
3. Miller: Data & Network Communication
4. Stallings: Data & Computer Communication

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking", Pearson Education
2. Dr. Prasad: Data Communication & Network
3. Scitech: Computer Network Theory
4. Shanmugam & Rajeev: Computer Communication Networks
5. Prakash C. Gupta: Data Communication

Computer Network Lab

Course outcomes:

1. Understand and explain the concept of Data Communication and networks, layered architecture and their applications.
2. Analyze and Set up protocol designing issues for Communication networks.
3. Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction.
4. Apply various network layer techniques for designing subnets and supernets and analyze packet flow on basis of routing protocols.
5. Estimate the congestion control mechanism to improve quality of service of networking application

Software based Lab on Computer Networks:

Implement the concepts of Computer Networks such as:

1. Simulate Checksum Algorithm.
2. Simulate CRC Algorithm
3. Simulate Stop & Wait Protocol.
4. Simulate Go-Back-N Protocol.
5. Simulate Selective Repeat Protocol.
6. Boson NetSim Network Simulator.

Reference Books:

1. James Kurose: Computer Networking – A Top -Down Approach
2. Mike Meyers: *CompTIA Network+ Certification Passport, 4th Edition (Exam N10-005)*, 4th Edition now with the O'Reilly learning platform.
3. Akshay Singhal: Checksum in Networking
4. Granino A. Korn: Interactive Dynamic-System Simulation
5. J. M. Morris, "On another go-back-N ARQ technique for high error rate conditions," IEEE Trans. Communication., vol. COM-26, pp. 187-189, Jan. 1978.
6. M. Anagnostou: Performance Analysis of the Selective Repeat ARQ Protocol.



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Microprocessor	ITS2402C
T: 4 Credits	Prerequisites: None

Unit 1. Introduction to Microprocessor

Introduction to Microprocessor. Components of a Microprocessor: Registers, ALU and control & timing, System bus (data, address and control bus). Microprocessor systems with bus organization.

Unit 2. Basic Architecture

Microprocessor Architecture and Operations, Memory, I/O devices, Memory and I/O operations, 8085 Microprocessor Architecture, Address, Data And Control Buses, 8085 Pin Functions, Demultiplexing of Buses, Generation Of Control Signals.

Unit 3. Instruction Cycle

Fetch Operation and Timing Diagram; Execute Operation and Timing Diagram, Instruction Cycle, Machine Cycle, T-States, T-States, Memory Interfacing.

Unit 4. Assembly Language Programming

Assembly instruction format, Instruction Types, Mnemonics, Operands, Macro assemblers, Linking, Assembler directives, Addressing Modes, Simple sequence programs, Flags, Branch, Jumps, While-Do, Repeat-Until, If-Then-Else and Multiple If-then Programs, Debugging.

Unit 5. Basic I/O, Memory R/W and Interrupt Operations

Memory Read, Memory Write, I/O Read, I/O Write, Direct Memory Access, Interrupt, Types, Interrupt Masking.

Unit 6. Input/ Output Interfaces 6 Hrs.

Interfacing Concepts, Ports, Interfacing Of I/O Devices, Interrupts In 8085, Programmable Interrupt Controller 8259A, Programmable Peripheral Interface 8255A.

Unit 7. Advanced Microprocessors

8086: logical block diagram and segments, 80286: Architecture, Registers, (Real/Protected mode), Privilege levels, descriptor cache, Memory access in GDT and LDT, multitasking, addressing modes, flag register 80386: Architecture, Register organization, Memory access in protected mode, Paging.

Laboratory Works:

The laboratory work includes Assembly language programming using 8085/8086/8088 trainer kit. The programming should include: Arithmetic operation, base conversion, conditional branching etc. The lab work list may include following concepts:

1. Assembly language program using 8085 microprocessor kit.
2. Use of all types of instructions and addressing modes.
3. Arrays and the concept of Multiplications and Division operations on Microprocessor.
4. Assembly language programming, using any types of Assembler, including the different functions of Int 10h, and 12h

Text Books:

- Ramesh S.Gaonkar, Microprocessor Architecture, Programming, and Applications with 8085, Prentice Hall

Reference Books:

- A.P.Malvino and J.A.Brown, Digital Computer Electronics, 3rd Edition, Tata McGraw
- Hill D.V.Hall, Microprocessors and Interfacing – Programming and Hardware, McGraw Hill
- 8000 to 8085 Introduction to 8085 Microprocessor for Engineers and Scientists, A.K.Gosh, Prentice Hall



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PRE-REQUISITE COURSES FOR STUDENTS who are MIGRATING to B. Sc. in Information Technology (IT) Program in 3rd Year for Admission

Yr	Sem	Course Code	Course Title	Credits	Type
II	III	ITS2300A	Basics of Computer Networking	4(T+L)	Pre-Requisite-III
	IV	ITS2400A	Computer Architecture & Microprocessor	4(T+L)	Pre-Requisite-IV

Basics of Computer Networking	ITS2300A
3 - 0 - 2 : 4 Credits	

UNIT-I

Introduction to Signals Data and Information, Data communication, Characteristics of data communication, Components of data communication, Data Representation, Data Flow, Simplex, Half Duplex, Full Duplex, Analog and Digital Signals, Periodic and Aperiodic signals, Time and Frequency Domain, Composite Signals

Basic concepts of Networks: Components of data communication, standards and organizations, Network Classification, Network Topologies; network protocol; layered network architecture;

Network definition: Layered network architecture, OSI reference model, TCP/IP Model, Comparison between OSI and TCP/IP.

UNIT-II

Analog and digital signal, data-rate limits, digital to digital line encoding schemes, PCM, digital to analog modulation, multiplexing techniques FDM, TDM, transmission media,

Physical Layer: Cabling, Network Interface Card, Transmission Media Devices- Repeater, Hub, Bridge, Switch, Router, Gateway.

UNIT-III

Data Link Layer: Designing issues, Flow control, Framing and Data Link Control, Error detection schemes (parity, checksums, CRCs), Error correction schemes (Hamming codes, binary convolution codes), Data link layer protocols (Simplex, Stop & Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, Sliding Window), MAC sublayer (Ethernet, ALOHA, CSMA family, Contention-free access/Token Ring), Ethernet LANS, connecting LAN.

UNIT-IV

Network Layer: Design issues, Switching (Circuit switching, packet switching- connection-less datagram switching, connection-oriented virtual circuit switching), Routing algorithms (Shortest path, Link state, Flooding, Broadcast, Multicast), Distance vector routing and link state routing, Packet Scheduling, Internetworking, Internet Protocol (IPv4, IPv6), IP addressing, Internet Control Protocols (IMCP, ARP, DHCP), Mobile IP, dial-up modems, digital subscriber line, cable TV for data transfer.

UNIT-V

Transport Layer: Transport layer services, Connection establishment and teardown, TCP, UDP, Congestion Control, Quality of Service, Domain Name System, World Wide Web.



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UNIT-VI

Application Layer: Application layer protocols and services – Domain Name System, HTTP, WWW, TELNET, FTP, SMTP

UNIT-VII

Network Security: Common Terms, Network security issues, Common threats, Security barriers in the network pathways, Official levels of computer security, Types of security controls, Approaches to network security, Ethical Hacking, Virtual Private Networks.

Firewalls: Need and features of firewalls, Types of firewall technology – network level and application level, IP packets filter screening routers, limitations of firewalls.

Cryptography: Encryptions and Decryption, Type of encryptions, encryption keys, Public/Private key encryption.

Text Books:

1. B. A. Forouzan: Data Communications and Networking
2. Tannenbaum: Computer Networks
3. Miller: Data & Network Communication
4. Stallings: Data & Computer Communication

Reference Books:

1. James F. Kurose, Keith W. Ross, “Computer Networking”, Pearson Education
2. Dr. Prasad: Data Communication & Network
3. Scitech: Computer Network Theory
4. Shanmugam & Rajeev: Computer Communication Networks
5. Prakash C. Gupta: Data Communication

Computer Network Lab

Course outcomes:

1. Understand and explain the concept of Data Communication and networks, layered architecture and their applications.
2. Analyze and Set up protocol designing issues for Communication networks.
3. Evaluate data communication link considering elementary concepts of data linklayer protocols for error detection and correction.
4. Apply various network layer techniques for designing subnets and supernets and analyze packet flow on basis of routing protocols.
5. Estimate the congestion control mechanism to improve quality of service of networking application

Software based Lab on Computer Networks:

Implement the concepts of Computer Networks such as:

1. Simulate Checksum Algorithm.
2. Simulate CRC Algorithm
3. Simulate Stop & Wait Protocol.
4. Simulate Go-Back-N Protocol.
5. Simulate Selective Repeat Protocol.
6. Boson NetSim Network Simulator.



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Reference Books:

1. James Kurose: Computer Networking – A Top -Down Approach
2. Mike Meyers: *CompTIA Network+ Certification Passport, 4th Edition (Exam N10-005), 4th Edition* now with the O'Reilly learning platform.
3. Akshay Singhal: Checksum in Networking
4. Granino A. Korn: Interactive Dynamic-System Simulation
5. J. M. Morris, "On another go-back-N ARQ technique for high error rate conditions," IEEE Trans. Communication., vol. COM-26, pp. 187-189, Jan. 1978.
6. M. Anagnostou: Performance Analysis of the Selective Repeat ARQ Protocol.

Computer Architecture & Microprocessor	ITS2400A
(T+L): Credits	

UNIT-I

Data Representation and basic Computer Arithmetic: Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison.

Logic gates and circuits: logic gates, boolean algebra, combinational circuits, circuit simplification, introduction to flip-flops and sequential circuits, decoders, multiplexers, registers, counters.

UNIT-II

Basic Computer Organization and Design: Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt.

Central Processing Unit: Register organization, arithmetic and logical micro-operations, stack organization, Hardwired vs. micro programmed control. Pipeline control: Instruction pipelines, pipeline performance, super scalar processing, Pipelining, RISC & CISC.

UNIT-III

Programming the Basic Computer: Instruction formats, addressing modes, instruction codes, assembly language.

Memory Organization: Memory device characteristics, random access memories, serial access memories, Multilevel memories, address translation, memory allocation, Main features, address mapping, structure versus performance.

UNIT-IV

Input-output Organization: Peripheral devices, I/O interface, Modes of data transfer: Programmed, Interrupt Driven and Direct Memory Access.

Parallel processing: Processor-level parallelism, multiprocessor architecture

UNIT-V

INTRODUCTION OF MICROPROCESSOR & INTERFACING DEVICES: Introduction to Microprocessor, Evolution of Microprocessor, and Microprocessor based Systems
Microprocessor Instruction Sets & Various Computer Languages.

MICROPROCESSOR ARCHITECTURE:

Features of 8085 Microprocessor
Pin Diagram of 8085 Microprocessor, Address Bus & Multiplexed Address/Data Bus Control and status signals
Power supply and clock frequency
Externally initiated signals including Interrupts
Serial I/O Ports
Block Diagram of 8085 Microprocessor
8085 BUS Organization and 8085 registers
Microprocessor operations: Microprocessor initiated Operations, Internal data operations, Externally Initiated operations, Microprocessor Communication & Bus



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Timings De-multiplexing the Bus AD7 to AD0 Generating Control Signals, 8085 Machine Cycles & Bus Timings Opcode Fetch Machine Cycle Memory Read Machine Cycle, Example of an 8085-based microcomputer.

UNIT-VI

INSTRUCTION SET & PROGRAMMING TECHNIQUES:

Single Byte, Two Bytes & Three Bytes Instructions Opcode, Format Instruction Formats: Instruction Timings & Operation Status, DATA Transfer Operations, Arithmetic Operations, Logic Operations, Branch Operations, Stack, I/O & Machine Control Instructions. Looping, Counting and Indexing Counter and Timing delays Stack and Subroutines, Code conversion, BCD Arithmetic operations and 16 Bit data operations How to write an assembly language program & execute a simple program.

Text Books:

1. J. P. Hayes: Computer Architecture & Organization
2. Govind Rajalu: Computer Organization
3. Pal Chaudhury: Computer Architecture & Organization
4. Ramesh Gaonkar, Microprocessor Architecture, Programming, and application with 8085, Penram International Publication, 2011.
5. K.R. Venugopal & Rajkumar, Microprocessor x86 programming, BPB Publication, 2007.
6. John Ufferbeck, The 8080/85 Family: Design, Programming & Interfacing, PHI India.
7. A. K. Ray & K. M. Bhurchandani, Advance Microprocessor and Peripherals, 2nd Edition, Tata McGraw Hill, 2006.

References:

1. M. Mano, "Computer System Architecture", Pearson Education, New Jersey, 2017, Third Edition.
2. W. Stallings, "Computer Organization and Architecture Designing for Performance", Prentice Hall of India, 2015, Tenth Edition.
3. M. Mano, "Digital Design", Pearson Education, New Jersey, 2018, Sixth Edition.
4. Vranasic and Hamacher, Computer Organization, TMH"

List of Experiments

1. Introduction to Microprocessor Trainer Kit and identify the different peripheral devices on it.
2. Introduction to 8085 simulator IDE and understand the steps to simulate the program using it.
3. To write an assembly language program using data transfer instructions and verify it using microprocessor trainer kit.
4. To write an assembly language program using arithmetic instructions and verify it using microprocessor trainer kit.
5. To write an assembly language program using Logical instructions and verify it using microprocessor trainer kit.
6. To write an assembly language program using branching instructions and verify it using microprocessor trainer kit.
7. To demonstrate the assembly language programming for delays & subroutines.
8. To demonstrate the programming & interfacing of 8255 Programmable Peripheral Interface.
9. To demonstrate the interfacing of 8279 Display and keyboard controller.
10. To study the Binary to BCD conversion using assembly language programming and perform it using microprocessor trainer kit & 8085 simulator.
11. To understand the Working of Hardware interrupts.
12. To perform the various applications of 8085 microprocessor.



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B. Sc. in Information Technology (IT) Program 3rd Year

Yr	Sem	Course Code	Course Title	Credits	Type
III	V	ITS3501C	Database Management System	4(T+L)	Major-9
		ITS3502C	Software Engineering	4(T+L)	Major-10
		ITS3503C	Technical Writing with Minor Project	4(L)	Major-11
		ITS30XXE	Departmental Optional Paper-I	4(T)	Major-12
			Minor/Elective-V	4	Minor/Elective-5
			Qualifying Prescribed Course-III	2	Ability Enhancement Courses (language)
		Total Credits of Semester V		22	
	VI	ITS3601C	Object Oriented Programming	4(T+L)	Major-13
		ITS3602C	Web Technology	4(T+L)	Major-14
		ITS3603C	Major Project	4(L)	Major-15
		ITS30XXE	Departmental Optional Paper-II	4(T)	Major-16
			Minor/Elective-VI	4	Minor/Elective-6
		Total Credits of Semester VI		20	

Departmental Optional Papers I/II (Select any two)

Course Code	Course Title	Course Code	Course Title
ITS3001E	Cloud Computing	ITS3006E	Distributed Computing
ITS3002E	Computer Graphics	ITS3007E	E-Commerce
ITS3003E	Cyber Security & Cyber Law	ITS3008E	Formal Languages & Automata Theory
ITS3004E	Data Science	ITS3009E	Internet of Things
ITS3005E	Digital Marketing	IST3010E	Operation Research

Total Cumulative Credits after completion of 3rd Year=114+8* =122 Credits

- 64 credits Major
- 24 Credits Minor
- 9 Credits Interdisciplinary Course (Prerequisite Allied/MOOC)
- 9 Credits Skill Enhancement/ Vocational
- 8 Credits Ability Enhancement Courses (language)
- 8* Credits Common Value-Added Courses (VAC Project/ Internship/ Survey)

Students Exiting the program after securing above Credits will be awarded **B. SC. IN INFORMATION TECHNOLOGY (IT)**

N.B. 50% courses of minor stream must be from the relevant subject/discipline and remaining 50% from any discipline.



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Database Management System	ITS3501C
(T+L): 4 Credits	Prerequisites: <i>None</i>

UNIT – I

Database System Applications: A Historical Perspective, File Systems versus a DBMS, the Data Model, Levels of Abstraction in a DBMS, Data Independence, Structure of a DBMS.

Introduction to Database Design: Database Design and ER Diagrams, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design With the ER Model.

UNIT – II

Introduction to the Relational Model: Integrity constraint over relations, enforcing integrity constraints, querying relational data, logical data base design, introduction to views, destroying/altering tables and views. Relational Algebra, Tuple relational Calculus, Domain relational calculus.

UNIT – III

SQL: Queries, Constraints, Triggers: form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, triggers and active data bases.

Schema Refinement: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms, BCNF, lossless join decomposition, multi-valued dependencies, FOURTH normal form, FIFTH normal form.

UNIT – IV

Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock Based Protocols, Timestamp Based Protocols, Validation- Based Protocols, Multiple Granularity, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions.

UNIT – V

Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, Tree base Indexing, Comparison of File Organizations, Indexes and Performance Tuning, Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic Index Structure.

Database management systems Course Outcomes

Gain knowledge of fundamentals of DBMS, database design and normal forms

Master the basics of SQL for retrieval and management of data.

Be acquainted with the basics of transaction processing and concurrency control.

Familiarity with database storage structures and access techniques

Database management systems Text Books

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata Mc Graw Hill 3rd Edition
2. Database System Concepts, Silberschatz, Korth, Mc Graw hill, V edition.

Database management systems Reference Books

1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate, Pearson Education
3. Introduction to Database Systems, C. J. Date, Pearson Education
4. Oracle for Professionals, The X Team, S.Shah and V. Shah, SPD.
5. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL, Shah, PHI.
6. Fundamentals of Database Management Systems, M. L. Gillenson, Wiley Student Edition.



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Database Management System Lab

1. Create a database table, add constraints (primary key, unique, check, Not null), insert rows, update and delete rows using SQL DDL and DML commands.
2. Create a set of tables, add foreign key constraints and incorporate referential integrity.
3. Query the database tables using different 'where' clause conditions and also implement aggregate functions.
4. Query the database tables and explore sub queries and simple join operations.
5. Query the database tables and explore natural, equi and outer joins.
6. Write user defined functions and stored procedures in SQL.
7. Execute complex transactions and realize DCL and TCL commands.
8. Write SQL Triggers for insert, delete, and update operations in a database table.
9. Create View and index for database tables with a large number of records.
10. Create an XML database and validate it using XML schema.
11. Create Document, column and graph-based data using NOSQL database tools.
12. Develop a simple GUI based database application and incorporate all the above-mentioned features
13. Case Study using any of the real-life database applications from the following list
 - Inventory Management for a EMart Grocery Shop
 - Society Financial Management
 - Cop Friendly App – Eseva
 - Property Management – eMall
 - Star Small and Medium Banking and Finance
 - Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.
 - Apply Normalization rules in designing the tables in scope.
 - Prepared applicable views, triggers (for auditing purposes), and functions for enabling enterprise grade features.
 - Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.
 - Ability to showcase ACID Properties with sample queries with appropriate settings.

Software Engineering	ITS3502C
(T+L): 4 Credits	Prerequisites: None

Course Objectives

- The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.
- Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams.

Course Outcomes

- Ability to translate end-user requirements into system and software requirements, using e.g. UML, and structure the requirements in a Software Requirements Document (SRD).
- Identify and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.
- Will have experience and/or awareness of testing problems and will be able to develop a simple testing report



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UNIT-I

Introduction to Software Engineering: The evolving role of software, changing nature of software, software myths.

A Generic view of process: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models.

Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.

UNIT-II

Software Requirements: Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document.

Requirements engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management.

System models: Context models, behavioral models, data models, object models, structured methods.

UNIT-III

Design Engineering: Design process and design quality, design concepts, the design model. **Creating an architectural design:** software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequenced diagrams, collaboration diagrams, use case diagrams, component diagrams.

UNIT-IV

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.

Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.

UNIT-V

Metrics for Process and Products: Software measurement, metrics for software quality.

Risk management: Reactive vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan.

Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.

TEXTBOOKS:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, McGraw Hill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson Education.
3. The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.

REFERENCE BOOKS:

1. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley.
2. Software Engineering principles and practice- Waman S. Jawadekar, The McGraw-Hill Companies.
3. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

Software Engineering Lab

Prerequisites

A course on "Programming for Problem Solving"

Co-requisite



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A Course on “Software Engineering”

Course Objectives

To have hands on experience in developing a software project by using various software engineering principles and methods in each of the phases of software development.

Course Outcomes

1. Ability to translate end-user requirements into system and software requirements
2. Ability to generate a high-level design of the system from the software requirements
3. Will have experience and/or awareness of testing problems and will be able to develop a simple testing report

List of Experiments

Do the following 8 exercises for any two projects given in the list of sample projects or any other projects:

- 1) Development of problem statement.
- 2) Preparation of Software Requirement Specification Document, Design Documents and Testing Phase related documents.
- 3) Preparation of Software Configuration Management and Risk Management related documents.
- 4) Study and usage of any Design phase CASE tool
- 5) Performing the Design by using any Design phase CASE tools.
- 6) Develop test cases for unit testing and integration testing
- 7) Develop test cases for various white box and black box testing techniques.

Sample Projects:

1. Passport automation System
2. Book Bank
3. Online Exam Registration
4. Stock Maintenance System
5. Online course reservation system
6. E-ticketing
7. Software Personnel Management System
8. Credit Card Processing
9. E-book management System.
10. Recruitment system

TEXT BOOKS:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, Mc Graw Hill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson Education.
3. The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.

Technical Writing with Minor Project	ITS3503C
L : 4 Credits	Prerequisites: <i>None</i>

1. At least two paper writing
2. A Minor Project

Departmental Optional Paper-I	ITS30XXE
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T : 4 Credits	Prerequisites: <i>None</i>
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Object Oriented Programming	ITS3601C
(T+L): 4 Credits	Prerequisites: <i>None</i>

UNIT-I: Introduction to Java

Java Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods)

UNIT-II: Arrays, Strings and I/O

Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects, Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files.

UNIT-III: Object-Oriented Programming Overview

Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

UNIT-IV: Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata

Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

UNIT-V: Exception Handling, Threading, Networking and Database Connectivity

Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

UNIT-VI: Applets and Event Handling

Java Applets: Introduction to Applets, Writing Java Applets, Working with Graphics, Incorporating Images & Sounds. Event Handling Mechanisms, Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, textfields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of servlets.

Reference Books:

- 1 Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson.
- 2 Programming in Java, Sachin Malhotra & Saurabh Chaudhary, Oxford University Press.
- 3 Murach's Beginning Java 2, Doug Lowe, Joel Murach and Andrea Steelman, SPD.
- 4 Core Java Volume-I Fundamentals, Eighth Edition, Horstmann & Cornell, Pearson Education.
- 5 The Complete Reference, Java 2 (Fourth Edition), Herbert Schildt, TMH.
- 6 Java Programming, D.S. Malik, Cengage Learning.



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Object Oriented Programming Lab using JAVA

1. To write a java program to find the area of rectangle.
2. To write a java program to print the individual digits of a 3 digit number.
3. To write a java program to read two integers and print the larger number followed by the words “is larger”. If the numbers are equal print the message “These numbers are equal”.
4. To write a java program to read an integer and find whether the number is odd or even.
5. To write a java program find the biggest of three integers.
6. To write a java program to find the sum of digits of a given number.
7. To write a java program to find the first 15 terms of Fibonacci sequence.
8. To write a java program to print the Armstrong numbers.
9. To write a java program to find the largest and smallest number in an array.
10. To write a java program to multiply two matrices.
11. To write a menu based java program that accepts a shopping list of four items from the commandline and store in a Vector and perform operations
 - a. To add an item at a specific location in the list.
 - b. To delete an item in the list.
 - c. To print the contents of the vector.
 - d. To delete all elements.
 - e. To add an item at the end of the vector.
12. To write a java program that creates a string object and initializes it with your name and perform the following operations
 - a) To find the length of the string object using appropriate String method.
 - b) To find whether the character ‘a’ is present in the string. If yes find the number of times ‘a’ appear in the name and the location where it appears
13. To write a java program to create a StringBuffer object and illustrate how to append characters and to display the capacity and length of the string buffer.
14. To write a java program to Create a StringBuffer object and illustrate the operations of the append() and reverse() methods.
15. To write a program in java with a class Rectangle with the data fields width, length, area and colour. The length, width and area are of double type and colour is of string type. The methods are get_length(), get_width(), get_colour() and find_area(). Create two objects of Rectangle and compare their area and colour. If the area and colour both are the same for the objects then display “Matching Rectangles”, otherwise display “ Non-matching Rectangle”.

Part A: Programming Lab – Java Fundamentals – OOPS in JAVA

1. Program to assign two integer values to X and Y. Using the „if“ statement the output of the program should display a message whether X is greater than Y.
2. Program to list the factorial of the numbers 1 to 10. To calculate the factorial value, use while loop. (Hint: Fact of 4 = 4*3*2*1)
3. Program to find the area and circumference of the circle by accepting the radius from the user.
4. Program to add two integers and two float numbers. When no arguments are supplied, give a default value to calculate the sum. Use function overloading.
5. Program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide. A main function should access the methods and perform the mathematical operations.
6. Program with class variable that is available for all instances of a class. Use static variable declaration. Observe the changes that occur in the object's member variable values.



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7. Program to create a student class with following attributes; Enrollment No: Name, Mark of sub1, Mark of sub2, mark of sub3, Total Marks. Total of the three marks must be calculated only when the student passes in all three subjects. The passing mark for each subject is 50. If a candidate fails in any one of the subjects his total mark must be declared as zero. Using this condition write a constructor for this class. Write separate functions for accepting and displaying student details. In the main method create an array of three student objects and display the details.
8. Write a program to demonstrate multiple inheritance and use of Implementing Interfaces
9. Illustrate creation of thread by
 - a) Extending Thread class. b) Implementing Runnable Interfaces
10. Write a program to demonstrate multiple inheritance and use of implementing Interfaces.
11. Create a package. BCA. in your current working directory.
 - a. Create a class student in the above package with the following attributes: Name, age, gender. Include appropriate constructor and a method for displaying the details.
 - b. Import above package and access the member variables and function contained in a package.

PART B: Exception Handling & GUI Programming

1. Program to catch Negative Array Size Exception. This exception is caused when the array size is initialized to negative values.
2. Program to demonstrate exception handling with try, catch and finally.
3. Program which create and displays a message on the window
4. Program to draw several shapes in the created window
5. Program to create a 4x4 grid and fills it in with 15 buttons, each labelled with its index.
6. Program which creates a frame with two buttons father and mother. When we click the father button the name of the father, his age and designation must appear. When we click mother button similar details of mother also appear.
7. Create a frame which displays your personal details with respect to a button click
8. Program to create a window with TextFields and Buttons. The "ADD" button adds the two integers and display the result. The "CLEAR" button shall clear all the text fields.
9. Program to create a window, when we press M or m, the window displays "Good Morning", A or a, the window displays "Good Afternoon", E or e, the window displays "Good Morning", N or n, the window displays "Good Morning".
10. Demonstrate the various mouse handling events using suitable example.
11. Program to create menu bar and pull-down menus.

Web Technology	ITS3602C
(T+L): 4 Credits	Prerequisites: None

COURSE OVERVIEW:

The World Wide Web continues to provide a foundation for the development of a broad range of increasingly influential and strategic technologies, supporting a large variety of applications and services, both in the private and public sectors. There is a growing need for management and decision makers to gain a clearer understanding of the application development process, from planning through to deployment and maintenance.

COURSE OBJECTIVES:

1. To teach students the basics of server-side scripting using PHP
2. To explain web application development procedures
3. To impart servlet technology for writing business logic
4. To facilitate students to connect to databases using JDBC



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5. To familiarize various concepts of application development using JSP

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

1. Create web pages using PHP
2. Identify the difference between the HTML, PHP and XML documents.
3. Identify the engineering structural design of XML and parse tree
4. Analyze the difference between PHP and XML.
5. Understand the concept of JAVASCRIPTS.
6. Identify the difference between the JSP and Servlet.
7. Design web application using MVC architecture
8. Understand the JSP and Servlet concepts.
9. Apply JDBC and ODBC technologies to create database connectivity

UNIT-I

The Internet: Introduction, Evolution, basic internet terms, Getting connect to internet, Internet applications, Data over the internet. Internet tools: Web browser, Web browser features, Internet Explorer environment, Electronic mail, Email address structure, checking email, sending email, email attachment, How email works, advantages and disadvantages of email. Search Engines: Searching an internet, refining the search, Instant messaging, Features of messengers.

UNIT-II

Overview of HTML5 -Exploring new features of HTML5, Structuring an HTML Document, Creating and saving HTML document, Viewing an HTML document.

Fundamentals of HTML-Understanding Elements, Root elements, Metadata elements, Style element, Section element, Header and Footer element, Address element, Basic HTML data types, Data types defined by RFC and IANA Documentation.

Working with Text: Formatting Text with HTML Elements, Defining MARK element, Defining STRONG element, Defining CODE element, Defining SMALL element.

Organizing Text in HTML: Arranging text, Displaying Lists.

UNIT-III

Overview of CSS3- Understanding the syntax of CSS, Exploring CSS Selectors, Inserting CSS in an HTML document.

Background and Color Gradients in CSS: Exploring Background of a Web Page, Exploring Color Properties, Exploring Gradient Properties, Exploring Font properties.

Working with Basics of XML-Exploring XML, Comparing XML with HTML, Describing the Structure of an XML document.

XML: Introduction to XML, Defining XML tags, their attributes and values, Document type definition, XML Schemas, Document Object model, XHTML

Parsing XML Data-DOM and SAX parsers in java

UNIT-IV

Introduction to PHP: Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, list setc., Handling File Uploads, Connecting to database (My SQL as reference), executing simple queries, handling results, Handling sessions and cookies.

File Handling in PHP: File operations like opening, closing, reading, writing, appending, deleting etc. on text and binary files, listing directories.

Introduction to Servlets: Common Gateway Interface (CGI), Lifecycle of a Servlets, deploying a Servlets, The Servlets API, Reading Servlets parameters, Reading initialization parameters, Handling Http Request & Responses, Using Cookies and sessions, connecting to database using JDBC.



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UNIT-V

Introduction to JSP: The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects, Using Beans in JSP Pages, Using Cookies and session tracking, connecting to database in JSP.

TEXTBOOKS:

1. Web Technologies, Uttam K Roy, Oxford University Press
2. The Complete Reference PHP – Steven Holzner, Tata McGraw-Hill
3. ITL Education Solution Limited, Introduction to Information Technology, Pearson Education, 2012
4. DT Editorial Services, HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery), Second Edition, Dreamtech Publisher, 2016

REFERENCEBOOKS:

1. Laura Lemay & Rafe Colburn, Mastering Html, CSS & JavaScript, Web Publishing, 2016
2. Firuza Aibara, HTML 5 for Beginners, 2012
3. Glenn Johnson, Training Guide – Programming in HTML5 with JavaScript and CSS3 (Microsoft Press Training Guide), 2013
4. Web Programming, building internet applications, Chris Bates 2nd edition, Wiley Dreamtech
5. Java Server Pages – Hans Bergsten, SPDO' Reilly
6. JavaScript, D. Flanagan, O'Reilly, SPD.
7. Beginning Web Programming – Jon Duckett WROX.
8. Programming world wide web, R. W. Sebesta. Fourth Edition, Pearson.
9. Internet and World Wide Web – How to program, Dietel and Nieto, Pearson.

Web Technology Lab

COURSE LEARNING OUTCOMES (CLOs):

The students should enable to:

1. Understand the basic HTML tags.
2. Understand and apply the design principles of HTML and JavaScript to create static and dynamic web pages.
3. Understand the difference between HTML and XML scripting languages.
4. Analyze the client side validation procedure in web applications.
5. Identify the difference between the JSP and Servlet.
6. Able to use web server and database servers using specific vendor related software's.
7. Create web applications by using the concepts like JSP and Servlet.
8. Identify and perform requesting and response generation process in web servers Draw and analysis of characteristic curves of flow meters.
9. Understand the PHP downloading, installation and configuring PHP process.
10. Understand branching statements, loop statements and use them in problem solving.
11. Identify the method to read data from web pages using PHP.
12. Understand how MySQL server is connected with PHP
13. Able to perform crude operations in data bases servers, operations in PHP.
14. Familiar with basic HTML, XML, JSP and PHP techniques: Creation of web pages that includes verification and validation of web pages.

HTML

1. Create a table to show your class time table.
2. Use a table to provide layout to your HTML page describing your college infrastructure.
3. Use and <div> tag to provide a layout to the above page instead of a table layout.



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4. Use frames such that page is divided into 3 frames 20% on left to show contents of pages, 60% in center to show body of page, remaining on right to show remarks.
5. Embed Audio and Video into your HTML webpage.
6. Create a webpage with HTML describing your department use paragraph and list tags.
7. Apply various colors to suitably distinguish keywords, also apply font styling like italics, underline and two other fonts to words you find appropriate, also use header tags.
8. Create links on the word se.g. —Wi-Fi and —LAN to link them to Wikipedia pages.
9. Insert an image and create a link such that clicking on image takes user to other page.
10. Change the background color of the page; At the bottom create a link to take user to the top of the page.
11. Develop static pages (using only HTML) of an online bookstore, the pages should resemble: www.amazon.com, the websites should consist the following pages, homepage, registration and user login, user profile page, books catalog, shopping cart, payment by credit card, order confirmation.

CASCADING STYLESHEET

Write an HTML page that contains a selection box with a list of 5 countries, when the user selects a country, its capital should be printed next to the list; Add CSS to customize the properties of the font of the capital (color, bold and font size).

JAVASCRIPT

1. Write a javascript program to test the first character of a string is uppercase or not.
2. Write a pattern that matches e-mail addresses.
3. Write a javascript function to print an integer with commas as thousands separators.
4. Write a javascript program to sort a list of elements using quicksort.
5. Write a javascript for loop that will iterate from 0 to 15 for each iteration, it will check if the current number is odd or even, and display a message to the screen.
6. Write a javascript program which compute the average marks of the following students then this average is used to determine the corresponding grade.
7. Write a javascript program to sum the multiples of 3 and 5 under 1000.
8. To design the scientific calculator and make event for each button using javascript.

PHP

1. A simple calculator web application that takes two numbers and an operator (+, -, *, and %) from an HTML page and returns the result page with the operation performed on the operands.
2. Write PHP program how to send mail using PHP.
3. Write PHP program to convert a string, low to upper case and upper case to lower case or capital case.
4. Write PHP program to change image automatically using switch case.
5. Write PHP program to calculate current tag without using any pre-define function.
6. Write PHP program to upload image to the server using html and PHP.
7. Write PHP program to upload registration form into database.
8. Write PHP program to display the registration form from the database.
9. Write PHP program to update the registration form present in database.
10. Write PHP program to delete the registration form from database.

Text Books:

1. Chris Bates, "Web Programming: Building Internet Applications", Wiley Dream Tech, 2nd Edition, 2002
2. Jeffrey CK Jackson, "Web Technologies", Pearson Education, 1st Edition, 2006
3. Steven Holzner, "The Complete Reference PHP", Tata McGraw-Hill, 1st Edition, 2007



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Reference Books:

1. WHansBergsten, "JavaServerPages", O'Reilly, 3rd Edition, 2003.
2. D.Flanagan, "JavaScript", O'Reilly, 6th Edition, 2011.
3. JonDuckett, "BeginningWeb Programming", WROX, 2nd Edition, 2008.
4. HerbertSchildt, "JavatheCompleteReference", Hill-Osborne, 8th Edition, 2011.

Major Project	ITS3603C
L : 4 Credits	Prerequisites: <i>None</i>

1. At least two paper writing
2. A Minor Project

Departmental Optional Paper-II	ITS30XXE
T : 4 Credits	Prerequisites: <i>None</i>



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Departmental Optional Papers I/II (Select any two)

Course Code	Course Title
ITS3001E	Cloud Computing
ITS3002E	Computer Graphics
ITS3003E	Cyber Security & Cyber Law
ITS3004E	Data Science
ITS3005E	Digital Marketing
ITS3006E	Distributed Computing
ITS3007E	E-Commerce
ITS3008E	Formal Languages & Automata Theory
ITS3009E	Internet of Things
IST3010E	Operation Research



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B. Sc. in Information Technology (IT) Program 4th Year

Yr	Sem	Course Code	Course Title	Credits	Type
IV	VII	ITS4701C	Introduction to AI & Machine Learning	4(T+L)	Major-17
		ITS4702C	Discrete Mathematical Science	4(T)	Major-18
		ITS4703C	Research Project/Dissertation Phase-I	4(L)	Major-19
		ITS40XXE	Departmental Optional Paper-III	4(T)	Major-20
			Minor/Elective-VII	4	Minor/Elective-7
		Total Credits of Semester VII		20	
	VIII	ITS4801C	Advanced Computer Architecture	4(T)	Major-21
		ITS4802C	Research Project Phase-II	4(L)	Major-22
		ITS4803C	Dissertation & Presentation	4(L)	Major-23
		ITS40XXE	Departmental Optional Paper-IV	4(T)	Major-24
			Minor/Elective-VIII	4	Minor/Elective-8
		Total Credits of Semester VIII		20	

Departmental Optional Papers III/IV (Select any two)

Course Code	Course Title	Course Code	Course Title
ITS4001E	Adhoc & Sensor Network	ITS4005E	Information & System Security
ITS4002E	Advanced DBMS+	ITS4006E	Mobile Computing
ITS4003E	Deep Learning	ITS4007E	Numerical Methods
ITS4004E	Digital Signal Processing	ITS4008E	Soft Computing

Total Cumulative Credits after completion of 4th Year=154+8* =162 Credits

- 96 credits Major
- 32 Credits Minor
- 9 Credits Interdisciplinary Course (Prerequisite Allied/MOOC)
- 9 Credits Skill Enhancement/ Vocational
- 8 Credits Ability Enhancement Courses (language)
- 8* Credits Common Value-Added Courses (VAC Project/ Internship/ Survey)

Students Exiting the program after securing above Credits will be awarded B. SC. IN INFORMATION TECHNOLOGY (IT) WITH RESEARCH

N.B. 50% courses of minor stream must be from the relevant subject/discipline and remaining 50% from any discipline.