Curriculum & Syllabus for

Bachelor of Computer Application

Under Autonomy

Department: CSE (BCA)

Curriculum Structure & Syllabus

(Effective from 2023-24 admission batch)

1stYear1stSemester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	YCA1001	Programming for Problem Solving	3	1	0	4	4
2	ENGG	Major	YCA1002	PC Software	3	1	0	4	4
3	SCI	Minor	YBT1003	Environmental Science	3	1	0	4	4
4	SCI	Inter Disciplinary	YMT1002	Basic Mathematics	3	1	0	4	4
B.PRACTICAL									
5	ENGG	Major	YCA1101	Programming for Problem Solving Laboratory	0	0	3	3	1.5
6	ENGG	Major	YCA1102	Office tools Laboratory	0	0	3	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)									
7	PRJ	Project	YCA1201	SkillX	0	0	0	0	1
Total of Theory, Practical and Mandatory Activities /Courses								22	19

***HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ: Project; MC:* Mandatory Activities/Courses**

1st Year 2nd Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	YCA2001	Data Structures	3	0	0	3	3
2	ENGG	Major	YCA2002	Digital Electronics	3	0	0	3	3
3	ENGG	Minor	YCA2003	Programming with C/C++	3	1	0	4	4
4	SCI	Inter Disciplinary	YMT2002	Advanced Mathematics	3	1	0	4	4
5	HUM	Ability Enhancement	YED2002	Communicative English	2	0	0	2	2
B.PRACTICAL									
6	ENGG	Major	YCA2101	Data Structures Laboratory	0	0	3	3	1.5
7	ENGG	Major	YCA2102	Digital Laboratory	0	0	3	3	1.5
8	HUM	Ability Enhancement	YED2102	Language Laboratory	0	0	3	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)									
9	MC	Mandatory Course	YCA2501	NSS/Physical Activities /Meditation &Yoga/ Photography	0	0	1	1	1
10	MC	Mandatory Course	YCA2503	SkillX	0	0	1	1	1
11	MC	Ability Enhancement	YCA2502	Seminar/ GD	0	0	1	1	1
Total of Theory, Practical and Mandatory Activities / Courses								28	20.5

2nd Year 3rd Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Minor	YCA3001	Operating System	3	1	0	4	4
2	ENGG	Minor	YCA3002	Computer Graphics	3	1	0	4	4
3	ENGG	Major	YCA3003	Software Engineering	3	1	0	4	4
4	SCI	Inter Disciplinary	YMT3002	Mathematics for Computing	3	1	0	4	4
B.PRACTICAL									
5	ENGG	Major	YCA3101	Operating System Laboratory	0	0	3	3	1.5
6	ENGG	Major	YCA3102	Computer Graphics Laboratory	0	0	3	3	1.5
7	ENGG	Major	YCA3103	Software Engineering Laboratory	0	0	3	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)									
8	MC	Mandatory Course	YCA3201	NPTEL courses	0	0	0	0	2
9	HUM	Ability Enhancement	YCA3202	Seminar and GD	0	0	1	1	1
10	MC	Mandatory Course	YCA3203	SkillX	0	0	1	1	1
Total of Theory , Practical and Mandatory Activities/Courses								27	20.5

2ndYear4th Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	YCA4001	Data Base Management System	3	1	0	4	4
2	ENGG	Major	YCA4002	Programming with Java	3	1	0	4	4
3	ENGG	Major	YCA4003	Computer Organization and Architecture	3	1	0	4	4
4	SCI	Inter Disciplinary	YMT4002	Numerical Analysis	3	1	0	4	4
B.PRACTICAL									
5	ENGG	Major	YCA4101	DBMS Laboratory	0	0	3	3	1.5
6	ENGG	Major	YCA4102	JAVA Laboratory	0	0	3	3	1.5
7	ENGG	Minor	YCA4103	Computer Organization and Architecture Laboratory	0	0	3	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)									
8	MC	Mandatory Course	YCA4201	Soft Skill Development	1	0	0	1	1
9	HUM	Ability Enhancement	YCA4202	Seminar and GD	0	0	1	1	1
10	MC	Mandatory Course	YCA4203	SkillX	0	0	1	1	1
Total of Theory, Practical and Mandatory Activities /Courses								26	20.5

3rdYear5thSemester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	YCA 5001	Computer Networking	3	1	0	4	4
2	HUM	Minor	YBB 5001	Management and Accounting	3	1	0	4	4
3	ENGG	Major	YCA 5002	Web Technology (UI/UX Development)	3	1	0	4	4
B.PRACTICAL									
4	ENGG	Major	YCA5101	Computer Networking Laboratory	0	0	3	3	1.5
5	ENGG	Major	YCA5102	Web Technology Laboratory	0	0	3	3	1.5
6	ENGG	Major	YCA5103	Minor Project	0	0	3	3	2
7	ENGG	Project	YCA5201	Industrial Training	0	0	3	3	3
C.MANDATORYACTIVITIES/COURSES (Non-CGPA)									
8	HUM	Ability Enhancement	YCA5202	Seminar and GD	0	0	1	1	1
9	ENGG	Project	YCA5203	SkillX	0	0	1	1	0
Total of Theory , Practical and Mandatory Activities /Courses								23	20

3rdYear6thSemester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	YCA601A YCA601B YCA601C	Mobile Computing Cyber Law and Security Machine Learning	3	0	0	3	3
2	ENGG	Minor	YCA602A YCA602B YCA602C	PHP/MySQL Python Programming Artificial Intelligence	3	0	0	0	3
3	HS	Minor	YBB6007	Values and Ethics	3	0	0	0	3
B.PRACTICAL									
4	ENGG	Major	YCA612A YCA612B YCA612C	PHP/MySQL Laboratory Python Programming Laboratory Artificial Intelligence Laboratory	0	0	3	3	1.5
5	ENGG								
6	ENGG								
7	ENGG	Project	YCA6101	Major Project with viva voice	0	0	3	3	12
C.MANDATORYACTIVITIES/COURSES									
8	ENGG	Ability Enhancement	YCA6201	Seminar and GD	0	0	1	1	1
9	ENGG	Project	YCA6202	SkillX	0	0	1	1	0
Total of Theory, Practical and Mandatory Activities /Courses								26	22.5

4thYear7thSemester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	YCA7001	Data Mining	3	0	2	5	5
			YCA7002	Introduction to IoT					
			YCA7003	Introduction to Data Science					
			YCA7004	Pattern recognition					
2	ENGG	Major	YCA7005	Research Methodology and IPR	3	1	0	4	4
			YCA7006	Natural Language Processing					
			YCA7007	Cyber security					
3	ENGG	Minor	YCA7008	Consumer behavior	3	1	0	4	4
			YCA7009	Exploring Business Opportunity					
			YCA7010	Strategic Management					
B.PRACTICAL									
4	ENGG	Major	YCA7010	Data Mining Laboratory	0	0	3	3	2
5	ENGG	Major	YCA7011A	Machine Learning Laboratory	0	0	3	3	2
			YCA7011B	Parallel Computing Laboratory					
C.MANDATORYACTIVITIES/COURSES									
6	MC	Mandatory Course	MC781	Constitution of India	3	0	0	3	0
7	ENGG	Project	YCA7202	SkillX				1	0
Total of Theory, Practical and Mandatory Activities /Courses								23	17

4thYear8thSemester									
Sl.No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
B.PRACTICAL									
1	PRJ	Skill Enhancement	AM891	Project	0	0	24	24	12
2	ENGG	Project	YCA7202	SkillX				1	0
C.MANDATORYACTIVITIES/COURSES									
Total of Theory, Practical and Mandatory Activities /Courses								25	12

Total Credit =160

1St Year 1st Semester

Course Code	YCA1001			
Course Title	Programming for Problem Solving			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	3	1		4
Total Contact Hours	48			
Pre-requisites	None/ If Any			

Learning Objective:

The course is oriented towards advancing structured and procedural programming understanding and improving C programming skills. The major objective is to provide students with an understanding of code organization and functional hierarchical decomposition using complex data types.

Course Outcome:

CO1: Understand the basics of computer generations and system architecture.
CO2: Learn the way of designing, executing, and debugging programs in the C language.
CO3: Understand and learn the data types, loops, functions, and apply them to solve different problems.
CO4: Apply the dynamic behavior of memory by the use of pointers through Functions.
CO5: Design and analyze modular programs using control structures, selection unions, and understand file handling.

Course Content:

Module 1: Introduction to Computers [12L]

Introduction, Characteristics of Computers, Block diagram of a computer, Types of computers and features, Mini Computers, Micro Computers, Mainframe Computers, Super Computers, Types of Programming Languages, Machine Languages, Assembly Languages, High-Level Languages, Data Organization, Drives, Files, Directories. Types of Memory: Primary And Secondary Memory, RAM, ROM, PROM, EPROM, Secondary Storage Devices, CD, HD, Pen drive. I/O Devices: Scanners, Plotters, LCD, Plasma Display. Number Systems: Decimal, Binary, Octal, Hexadecimal.

Module 2: Algorithm and Flowcharts [6L]

Algorithm: Definition, Characteristics, Advantages, and disadvantages with Examples. Flowchart Definition, Define symbols of the flowchart, Advantages, and disadvantages, Examples

Module 3: Operating System and Services in O.S [4L]

DOS History, Files and Directories, Internal and External Commands, Batch Files, Types of O.S.

Module 4: Windows Operating Environment [4L]

Features of MS Windows, Control Panel, Task Bar, Desktop, Windows Application, Icons, Windows Accessories, Notepad

Module 5: Overview of C [6L]

Constants, Variables & Data Types – Operators and Expressions

Module 6: Decision Making and Branching Statements [10L] Looping Statements – User-Defined Functions.

Module 7: Arrays [8L]

Strings – Structures and Unions.

Module 8: Pointers [8L]

Pointer Expressions – Pointers and Arrays – Pointers and Functions.

Text/Reference Books:

1. S. K. Basandra, “Computer Today”, Galgotia Publications, New Delhi.
2. E Balagurusamy, “Programming in ANSI C”
3. Gottfried, "Programming With C", TMH
4. Tondo, "The C Answer Book", PHI
5. "Programming and Problem Solving Through C Language", EXCEL BOOKS

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	1	1	-	-	2	-	1	1			
CO2	2	1	2	-	1	1	-	-	2	-	1	2			
CO3	2	2	-	-	1	1	-	-	2	-	1	2	2		
CO4	2	2	1	-	1	1	-	-	2	-	1	2		1	
CO5	2	3	2	-	1	1	-	-	2	-	1	2	2		

Course Code	YCA1002			
Course Title	PC Software			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	3	1	0	4

Total Contact Hours	48
Pre-requisites	None/If Any

Learning Objective: To develop skills for effective use of Open Office tools by preparing and applying various features in documentation, spreadsheet, and presentation.

Course Outcome:

- CO1: Educate on MS-Office system, internet operations, online, offline working areas.
- CO2: List Open Office Software.
- CO3: Apply Word Processing Tools including Document Formatting, Using Graphics, Working with Macro and Mail Merge.
- CO4: Apply Spreadsheet Tools including Worksheet formatting, Using Functions, Graphics, and Charts.
- CO5: Create effective Presentation Using Animation and Transition.

Course Content:

Module 1: Using Open Office Writer [10L]

- Introduction to word processing software and its features.
- Creating new documents, Saving documents, Opening, and Printing documents.
- Using Home Tab for setting fonts, paragraph settings, styles, Find & Replace, Format Painter, Copy Paste.
- Insert Tab: Pages, Tables, Pictures, Clipart, Shapes, Header & Footer, Word Art, Equation, Symbols.
- Page Layout Tab: Page setup, Page Background, Paragraph (indent and spacing).
- Mailing Tab: Creating envelopes and Labels, Mail Merge.
- Review Tab: Spelling and Grammar check, New comment, Protect document.
- View Tab: Document views, Zoom, Window (New window, Split, Switch window).

Module 2: Working with Open Office Calc [10L]

- Introduction to Spreadsheet, Creating new sheet, Saving, Opening, and Printing workbook.
- Home Tab: Font, Alignment, Number, Styles, and Cells editing, Conditional Formatting.
- Insert Tab: Table, Charts (column chart, Pie chart, Bar chart, Line chart), Texts (header & footer, word art, signature line).
- Page Layout Tab: Page setup options, Scale to fit (width, height, scale).

- Formulas Tab: Autosum (sum, average, min, max), logical(IF, and ,or ,not ,true, false), Math String (sin, cos, tan, ceiling, floor, fact, mod, log), watch window.
- Data Tab: Get external data from MS Access, Sort and filter options, Data validation, Group and ungroup.
- Review Tab: Protect sheet, Protect workbook, Share workbook.
- View Tab: Page breaks, Page layout, Freezing panes, Split and hide.

Module 3: Working with Open Office Impress [10L]

- Introduction to PowerPoint, Creating new slides, Saving, Opening, and Printing.
- Home Tab: New slide, Layout, Reset, Delete, Setting text direction, Align text, Convert to smart art, drawing options.
- Insert Tab: Table, Picture, Clipart, Photo album, Smart art, Shapes, Chart, Movie and Sound, Hyperlink and Action, Text box, Word art, Object.
- Design Tab: Page setup options, slide orientation, applying various themes, selecting background style, and formatting it.
- Animations Tab: Custom animation for entrance, exit, and emphasis, applying slide transition, setting transition speed and sound, animation on rehearsal timing.
- Slide show & view Tab: Start slide show options, setup options.
- View tab: Presentation views, colors, and window option.

Module 4: Working with Open Office Base [10L]

- Front end and back end of application, Introduction to DBMS, Features of DBMS, Creating blank databases, Saving it in accdb format.
- Defining data types in MS Access.
- Home Tab: Datasheet view, design view, pivot chart view, pivot table view, sort and filter options.
- Create Tab: Creating tables, Creating reports, Query wizard.
- External Data Tab: Importing data from Access and Excel sheet, exporting data to Excel and MS Word.
- Datasheet Tab: Relationships, Fields, and columns options, Data type, and formatting options.

Module 5: Introduction to Operating System [8L]

- Definition and functions of an Operating System, Types of OS (Single User, Multi-user, Single-tasking, Multitasking, Real-time, Network OS, Distributed OS), Introduction to DOS.
- System files of DOS, concept of Booting, Files and Directory Structure, Concept of Paths, Internal and External commands, Batch File.

Text/Reference Books:

1. Microsoft Office 2007 fundamentals, L Story, D Walls.
2. MS Office, S. S. Shrivastava, Firewall Media.
3. Office 2000 made easy, Alan Neibauer, Tata McGraw Hill.
4. FLASHMX Bible, Robert Reinhart.
5. Sams Teach Yourself Macromedia Flash 8 in 24 Hours, Phillip Kerman.
6. How to do everything with Macromedia, Bonnie Blake, Doug Sahlin.
7. Multimedia Making it works, Tay Vaughan, Tata McGraw Hills.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	3	1	-	3	2	-	2	2	3	3	-
CO2	3	3	2	2	2	1	-	1	2	1	1	2	3	3	2
CO3	3	3	2	2	2	1	-	1	2	-	1	2	2	3	2
CO4	3	3	2	2	2	1	-	1	2	1	1	2	-	-	-

Course Code	YBT1003			
Course Title	Environmental Science			
Category	Minor SCI			
LTP & Credits	L	T	P	Credits
	3	1		4
Total Contact Hours	48			
Pre-requisites	None/ If Any			

Learning Objective: Students will be able to understand the natural environment and its relationships with human activities, apply fundamental knowledge of science and engineering to assess environmental and health risks, understand environmental laws and regulations, and develop guidelines and procedures for health and safety issues related to air, water, noise, and land pollution.

Course Outcome:

CO1: Understand the natural environment and its relationships with human activities.
CO2: Apply fundamental knowledge of science and engineering to assess environmental and health risks.
CO3: Develop guidelines and procedures for health and safety issues obeying environmental laws and regulations.

CO4: Acquire skills for scientific problem-solving related to air, water, noise, and land pollution.
CO5: Understand the principles and practices of waste management, including recycling, composting, and landfill management, to minimize environmental impact and promote sustainability.

Course Content:

Module 1: Introduction [6L]

- Introduction to environment and ecology.
- Components of the environment, environmental degradation, natural cycles of the environment.

Module 2: Ecology [6L]

- Elements of Ecology.
- Ecological balance.
- Cause & Effects of afforestation and deforestation.

Module 3: Air Pollution and Control [15L]

- Atmospheric composition, Segments of atmosphere climate, weather.
- Atmospheric Stability, dispersion of pollutants.
- Sources and effects of air pollutants, primary and secondary pollutants.
- Criteria Pollutants: PM10, CO, NOx, Sox, Lead, Ozone.
- Greenhouse effect, Control Measures.
- Depletion of ozone layer, Effects of UV exposure, Control Measures.

Module 4: Water Pollution and Control [10L]

- Hydrosphere, natural water resources and reserves.
- Pollutants: their origin and effects.
- COD and BOD test, NBOD and CBOD.
- River / lake / ground water Pollution.
- Control Measures of water pollution.
- Drinking water and waste water treatment.

Module 5: Land Pollution [5L]

- Lithosphere, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes) their origin and effects.
- Collection and disposal of solid waste, recycling and treatment methods.

Module 6: Noise Pollution [6L]

- Sources, effects, standards, and control converters.
- Gray code to binary converters, Encoder.

Text/Reference Books:

1. A. K. Dey, “Environmental Chemistry”, New Age international
2. G.M. Masters, “Environmental Engineering”, Prentice Hall India

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	1	2	2	2	-	-	-	2	3	3	-
CO2	3	2	2	-	-	2	2	2	-	-	-	3	3	3	2
CO3	2	2	2	-	1	2	-	2	-	-	-	2	2	3	2
CO4	2	2	2	-	-	-	2	2	-	-	-	2	-	-	-
CO5	2	3	2	-	1	1	-	-	2	-	1	2	2	-	-

Course Code	YMT1002			
Course Title	Basic Mathematics			
Category	BS			
LTP & Credits	L	T	P	Credits
	3	1		4
Total Contact Hours	48			
Pre-requisites	None / If Any			

Learning Objective:

In this course, students will acquire a basic understanding of linear algebra, two-dimensional geometry, differential calculus, and integral calculus. They will develop the skills necessary to solve engineering problems using these mathematical concepts.

Course Outcome:

CO1: Explain the unique characteristics of linear algebra and its practical applications.
CO2: Describe the theoretical principles of geometry and apply them to problem-solving.
CO3: Understand the theoretical principles of differential calculus and apply them to solve problems.

CO4: Understand indefinite and definite integrals and apply the concept to solve problems.
CO5: Apply basic mathematics concepts to formulate and solve engineering problems involving linear algebra, geometry, differential calculus, and integral calculus.

Course Content:

Module 1: Linear Algebra [12L]

- Determinant and its properties (up to the third order)
- Minor and cofactors
- Matrices: addition, multiplication, transpose
- Symmetric and skew-symmetric matrices and their properties
- Adjoint, Inverse matrix
- Solution of linear equations in three variables using Cramer's rule and matrix inversion method
- Permutation and Combinations
- Binomial theorem

Module 2: Two-dimensional Geometry [10L]

- Locus
- Straight lines
- Circle
- Conic section
- Transformation of axes
- Plane polar curves

Module 3: Differential Calculus [16L]

- Limits of function and continuity
- Fundamental properties of continuous functions (without proof)
- Derivatives
- Geometric meaning of derivative
- Successive differentiation
- Rolle's theorem
- Mean value theorems
- Taylor's and Maclaurin's theorem
- Taylor's series

- Functions of several variables
- Limit and Continuity
- Partial derivatives
- Total differential
- Euler's theorem on homogeneous functions of two variables
- Tangents and normal

Module 4: Integral Calculus [10L]

- Indefinite integrals
- Definite integrals and their elementary properties
- Definite integral as the limit of a sum
- Idea of improper integrals
- Area under a plane curve

Text/Reference Books:

1. S. K. Mapa, "Higher Algebra", Levant Books.
2. Chakravorty and Ghosh, "Advanced Higher Algebra", U N Dhar Pvt. Ltd.
3. S. L. Loney, "Co-ordinate Geometry", Arihant.
4. Das and Mukherjee, "Integral Calculus", U N Dhar Pvt. Ltd.
5. Das and Mukherjee, "Differential Calculus", U N Dhar Pvt. Ltd.
6. E Kreyszig, "Advanced Engineering Mathematics", Wiley.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	3	3	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1	2	3	1
CO4	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO5	2	1	2	-	1	1	-	-	2	-	1	2	-	1	-

Course Code	YCA1101			
Course Title	Programming for Problem Solving Laboratory			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None/ If Any			

Learning Objective:

This course is designed for those looking to advance their understanding of structured and procedural programming, specifically focusing on improving C programming skills. The primary objective is to provide students with an understanding of code organization and functional hierarchical decomposition using complex data types.

Course Outcome:

CO1: Develop simple algorithms for arithmetic and logical problems.
CO2: Translate algorithms into programs and execute them in the C language.
CO3: Implement conditional branching, iteration, and recursion.
CO4: Decompose a problem into functions and synthesize a complete program using the Divide and Conquer approach.
CO5: Use arrays, pointers, and structures to develop algorithms.

Course Content:

Programming for Problem Solving Lab

1. Write a program that accepts the marks of five subjects and calculates the sum and percentage marks obtained by the student.
2. Write a program that calculates Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest, and Time are entered through the keyboard.
3. Write a program to calculate the area and circumference of a circle.
4. Write a program that accepts the temperature in Centigrade and converts it into Fahrenheit using the formula C/5=(F-32)/9.
5. Write a program that swaps the values of two variables using a third variable.
6. Write a program that checks whether two numbers entered by the user are equal or not.
7. Write a program to find the greatest of three numbers.
8. Write a program that determines whether a given number is even or odd.
9. Write a program that determines whether a given year is a leap year or not.
10. Write a program that accepts marks of five subjects, calculates the percentage, and prints grades according to the following criteria:

- Between 90-100%: Print ‘A’
- Between 80-90%: Print ‘B’
- Between 60-80%: Print ‘C’
- Below 60%: Print ‘D’

11. Write a program that takes two operands and one operator from the user, performs the operation, and prints the result using a Switch statement.
12. Write a program to print the sum of all numbers up to a given number.
13. Write a program to find the factorial of a given number.

14. Write a program to print the sum of even and odd numbers from 1 to N numbers.
15. Write a program to print the Fibonacci series.
16. Write a program to check whether the entered number is prime or not.
17. Write a program to find the sum of digits of the entered number.
18. Write a program to find the reverse of a number.
19. Write a program to print Armstrong numbers from 1 to 100.
20. Write a program to convert a binary number into a decimal number and vice versa.
21. Write a program that takes elements of an array from the user and finds the sum of these elements.
22. Write a program that inputs two arrays, saves the sum of corresponding elements of these arrays in a third array, and prints them.
23. Write a program to find the minimum and maximum element of an array.
24. Write a program to search for an element in an array using Linear Search.
25. Write a program to sort the elements of an array in ascending order using the Bubble Sort technique.
26. Write a program to add and multiply two matrices of order nxn.
27. Write a program that finds the sum of diagonal elements of a mxn matrix.
28. Write a program to implement strlen(), strcat(), strcpy() using the concept of Functions.
29. Define a structure data type TRAIN_INFO. The type should contain:
    - Train No.: integer
    - Train name: string
    - Departure Time: aggregate type TIME
    - Arrival Time: aggregate type TIME
    - Start station: string
    - End station: string The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:
    - List all the trains (sorted according to train number) that depart from a particular section.
    - List all the trains that depart from a particular station at a particular time.
    - List all the trains that depart from a particular station within the next one hour of a given time.
    - List all the trains between a pair of start station and end station.
30. Write a program to swap two elements using pointers.
31. Write a program to compare the contents of two files and determine whether they are the same or not.
32. Write a program to check whether a given word exists in a file or not. If yes, then find the number of times it occurs.

Text/Reference Books:

1. S. K. Basandra, “Computer Today”, Galgotia Publications, New Delhi.
2. E Balagurusamy, “Programming in ANSI C”
3. Gottfried, "Programming With C",TMH
4. Tondo,"The C Answer Book",PHI
5. "Programming and Problem Solving Through C Language", EXCEL BOOKS

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	1	1	-	-	2	-	1	1			1
CO2	2	1	2	-	1	1	-	-	2	-	1	2		2	
CO3	2	2	-	-	1	1	-	-	2	-	1	2			2
CO4	2	2	1	-	1	1	-	-	2	-	1	2	1		
CO5	2	3	2	-	1	1	-	-	2	-	1	2	2		

Course Code	YCA1102			
Course Title	Office tools Laboratory			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None/ If Any			

Learning Objective:

In this course, students will learn the basic knowledge of OpenOffice tools by preparing and applying various features in documentation, spreadsheet, presentation, and database connectivity.

Course Outcome:

CO1: Educate students on MS Office systems, internet operations, and online/offline working areas.

CO2: List Open Office software.

CO3: Apply word processing tools including document formatting, using graphics, working with macros, and mail merge.

CO4: Apply spreadsheet tools including worksheet formatting, using functions, graphics, and charts.

CO5: Create effective presentations using animation and transitions.

Course Content:

Basic skills lab Introduction to MS Office, Windows Overview, Office features, Templates and Wizards, MS Word, Excel, PowerPoint, Outlook(Overview), MS Access(Table, relation,queries,reports) (MS Office Version 2010) Text/Reference Books:

1. Microsoft Office 2007 fundamentals, L Story, D Walls.
2. MS Office, S. S. Shrivastava, Firewall Media.
3. Office 2000 made easy, Alan Neibauer, Tata McGraw Hill.
4. FLASHMX Bible, Robert Reinhart.
5. Sams Teach Yourself Macromedia Flash 8 in 24 Hours, Phillip Kerman.
6. How to do everything with Macromedia, Bonnie Blake, Doug Sahlin.
7. Multimedia Making it works, Tay Vaughan, Tata Mcgraw Hills

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	3	1	-	3	2	-	2	2	3	3	-
CO2	3	3	2	2	2	1	-	1	2	1	1	2	3	3	2
CO3	3	3	2	2	2	1	-	1	2	-	1	2	2	3	2
CO4	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**1**	**2**	**1**	**1**	**2**	**-**	**-**	**-**
CO5	2	3	2	-	1	1	-	-	2	-	1	2	2	-	-

1St Year 2nd Semester

Course Code	YCA2001			
Course Title	Data Structures			
Category	PC			
LTP& Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	Basic programming			

Learning Objective:

In this course, students will learn about the significance of nonlinear data structures in organizing and accessing data. They will explore various algorithmic approaches to solving engineering problems using different data structures and understand the merits and demerits of iterative algorithms in terms of time complexity.

Course Outcome:

CO1: Differentiate how the choice of data structures and algorithm methods impacts program performance.

CO2: Solve problems using different data structures and write programs accordingly.

CO3: Identify appropriate data structures and algorithmic methods for solving problems.
CO4: Discuss the computational efficiency of principal algorithms for sorting, searching, and hashing.

CO5: Compare and contrast the benefits of dynamic and static data structure implementations.

Course Content:

Module 1: Introduction to Data Structures [11L]

- Concepts of data structures and abstract data types.
- Algorithms and programs, basic idea of pseudo-code.
- Properties of an algorithm, algorithm efficiency, and analysis.
- Time and space analysis of algorithms – order notations.
- Array: Different representations (row major, column major).
- Sparse matrix – implementation and usage.
- Array representation of polynomials.
- Linked List: Singly linked list operations.
- Doubly linked list operations.
- Circular linked list operations.

- Linked list representation of polynomials and applications.
- Binary codes: BCD, excess-3 code, Gray code.

Module 2: Linear Data Structure [10L]

- Stack and its implementations (using array and linked list).
- Applications (Infix, Prefix, and Postfix with their conversions, Postfix Evaluation).
- Queue, circular queue, de-queues.
- Implementation of queue-linear and circular (using array and linked list).
- Recursion: Principles of recursion-use of stack, tail recursion.
- Applications - The Tower of Hanoi, Eight-queen problem.

Module 3: Nonlinear Data Structure [18L]

- Trees: Basic terminologies, forest, tree representation (using array and linked list).
- Binary trees - binary tree traversal (pre-, in-, post-order).
- Threaded binary tree operations.
- Binary search tree operations (creation, insertion, deletion, searching).
- Concept of Max-Heap and Min-Heap (creation, deletion).
- Height balanced binary tree-AVL tree (insertion, deletion with examples only).
- Graph traversal and connectivity-Depth-first search (DFS), Breadth-first search (BFS).
- Concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge).
- Minimal spanning tree Prim's algorithm, Kruskal's algorithm (basic idea of greedy methods).

Module 4: Searching and Sorting [9L]

- Sorting Algorithms: Bubble sort, Insertion sort, Selection sort – with notion of complexity.
- Quick sort, Merge sort – with complexity, Radix sort – with complexity.
- Searching: Sequential search, Binary search, Interpolation Search – with complexity.
- Hashing: Hashing functions, Collision resolution techniques.

Text/Reference Books:

1. Ajay Agarwal, "Data Structures in C", Cyber Tec
2. Radhakrishnan and Shrinivasan, "Data Structures Using C", ISTE / EXCEL BOOKS
3. Radhaganesan, "C and Data Structure", Scitech

4. Tannenbaum, "Data Structure Using C and C++", PHI
5. Loudon, "Mastering Algorithms with C", SPD/O'REILLY

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	3	-	2	-	-	-
CO2	2	2	1	2	1	2	3	2	2	-	-	2	-	-	-
CO3	2	2	1	2	1	2	-	-	2	3	-	2	-	-	-
CO4	2	1	2	2	1	2	-	-	-	-	-	2	-	-	-
CO5	3	2	2	2	1	3	-	-	-	-	-	2	-	-	-

Course Code	YCA2002			
Course Title	Digital Electronics			
Category				
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective: In this course, students will be taught about the representation of numbers in a computer system and how digital circuits can be designed using logic gates and flip-flops. They will also learn about the process of digital-to-analog and analog-to-digital conversion. After completing this course, students will be better able to understand the basic operation of a computer system and how various functional blocks can be implemented.

Course Outcome:

CO1: Explain the binary number system and its importance in digital circuit design.

CO2: Classify and analyze various ways of minimizing switching functions.

CO3: Understand the process of designing combinational logic circuits.

CO4: Understand the process of designing sequential logic circuit modules.

CO5: Understand and remember the process of analog-to-digital and digital-to-analog conversion.

Course Content:

Module 1: Number Systems and Binary Codes [6L]

Introduction to number systems: Decimal, Binary, Octal, Hexadecimal. Conversion from one number system to another. 1's complement and 2's complement. Addition and subtraction of numbers. Binary codes: BCD, Excess-3 code, Gray code.

Module 2: Logic Families and Minimization of Switching Functions [6L]

Logic gates and their functionalities. Realization of logic gates. Boolean Logic Operations, Basic Law of Boolean Algebra, De-morgan's Theorem. Sum of Products, Product of Sums, Karnaugh Map (up to 4 variables).

Module 3: Combinational Logic Circuits [7L]

Half Adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexer, Demultiplexer, Decoder, Encoder.

Module 4: Sequential Logic Circuits [7L]

Latch, SR Flip Flop, D Flip Flop, T Flip Flop, JK Flip Flop, Master Slave Flip Flop.

Module 5: Counters and Registers [6L]

Asynchronous (Ripple or serial) counter, Synchronous (parallel) counter. SISO, SIPO, PISO, PIPO Register.

Module 6: D/A and A/D Conversion Techniques [4L]

Digital-to-analog converters: Principle of operation, Types of D/A converters. Analog-to-digital converters: Principle of operation, Types of A/D converters.

Text/Reference Books:

1. Salivahanan, "Digital Circuit and Design", VIKAS.
2. M. Morris Mano and Michael D. Ciletti, "Digital Design", PEARSON.
3. Anand Kumar, "Fundamentals of Digital Circuits", PHI.
4. Tokheim, "Digital Electronics", TMH.
5. S. Rangnekar, "Digital Electronics", ISTE/EXCEL.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	2	-	-	2	-	1	2	2	2	2
CO2	1	3	3	-	-	2	-	-	2	-	1	1	1	3	3
CO3	2	2	2	1	2	2	-	-	2	-	1	2	2	2	2
CO4	2	2	2	1	2	2	-	-	2	-	1	1	2	2	2
CO5	2	2	2	-	1	2	-	-	2	-	1	2	2	2	2

Course Code	YCA2003			
Course Title	Programming with C/C++			
Category	Minor ENGG			
LTP & Credits	L	T	P	Credit
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	Basic Programming			

Learning Objective: Object-oriented programming aims to implement real-world entities like inheritance, hiding, polymorphism, etc. in programming. The main aim of OOP is to bind together the data and the functions that operate on them so that no other part of the code can access this data except that function.

Course Outcome

CO1: To study the process of interaction between objects, classes, and functions.

CO2: To acquire basic knowledge of object orientation with different Properties.

CO3: To analyze various string handling functions with various I/O operations.

CO4: To remember the basic code reusability feature with respect to inheritance.

CO5: To demonstrate effective memory management techniques in C++ including dynamic memory allocation, deallocation, and understanding the concept of destructors in managing resources.

Course Contents:

Module 1: Concept of OOP [4L]

Introduction OOP, Procedural vs. Object-Oriented Programming, Principles of OOP, Benefits and applications of OOP

Module 2: C++ Basics [6L]

Overview, Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures

Module 3: C++ Functions [4L]

Simple functions, Call and return by reference, Inline functions, Macro vs. Inline functions, Overloading of functions, default arguments, friend functions

Module 4: Objects and Classes [9L]

Basics of object and class in C++, Private and public members, static data and function members, constructors and their types, destructors, operator overloading, type conversion

Module 5: Inheritance [9L]

Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class.

Module 6: Polymorphism [6L]

Pointers in C++, Pointers and Objects, this pointer, virtual and pure virtual functions, implementing polymorphism

Module 7: I/O and File Management [7L]

Concept of streams, cin and cout objects, C++ stream classes, Unformatted and formatted I/O, manipulators, File stream, C++ File stream classes, File management functions, File modes, Binary and random Files

Module 8: Templates, Exceptions, and STL [3L]

About template, function templates and class templates, Introduction to exception, try-catch-throw, Overview and use of Standard Template Library

Text/Reference Books:

1. E. Balagurusamy, “Object-Oriented Programming with C++”, Tata McGraw Hill.
2. H. Schlitdt, “C++ the Complete Reference”, TMH Publication.
3. R. Lafore, "Object-oriented programming in Turbo C++", Galgotia publications.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	2	3	-	3	3	3	-
CO2	3	2	-	-	2	2	2	-	2	-	-	3	3	3	2
CO3	3	3	3	1	2	2	2	-	2	-	-	3	2	3	2
CO4	2	2	2	3	2	2	-	-	1	-	-	3	-	-	-
CO5	3	2	2	2	1	3	-	-	-	-	-	2	-	-	-

Course Code	YMT2002			
Course Title	Advanced Mathematics			
Category	SCI ,Inter Disciplinary			
LTP & Credits	L	T	P	Credit
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	Basic Mathematics			

Learning Objective: Prove mathematical theorems using mathematical induction. Understand sets and perform operations and algebra on sets. Determine properties of relations, identify equivalence and partial order relations, sketch relations. Identify functions and determine their properties.

Course Outcome:

CO1: To Understand the concepts of Abstract Algebra.
CO2: To Understand and apply the concepts of Theory of Equations.
CO3: To Understand and apply the concepts of Differential Equations.
CO4: To Understand and apply the concepts of Sequence.
CO5: To Understand and apply the concepts of infinite series

Module 1: Algebra [20L]

Abstract Algebra: Sets, Algebra of sets and their applications, Relations, Mapping, Compositions, Groups, Abelian groups, Sub-groups, Cyclic groups, Notion of ring and fields. Complex numbers: Modulus and amplitudes, De Moivre's theorem. Polynomials: Division algorithm, Fundamental theorem of classical algebra (statement only), Descartes rule of sign, Relation between roots and coefficients, symmetric function of the roots, transformation of polynomial equations, Binomial equations.

Module 2: Differential Equations [14L]

Order, Degree, formation of a differential equation, Solutions of ODE(First order and first degree), Variable separation method, Homogeneous equations, Exact equations, Condition of exactness (statement only), Rules for finding Integrating factors, Linear equation, Bernoulli's equation. General solution of ODE of first order and higher degree, Clairaut's equation, second order linear ODE with constant coefficients, Solutions using D operator method. Cauchy-Euler equations and their solutions.

Module 3: Sequence and Series [14L]

Bounded and unbounded sequences, convergence or divergence of a sequence, behavior of monotone sequences, algebra of convergent sequences, Cauchy's sequence, Cauchy's general principle of convergence, infinite series – its convergence and sum, series with positive terms and standard tests of convergence (without proof), alternating series, Leibnitz test, absolute convergence.

Text/Reference Books:

1. S. K. Mapa, "Higher Algebra", Levant Books
2. Chakravorty and Ghosh "Advanced Higher Algebra", U N Dhar Pvt. Ltd
3. S L Ross, "Differential Equations", Wiley
4. Das and Mukherjee, "Differential Calculus", U N Dhar Pvt. Ltd.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	2	-	-	-	-	-	1	2	3	1
CO2	2	2	2	2	2	2	-	-	-	-	-	1	2	1	2
CO3	2	2	2	2	1	1	-	-	-	-	-	1	2	2	2
CO4	2	2	2	3	2	2	-	-	1	-	-	3	-	-	-
CO5	3	2	2	2	1	3	-	-	-	-	-	2	-	-	-

Course Code	YED2002			
Course Title	Communicative English			
Category	Humanities			
LTP & Credits	L	T	P	Credits
	2	1	0	2
Total Contact Hours	24			
Pre requisites	None			

Learning Objective:

In this course, students will develop communicative competence in English to prepare them for the industry, with a special focus on grammar and English writing.

Course Outcome:

CO1: Employ communication skills effectively in the workplace.

CO2: Understand and use the various elements of English.

CO3: Develop skills for effective reading and comprehension of texts.

CO4: Compose formal written communication.

CO5: Develop effective presentation skills and the ability to communicate ideas clearly and persuasively in various professional contexts.

Course Content:

Module 1: Communication in a Globalized World [4L]

- Introduction to communication.
- Five stages of communication.
- Formal and informal communication.
- Verbal and non-verbal communication.
- Role of body language in communication.
- Barriers to effective communication.
- Prejudice and lack of sensitivity in communication.
- Gender/culture neutrality.

Module 2: Functional Grammar [8L]

- Articles and prepositions.
- Direct and indirect verbs.
- Subject-verb agreement.
- Tense and voice.
- Sentences: simple, complex, and compound.
- Direct and indirect speech.

Module 3: Reading Comprehension [6L]

- Reading purposes and skills: skimming, scanning, and intensive reading.
- Reading comprehension: fictional and non-fictional prose.
- One-word substitution and sentence making.
- Texts:
    1. "Where the Mind is Without Fear" by Rabindranath Tagore.
    2. "Out of Business" by R.K. Narayan.

Module 4: Writing Skills [6L]

- Paragraph writing.

- Formal letters.
- Emails.
- Job applications.
- Order and complaint letters.
- Importance of punctuation in writing.

Text/Reference Books:

1. Wren and Martin (Revised by N. D. V. Prasada Rao), "High School English Grammar and Composition", S. Chand Publishing.
2. S. A. Beebe and T. P. Mottet, "Business and Professional Communication – Principles and Skills and Leadership", Pearson Education.
3. Sethi and B. Adhikari, "Business Communication", Tata McGraw-Hill.

CO-PO Mapping:

Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	3	-	2	-	-	-
CO2	2	2	1	2	1	2	3	2	2	-	-	2	-	-	-
CO3	2	2	1	2	1	2	-	-	2	3	-	2	-	-	-
CO4	2	1	2	2	1	2	-	-	-	-	-	2	-	-	-
CO5	3	2	2	2	1	3	-	-	-	-	-	2	-	-	-

Course Code	YCA2101			
Course Title	Data Structure Laboratory			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None/ If Any			

Learning Objective: In this course, students will learn about implementing different algorithmic approaches in C programming using non-linear and linear data structures to solve problems in various engineering domains.

Course Outcome:

CO1: Select appropriate data structures for specified problem definitions.

CO2: Compare operations such as searching, insertion, deletion, and traversing mechanisms on various data structures.

CO3: Explain practical applications of data structures.

CO4: Analyze efficient storage, manipulation, and arrangement of data.

CO5: Demonstrate implementation of various data structures using arrays and linked lists.

Course Content:

Suggested List of Experiments:

1. Arrays (1 day)
    - Addition and Multiplication of Arrays
    - Implementation of Sparse Matrices
2. Abstract Data Types (2 days)
    - Implementation of stack using Array
    - Applications of stack – infix to postfix conversion, expression evaluation
3. Linked List (2 days)
    - Implementation of linked lists and its operations – insertion, deletion, and reverse
    - Implementation of stacks and queues using linked list
    - Polynomial addition and polynomial multiplication
4. Searching and Sorting (2 days)
    - Searching: Linear Search, Binary Search
    - Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, and Heap Sort
5. Non-linear Data Structures (2 days)
    - Traversals of binary tree, Binary Search Tree (BST), Threaded binary tree
    - Height balanced binary tree – AVL tree (insertion, deletion)
    - B-Trees – insertion, deletion
6. Hashing (1 day)
    - Implementation of Hash tables and its operations – searching, inserting, and deleting, handling collisions
7. Innovative Experiments (2 days)

Text/Reference Books:

1. C.E. Balagurusamy “Data Structures using C”, McGrawHill.
2. E.Horowitz, S.Sahni and S.Anderson-freed, “Fundamentals of Data Structures of C”, Universities Press.

3. A.K.Sharma, “Data Structures using C”, Pearson.
4. R.Thareja, “Data Structures using C”, Oxford University Press.

CO-PO Mapping:

Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	3	-	2	-	-	-
CO2	2	2	1	2	1	2	3	2	2	-	-	2	-	-	-
CO3	2	2	1	2	1	2	-	-	2	3	-	2	-	-	-
CO4	2	1	2	2	1	2	-	-	-	-	-	2	-	-	-
CO5	3	2	2	2	1	3	-	-	-	-	-	2	-	-	-

Course Code	YCA2102			
Course Title	Digital Laboratory			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective: In this laboratory course, students will conduct hands-on sessions to design and implement combinational and sequential digital circuit modules, as well as interface LED and 7-segment display units.

Course Outcome:

CO1: Understand and test the functionalities of basic gates.
CO2: Understand Boolean functions using various combinational circuit modules (e.g., gates, multiplexer, decoder).
CO3: Understand and verify the functions of flip-flops and other sequential circuit elements (e.g., counter, register).
CO4: Understand and analyze complex digital systems and verify functionality.
CO5: Understand the process of analog-to-digital and digital-to-analog conversion.

Course Content:

1. Verification of functionalities of basic gates and Universal gates. [1 day]
2. Realization of basic gates using Universal logic Gates. [1 day]
3. Design of Half Adder & Full Adder Circuit using Logic Gates. [1 day]
4. Design Half Subtractor & Full Subtractor Circuit using Logic Gates. [1 day]
5. Construction of simple Multiplexer & De Multiplexer circuits using logic gates. [1 day]

6. Construction of simple Encoder & Decoder circuits using logic gates. [1 day]
7. Realization of RS, D, JK and T flip-flops using logic gates. [1 day]
8. Realization of Register using flip-flops and logic gates. [1 day]
9. Realization of Asynchronous (Ripple or serial) counter, Synchronous (parallel) counter. [1 day]
10. Design a circuit for BCD to 7-segment display. [1 day]
11. One Innovative design of Digital Circuits. [1 day]

Text/Reference Books:

1. Z. Kohavi and N. K. Jha, "Switching and Finite Automata Theory (3rd Ed.)", Cambridge University Press
2. M. Morris Mano, "Digital Design (3rd Ed.)".
3. G. De Micheli, "Synthesis and Optimization of Digital Circuits", Tata-McGraw-Hill.

CO-PO Mapping:

Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	3	-	2	-	-	-
CO2	2	2	1	2	1	2	3	2	2	-	-	2	-	-	-
CO3	2	2	1	2	1	2	-	-	2	3	-	2	-	-	-
CO4	2	1	2	2	1	2	-	-	-	-	-	2	-	-	-
CO5	3	2	2	2	1	3	-	-	-	-	-	2	-	-	-

Course Code	YED 2102			
Course Title	Language Laboratory			
Category	Ability Enhancement HUM			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	24			
Pre-requisites	None			

Learning Objective:

In this laboratory course, students will be exposed to the need for English in the workplace and equipped with language skills, communication skills, and soft skills.

Course Outcomes:

CO1: Apply different skills of technical communication in English.

CO2: Use correct pronunciation when speaking English.

CO3: Use appropriate techniques for effective and active listening.

CO4: Learn to tell clearly and coherently in the professional arena.

CO5: Effectively communicate in English through written mediums, such as emails, reports, and formal letters.

Course Content:

Suggestive List of Experiments:

1. Learn about phonetics and pronunciation guide (Introduction to phonetics and the phonetic table, tongue and lip movements for vowels and consonants, monophthongs / diphthongs, Voiced/unvoiced, aspirated/unaspirated, minimal pairs, syllables, stress, and intonation). [4 Days]
2. Training on listening and comprehension (Active listening and its techniques, academic listening versus business listening, listening activities: answering questions, form filling, summarizing news bulletin, presentation, video clip, lecture, story). [6 Days]
3. Training on speaking skills (Basic parameters of speaking, fluency-focused activities: JAM, conversational role plays, speaking using pictures, group discussions, and personal interviews). [6 Days]
4. Laboratory project work (Making a 5-minute animation video with voiceover OR making a 10-minute documentary film). [8 Days]

Text/Reference Books:

1. P. Ladefoged, “A Course in Phonetics”, Harcourt Brace Jovanovich College Publishers.
2. J. Sullivan, “Simply Said: Communicating Better at Work and Beyond”, Wiley.
3. N. Leonardo, “Active Listening Techniques: 30 Practical Tools to Hone Your Communication Skills”, Rockridge Press.

CO-PO Mapping:

Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	3	-	2	-	-	-
CO2	2	2	1	2	1	2	3	2	2	-	-	2	-	-	-
CO3	2	2	1	2	1	2	-	-	2	3	-	2	-	-	-
CO4	2	1	2	2	1	2	-	-	-	-	-	2	-	-	-
CO5	3	2	2	2	1	3	-	-	-	-	-	2	-	-	-

2nd year 3rd Semester

Course Code	YCA3001			
Course Title	Operating System			
Category	ENGG Minor			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective: In this course, students will learn about the role of the operating system as the interface between application programs and computer hardware. The course will delve into the operating system's management of various computer resources, aiming to strengthen students' skills in handling large software projects.

Course Outcome:

CO1: Explain the role of the operating system and how it acts as an interface between hardware and software.
CO2: Contrast the concepts of processes and threads, and understand how they are scheduled.
CO3: Demonstrate the use of various synchronization tools in solving the critical section problem.
CO4: Explain and classify various memory management techniques, including virtual memory.
CO5: Apply knowledge of data structures to explain how file systems can be implemented on secondary storage.

Course Content:

Module 1: Introduction of OS [3L]

- Importance of OS
- Basic concepts and terminology
- Types of OS
- Different views Journey of a command execution
- Design and implementation of OS

Module 2: Process [10L]

- Concept and views
- OS view of processes
- OS services for process management
- Scheduling Algorithms
- Performance evaluation

- Inter-process communication and synchronization
- Mutual exclusion
- Semaphores
- Hardware support for mutual exclusion
- Queuing implementation of semaphores
- Classical problem of concurrent programming
- Critical region and conditional critical region
- Monitors
- Messages
- Deadlocks

Module 3: Resource Management [8L]

- Memory management Strategies
- Background, Swapping
- Contiguous Memory Allocation
- Segmentation
- Paging
- Structure of the Page Table
- Virtual Memory Management
- Demand Paging; Copy-on-Write
- Page Replacement
- Allocation of Frames
- Thrashing
- Memory-Mapped Files
- Allocating Kernel Memory
- File System
- File Concept
- Access Methods
- Directory and Disk Structure
- Protection
- File-System Implementation

- Structure File management
- Processor management
- Device management

Module 4: Security Related Issue [5L]

- Security and protection
- Authentication
- Protection and access control
- Formal models of protection
- Worms and viruses

Module 5: Multiprocessor System [6L]

- Multiprocessor system
- Classification and types
- OS functions and requirements
- Introduction to parallel computing
- Multiprocessor interconnection synchronization

Module 6: Distributed OS [4L]

- Introduction to distributed processing

Module 7: Case Studies [8L]

- Different Operating Systems

Text/Reference Books:

1. Silberschatz, P.B. Galvin and G. Gagne, “Operating System Concepts”, Wiley Asia.
2. D.M. Dhamdhere, “Operating Systems: A Concept-Based Approach”, Tata McGraw-Hill.
3. M. Bach, “Design of the Unix Operating System”, Prentice-Hall of India.
4. W. Stallings, “Operating Systems: Internals and Design Principles”, Prentice-Hall of India.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA3002			
Course Title	Computer Graphics			
Category	ENGG Minor			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	Basic Programming			

Learning Objective:

Introduce the components of a graphics system and familiarize students with the construction approach of graphics system components and related algorithms.

Course Outcome:

CO1: Explain the foundations of computer graphics and different display technologies and devices. CO2: Develop the concept of geometric, mathematical, and algorithmic approaches necessary for programming computer graphics. CO3: Implement clipping with an understanding of windows, viewports, and image display on the screen. CO4: Analyze and compare different hidden surface illumination methods. CO5: Demonstrate the implementation and utilization of basic computer graphics algorithms in practical applications.

Course Content:

Module 1: Introduction to Computer Graphics [6L]

- Introduction to Computer Graphics & Graphics systems
- Graphics Display Devices
- Raster and Random Scan Display
- Bit Planes
- Color Depth
- Color Palette
- Color CRT Monitor

Module 2: Line Drawing and Circle Drawing Algorithms [12L]

- Points & Lines
- Point-Plotting Techniques: Scan Conversion
- Scan-Converting a Straight Line: The Symmetrical DDA
- Line Drawing Algorithms (DDA Algorithm, Bresenham's Line Drawing Algorithm)
- Circle Generation algorithm (Midpoint Circle Algorithm, Bresenham's Algorithm)
- Ellipse: Polynomial Method, Trigonometric Method

Module 3: 2D Transformations [12L]

- Translation
- Rotation
- Scaling
- Reflection
- Shear
- Homogeneous Coordinates
- Composite Transformation

Module 4: Projection (2-dimension) [6L]

- Line of Sight
- Plane of Projection
- Projection methods (Perspective and Parallel)

Module 5: Viewing and Clipping [8L]

- Window to Viewport coordinate transformation
- Point Clipping
- Line Clipping (Cohen-Sutherland Line Clipping, Midpoint Sub-division Algorithm)

Module 6: Curves and Surfaces [4L]

- Bezier Curves
- B-splines
- Hidden line/surface removal methods (Depth Buffer (Z-Buffer) Method)

Text/Reference Books:

1. D. Hearn, M.P. Baker, "Computer Graphics", PHI.
2. D.F. Rogers, "Procedural & Mathematical Elements in Computer Graphics", TMH.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA3003				
Course Title	Software Engineering				
Category	ENGG Major				
LTP & Credits	L	T	P	Credits	
	3	1	0	4	
Total Contact Hours	48				
Pre-requisites	None/If Any				

Learning Objective:

In this course, students will learn about concepts in software engineering and its applications. They will learn about the layered architecture and the process framework, and analyze software process models like waterfall, spiral, and evolutionary models. After completing the course, students will be able to design software requirements and specifications documents, understand project planning, scheduling, cost estimation, risk management, and describe models such as object models, context models, and behavioral models. They will also learn about quality checking mechanisms for software process and product.

Course Outcome:

CO1: To analyze, elicit, and specify software requirements through a productive working relationship with various stakeholders of the project.

CO2: To design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal, and economic concerns.

CO3: To develop the code from the design and effectively apply relevant standards and perform testing and quality management practices.

CO4: To identify modern engineering tools necessary for software project management, time management, and software reuse, and an ability to engage in lifelong learning.

CO5: Implement effective communication and collaboration strategies within interdisciplinary teams to address software engineering challenges, including but not limited to resolving conflicts, managing diverse perspectives, and fostering innovation and creativity.

Course Content:

Module 1: Overview of Computer-Based Information Systems [12L]

- TPS, OAS, MIS, DSS, KBS Development Life Cycles - SDLC and its phases Models - Waterfall, Prototype, Spiral, Evolutionary Requirement Analysis and Specification, SRS System analysis - DFD, Data Modeling with ERD, Cost-Benefit Analysis.

Module 2: Feasibility Analysis, System Design Tools [12L]

- Software Design - Overview - Characteristics - Cohesion & Coupling - Layered design - Approaches Function-Oriented Design - Structured Analysis, data dictionary, structured chart, decision table, decision tree, Concept of User Interface, Essence of UML, CASE tool.

Module 3: Testing [12L]

- Test case, Test suit, Types of testing-unit testing, system testing, Black-box, White-box, integration testing, OO Testing, Smoke testing, acceptance testing, Design methodologies: top-down and bottom-up approach, stub, driver.

Module 4: SQA and CMM [12L]

- Planning software. Projects - project schedule, PERT, Gantt Charts, S/W project plan document. ERP, MRP, CRM, Software maintenance SCM, concept of standards (ISO and CMM), Risk Management, Configuration Management.

Text/Reference Books:

1. Igor Hawryszkiewycz, "System analysis and design", Pearson
2. V Rajaraman, "Analysis and design of Information System", PHI.
3. Ian Sommerville, "Software Engineering", Addison-Wesley

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YMT3002				
Course Title	Mathematics for Computing				
Category	SCI Inter Disciplinary				
LTP & Credits	L	T	P	Credits	
	3	1	0	4	
Total Contact Hours	48				
Pre-requisites	Basic Programming				

Learning Objective: The objective of the course is to introduce fundamental concepts and results in propositional logic, graph theory, probability, and statistics, and to develop

students' ability to apply these concepts to solve problems in discrete structures, as well as probabilistic and statistical applications in real-life situations.

Course Outcome:

CO1: Recall the distinctive characteristics of probability distributions.

CO2: Evaluate various statistical techniques to solve statistical problems.

CO3: Analyze statistical techniques to solve real-life problems.

CO4: Understand the theoretical concepts of propositional logic.

CO5: Solve a range of problems using graph theory techniques.

Course Content:

Module 1: Propositional Logic [10L]

Construction of truth tables, Tautology, Contradiction, Contingency, Logical equivalence, Generating functions, Recurrence relations.

Module 2: Graph Theory [18L]

Graphs, Digraphs, Weighted graph, Connected and disconnected graphs, Bipartite graph, Degree of a graph, Theorems on graphs, Complement of a graph, Regular graph, Complete graph, Sub-graph, Walks, Paths, Circuits, Hamiltonian and Euler Graph, Cut sets and cut vertices, Adjacency and incidence matrices of a graph, Graph isomorphism, Dijkstra's Algorithm for shortest path problem, Definition and properties of tree, Binary tree, Spanning tree of a graph, Minimal spanning tree, Algorithms: DFS, BFS, Kruskal's and Prim's algorithms.

Module 3: Probability Theory [12L]

Basics of Probability Theory: Axiomatic definition of probability, Conditional probability, Independent events and related problems, Bayes' theorem (Statement only) and its application, one-dimensional random variable, Probability distributions - discrete and continuous, Expectation, Binomial, Poisson, Uniform, Exponential, Normal distributions.

Module 4: Frequency Distribution [8L]

Collection of data, Charts and diagrams, Measures of central tendency, Measures of dispersion.

Text/Reference Books:

1. G.S. Rao, "Discrete Mathematical Structure", New Age International.
2. S.K. Rathore, "Discrete Structure & Graph Theory", EPH.
3. Banerjee, Dey, and Sen, "Mathematical Probability", U N Dhar Pvt. Ltd.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA3101			
Course Title	Operating Systems Laboratory			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a) Data Structures and Algorithms b) Computer Organization and Architecture			

Learning Objective:

In this laboratory course, students will carry out various software assignments on Unix/Linux shell programming and system calls. They will also work on assignments for simulating important OS modules like CPU scheduling, file system, etc.

Course Outcome:

- CO1: To learn how to write shell scripts.
- CO2: To learn how to use Unix/Linux system calls and to design a shell program.
- CO3: To analyze the performance of CPU scheduling algorithms through simulation.
- CO4: To learn how to use multi-threaded programming.
- CO5: To design and implement one OS module like memory management, file system, etc.

Course Content:

Suggestive List of Experiments:

1. Write shell scripts using “bash” shell scripting language for simple system administration tasks, text search and replacement, directory and file manipulation, simple numeric computations, etc. [2 days]
2. Write programs in C for familiarization with the Unix/Linux system calls fork, exec, wait, exit, dup, pipe, shared memory, etc. [2 days]
3. Write a command-line interpreter (shell) program using the Unix/Linux system calls with facilities for:
    - running executable programs,
    - running a program in the background,
    - input and output redirection,
    - command piping. [2 days]
4. Implementation of various CPU scheduling algorithms in C and compare their performances. [2 days]
5. Write programs using the “pthread” library with multiple threads and use semaphores for mutual exclusion. [1 day]
6. Design and implement a Unix-like memory-resident file system using the concept of i-nodes. OR Implementation of memory management system supporting virtual memory and analyze the performance. [3 days]

Text/Reference Books:

1. A. Silberschatz, P. B. Galvin, and G. Gagne, “Operating System Concepts”, Wiley Asia.
2. D. M. Dhamdhere, “Operating Systems: A Concept-Based Approach”, Tata McGraw-Hill.
3. M. Bach, “Design of the Unix Operating System”, Prentice-Hall of India.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA3102			
Course Title	Computer Graphics Laboratory			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None / If Any			

Learning Objective:

To make students aware of the concepts underlying modern Computer Graphics and Machine Vision. At the end of the course the student will have the generic skills to design algorithms for digital image synthesis for a broad-based set of computing problems in various domains.

Course Outcomes:

CO1: To draw Geometric primitives.
CO2: To execute scan line polygon filling
CO3: To implement basic transformations on objects
CO4: To implement clipping algorithm on lines
CO5: To create simple animations using computer graphics techniques.

Course Content:

Suggestive List of Experiments:

1. Study of basic graphics functions defined in “graphics.h”.
2. Program for Line Drawing using DDA algorithm.
3. Program for Line Drawing using Bresenhams algorithm.
4. Program for Circle Drawing using Bresenhams algorithm.
5. Program for Ellipse Drawing using Bresenhams algorithm.
6. Programs for 2-D transformations on different objects.
7. Study of basic graphics functions defined in “graphics.h”.
8. Program for Polygon filling algorithms [Flood-Fill Algorithm].
9. Program for Polygon filling algorithms [Boundary-Fill Algorithm].
10. Program for Polygon filling algorithms [Scan Line Algorithm].
11. Programs to study window to viewport transformations
12. Program for Cohen Sutherland Line clipping algorithm
13. Programs to study 3-D transformations in C.

Text/Reference Books:

1.D. Hearn, “Computer Graphics C ", Pearson Education.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA3103				
Course Title	Software Engineering Laboratory				
Category	ENGG Major				
LTP &Credits	**L**	**T**	**P**	Credits	
	0	0	3	1.5	
Total Contact Hours	36				
Pre-requisites	a)Object Oriented Programming Laboratory				

Learning Objective: In this course, students will build a fully functional, interactive, layered, distributed, database-backed software system from the ground up as part of a small, agile development team in a laboratory setting. They will become acquainted with historical and modern software methodologies. The course will also help students understand the phases of software projects and practice the activities of each phase, practice clean coding, take part in project management, and become adept at skills such as distributed version control, unit testing, integration testing, build management, and deployment.

Course Outcome:

CO1: To construct, elicit, and specify software requirements through a productive working relationship with various stakeholders of the project.

CO2: To design applicable solutions in one or more application domains using software engineering approaches with case studies.

CO3: To develop test cases from the design and effectively apply relevant standards and perform testing and quality management practices.

CO4: To construct modern engineering architecture for software project management, time management, software reuse, and an ability to engage in lifelong learning.

CO5: To effectively collaborate within a team environment, utilizing agile methodologies, version control systems, and project management tools to develop, integrate, test, and deploy a software solution adhering to industry best practices and standards.

Suggestive List of Experiments:

1. Write down the problem statement for a suggested system of relevance. [1 day]
2. Conduct a feasibility study along with requirement analysis and develop Software Requirement Specification Sheet (SRS) for the suggested system. [1 day]
3. Perform the function-oriented diagram: Data Flow Diagram (DFD) and Structured chart. [1 day]
4. Perform the user's view analysis for the suggested system: Use case diagram. [1 day]
5. Draw the structural view diagram for the system: Class diagram, object diagram. [1 day]
6. Draw the behavioral view diagram: State-chart diagram, Activity diagram. [1 day]
7. Perform the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram, timing diagram, component diagram, State diagram. [1 day]
8. Perform the implementation view diagram: Component diagram for the system. [1 day]
9. Perform the environmental view diagram: Deployment diagram for the system. [1 day]
10. Perform various testing using the testing tool unit testing, integration testing for a Sample code of the suggested system. [1 day]
11. Perform Estimation of effort using FP Estimation for the chosen system with other matrices. [1 day]
12. Prepare a timeline chart/Gantt Chart/PERT Chart for the selected software project. [1 day]

Software Required: MS Project, MS Visio, Docker

Text/Reference Books:

1. R.S. Pressman, "Software Engineering: A Practitioner’s Approach", Tata McGraw Hill.
2. P. Jalote, "Software Engineering", Wiley India.
3. R. Mall, "Software Engineering", Prentice-Hall of India.

CO-PO Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0

CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

2nd year 4th Semester

Course Code	YCA4001			
Course Title	Database Management System			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	None/If Any			

Learning Objective:

In this course, the students will be able to learn the data models, conceptualize, and depict a database system; design system using E-R diagram; learn SQL & relational database design; understand the internal storage structures using different file and indexing techniques; know the concepts of transaction processing, concurrency control techniques and recovery procedure

Course Outcome:

CO1: To apply the knowledge of E-R diagram for an application

CO2: To explain the creation of the normalized relational database model

CO3: To analyze real world queries to generate reports from it

CO4: To determine whether the transaction satisfies the ACID properties

CO5: To create and maintain the database of an organization

Course Content:

Module 1: Introduction to data and data management [5L]

Introduction, Data and Information, Database and Database Management System, Components of Database System, Basics of Database Management System, File-based System and Database Management System, Advantages of using Database over File based system, Data Dictionary and Metadata, ANSI-SPARC Architecture, Database Users, Role of Database Administrator (DBA) and Data Administrator (DA), Database Environment, Need for a Database, Characteristics, or Features, or Advantages of Database Systems, Limitations of Database

Module 2: Data Models and Architecture of DBMS [7L]

Schema and Instances, DBMS Architecture, Three Level Architecture of Database (ANSI SPARC architecture), Evolution of Data Models, Hierarchical Data Model, Network Data Model, Relational Data Model Object-oriented Data Model, Object-relational Data

Model, Data and Structural Independence, Database Languages DDL, DML, DCL, TCL, Database Access, Database Structure

Module 3: Data Modeling using ER modeling [7L]

Basic Terminology related to ER Model, Relational Model – Introduction, Advantages and Disadvantages, Identifying Entities ,and Relationships, Types of Relationships, Relationship Participation ,Notations in ER Model, Strong and Weak entity sets Composite entity, Managing Many-to-many, Relationship, Example of E-R Model, Types of Integrity Constraints, Extended E-R Model, Translating the ER Model into Relational Model, Object Modeling, Subclass and Super class, Specialization, Generalization and Aggregation, Class Diagram

Module 4: Relational Model and RDBMS [7L]

Introduction, RDBMS Terminology, Various Types of Keys, Relational Integrity Rules Entity integrity Rule, referential integrity rule, Functional Dependency, Armstrong Axioms, Relational Set Operators, Retrieval Operators, CODD's Twelve Rules of Relational Database, ACID properties, Views and their purpose, Database Life Cycle, Data Dictionary, Relational Algebra and relational calculus, exercise on Relational calculus and relational algebra, Comparisons of relational algebra and calculus Tuple Relational Calculus, Domain Relational,Calculus, Introduction to SQL.

Module 5: Normalization [7L]

Introduction, Need for Normalization, Types of Dependencies-Functional Partial Functional and Transitive, Multi-valued Dependency, Join Dependency, Lossless and Lossy Decompositions, Normalizing Tables, 1NF, 2NF, 3NF, Boyce-Codd Normal Form, Examples on Normalization, Determining, Candidate Key and further Decomposition, Closure of asset and FD's and MVD's, Armstrong's AXIOMS, Minimal or canonical cover of FD's, Lossless Decomposition.

Module 6: Managing Data Using Structured Query Language (SQL) [7L]

Features of SQL, Database Languages-DDL and DMLs, Data Definition Commands, Data Manipulation Commands, (SELECT Statement and different Clauses, SQL Functions-Aggregate, Date and Time Functions, String Functions, Conversion Functions Mathematical Functions, Special Operators), Types of Constraints, Different types of Join and Set Operators, Group by and having clauses, Sub-query, Views, Advances SQL Roll-up, Commit and Save point, Create user grant revoke, Introduction to PL/SQL–conditional statements, loop, variable binding, embedded SQL.

Module 7: Transaction and Query Processing [6L]

Transaction Processing States, ACID Properties of Transaction, read and write operations in transaction, concurrency problems and reasons for recovery, System log, Steps of Query Processing, Query Optimization

Module 8: Indexing and Hashing **[2L]**

Introduction, Overview, Primary Secondary Multilevel, Dense and Space Index

Text/ReferenceBooks:

1. A. Silberschatz et al., "Database System Concepts" ,TMH.
2. A. Kahate ,"Introduction to Database Management Systems", Pearson.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA4002			
Course Title	Programming with Java			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	Basic Programming			

Learning Objective:

On completion of the course the student should be able to: Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs. Read and make elementary modifications to Java programs that solve real-world problems.

Course Outcome:

CO1: Design the process of interaction between Objects, classes & methods w.r.t. Object Oriented Programming.
CO2: Acquire a basic knowledge of Object Orientation with different

properties as well as different features of Java.

CO3: Analyze various activities of different string handling functions with various I/O operations

CO4: Discuss basic code re-usability feature w.r.t. Inheritance, Package and Interface.

CO5: Implement Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

Course Content:

Module 1: OOPS Concept [5L]

Basic concepts of OOPs: Object, Class, Inheritance, Polymorphism, Abstraction, Encapsulation, Dynamic binding. Introduction to class diagram (UML diagram), Structure of JAVA Program Creating a JAVA source file.

Module 2: An overview of Java [3L]

Java features, JVM, Comparison between Java and C++, Idea of any Java Development Kit (JDK), Compiling of JAVA source file and Compilation process. Run the application using JAVA interpreter.Learn to run java program through command line and with any JDK.

Module 3: Data Concept [3L]

Data Types(Integers, Floating Point, Character, Boolean),variables, constants
Tokens in Java(Identifiers,Literals,Keywords),Operators(Arithmetic,Relational, Boolean, Increment and Ddecrement, conditional, Bitwise)

Module 4: Control and Iteration Statements [4L]

Simple if statement, if...else statement, Nesting of if-else statement, switch statement, for loop, while loop, Do-While loop

Module 5: Array and Vector [3L]

1D and 2D array, vector concepts: Declaring and initializing an array, Using two dimensional and multidimensional arrays , Passing arrays to methods , methods of arrays fill(), sort(),equal(),binary search().

Module 6: Class and Object [5L]

Creating main () in a separate class, Class variables and class methods , Classification of variable declared in a class(local variable, Instance variable, Class variable) Methods with parameters, Methods with a return type, Method overloading, Passing Objects as Parameters, Passing Values to methods and Constructor, Visibility modifiers for Access control (Public, Private , Protected),
Abstract classes.

Module 7: Inheritance **[3L]**

Basic concepts, types of inheritance, use of super keyword, overriding methods. Final method Static method, Abstract class, Aggregation and composition, messaging

Module 8: String and String Buffer **[3L]**

Use of different built-in functions, . Initialization of string, Manipulating string class (isUppercase(), toUppercase(), isLowercase(), toLowercase()) String methods

Module 9: Packages, Interfaces **[3L]**

User defined package, import package, Class path, Creation and Implementation of an interface, Interface reference, instance of operator, Interface inheritance, Dynamic method dispatch , Comparison between Abstract Class and interface

Module10: Exception Handling **[2L]**

Overview, what is Exceptions and handling exception? Compile time errors Runtime errors, try...catch Using Multiple catch Blocks, finally Block, Throwing an Exception, Using the throw and throws Statement.

Module 11: Stream **[3L]**

Byte Streams, Input Stream, Output Stream Character Streams (Reader, Writer), How Files and Streams Work, Working with Reader classes (Input Stream Reader, Buffered Reader)

Module 12: Multithreaded Programming **[3L]**

Overview, Thread Life cycle, Advantages of multithreading over multi-tasking Thread Creation and simple programs, Synchronized threads, Synchronized Methods

Module 13: Applets **[4L]**

Applet vs. Application, Applet class, Advantages of Applet, Applet Life cycle My First Applet, Applet tag, How to run applet

Module 14: Abstract Windows Toolkit **[4L]**

GUI Components, Interface and Classes of A WT Package, Labels, Buttons, Check Boxes, Radio button, Text Area, Text Field, Scrollbar, Panels, Layout managers, Simple Event driven programming with Text Field and Button.

Text/Reference Books:

1. H.Schildt, "Java 2 a beginner's guide", The McGraw-Hill Companies, Inc.
2. E.Balaguruswami," Programming with JAVA", McGraw-Hill Professionals.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA4003			
Course Title	Computer Organization and Architecture			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	None/If Any			

Learning Objective:

In this course, the students will learn about the evolution of computer systems and development in computer organization and architecture, and the various functional units of a computer system with special emphasis on how instructions get executed. This course will cover the processor unit, the arithmetic and logic unit, the memory unit and input/output organization. After the completion of this course, the student will better understand how exactly the pro- grams are executed in a computer system.

Course Outcome:

CO1: To explain the process of instruction execution
CO2: To analyze and design control unit of a computer system
CO3: To analyze and design adder, multiplier and division unit

CO4: To analyze and design memory subsystems
CO5: To explain and classify various input/output data transfer techniques

Course Content:

Module1: Data Representation[8L]

Number Systems–decimal, binary, octal, hexadecimal, alphanumeric representation, Complements–1'scomplement, 2'complement, 9'scomplement, 10'complement, Fixed point Representation–Integer representation, arithmetic addition, arithmetic subtraction, overflows, decimal fixed point representation, Floating point representation, IEEE 754 floating point representation.

Module2: Computer Arithmetic[6L]

Addition algorithm of sign magnitude numbers, Subtraction algorithm of sign magnitude numbers, Addition algorithm of signed 2's complement data, Subtraction algorithm of signed 2's complement data, Multiplication algorithm, Booth's algorithm, Division algorithm.

Module 3: Register transfer and micro operations[5L]

Register transfer language, Register transfer, Bus system for registers, Memory transfers – memory read, memory write, Micro operations– register transfer micro operations, arithmetic micro operations, logic micro operations, shift micro operations, Binary adder, binary adder subtractor,binary incrementer, arithmetic circuit for arithmetic micro operations, One stage logic circuit, Selective set, Selective complement, Selective clear, Mask, Insert, Clear.

Module 4: Basic Computer organization and design[5L]

Instruction codes, direct address, Indirect address and Effective address, List of basic computer registers, Computer instructions memory reference, register reference and input–output instructions, Block diagram and brief idea of control unit of basic computer, Instruction cycle.

Module 5: Micro programmed control[2L]

Control memory, Address sequencing, Micro program examples

Module 6: Central processing unit[5L]

General register organization, Stack organization, Register stack, Memory stack, Stack operations push and pop, Evaluation of arithmetic expression using stack, Instruction format, Types of CPU organization (single accumulator, general register and stack organization) and example of their Instructions, Three, two, one and zero address instruction, Definition and example of data transfer, data manipulation and program control instructions, Basic idea of different types of Interrupts (external, internal and software interrupts), Difference between RISC and CISC.

Module 7: Introduction to Microprocessors[5L]

Evolution of Microprocessors – Single Chip Microcontrollers – Embedded Microprocessors–Hardware, Software and Firmware–Central Processing Unit–Memory–Buses –Processing Speed of a Computer Classification of Computers–Von Neumann Architecture–Harvard Architecture–Data Flow Architecture– Types of Microprocessors–Microprocessor Applications.

Module 8: Input Output Organization[6L]

Peripheral devices, Input–output interface, Isolated I/O, Memory mapped I/O, Asynchronous Data transfer: strobe and hand shaking, Programmed I/O, Interrupt initiated I/O, Basic idea of DMA and DMAC Input – output processor

Module 9: Memory Organization[6L]

Memory hierarchy, Main memory definition, types of main memory, types of RAM, ROM, difference between SRAM and DRAM, Cache memory, Cache memory mapping – Direct, Associative, Set Associative, CAM, hardware organization of CAM, Virtual memory, mapping using pages, page fault, mapping using segments, TLB, Auxiliary memory, diagrammatic representation of magnetic disk and hard disk drive, Definitions of seek time, rotational delay, access time, transfer time, latency.

Text/Reference Books:

1. M. Morris Mano , “Computer System Architecture”, PEARSON
2. William Stallings, “Computer Organization and Architecture–Designing For Performance”, PEARSON
3. J. P. Hayes, “ Computer Architecture and Organization ”,TMH
4. T. K. Ghosh,“ Computer Organization and Architecture”, TMH
5. Behrooz Parham ,“Computer Architecture ”,OXFORD UNIVERSITY PRESS
6. Badri Ram, “Fundamentals of Microprocessors and Microcomputers”,Dhanpat Rai Publications

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YMT4002			
Course Title	Numerical Analysis			
Category	SCI Inter Disciplinary			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	Basic Programming			

Learning Objective:

The objective of the course is to introduce the fundamental concepts and results in Numerical analysis and to develop the student's ability to deal with different problems in real life where numerical methods are used.

Course Outcome:

CO1: Recall the distinctive principles of numerical analysis and the associated error measures.

CO2: Understand the theoretical workings of numerical techniques.

CO3: Apply numerical methods used to obtain approximate solutions to intractable mathematical problems such as interpolation, integration, the solution of linear and nonlinear equations and the solution of ordinary differential equations.

CO4: Select appropriate numerical methods to apply to various types of problems in engineering and science in consideration of the mathematical operations involved, accuracy requirements and available computational resources.

CO5: Develop and implement numerical algorithms to solve practical Problems in engineering and science, demonstrating proficiency in programming languages commonly used in numerical analysis such as MATLAB, Python, or similar.

Course Content:

Module 1: Error Analysis and Interpolation:[12L]

Numerical errors and their computations, Truncation and rounding errors, Calculus of differences: Forward, Backward, Shift, Average, Central, Differential and Divided difference operators, Relation between the operators, Problems on missing terms Interpolation: Newton's forward and backward interpolation, Lagrange's interpolation, Newton's divided difference, related problems.

Module2: Numerical Integration:[10L]

Numerical Integration: General quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Expression for corresponding error terms, related problems.

Module 3: Numerical Solution of Linear and Non-linear Equations: [10L]
Solutions of Non linear Equations: Bisection method, Regula–Falsi method, Method of Iteration, Newton Raphson method, Secant method related problems.

Module 4: Numerical Solution of a System of Linear Equations: [8L]

Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method, Gauss Jordan method, related problems.

Module 5: Numerical Solution of Differential Equation: [8L]

Euler's method, Modified Euler's method, Taylor's series method, Runga-Kutta method, Predictor-Corrector method, related problems.

Text/Reference Books:

1. S. S. Sastry ,"Introductory Methods of Numerical Analysis ", PHI.
2. S.A. Mollah ," Numerical Analysis and Computational Procedure ", Books & Allied Pvt. Ltd.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA4101			
Course Title	DBMS Laboratory			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None/If Any			

Learning Objective:

In this course, the students will able to learn the data models, conceptualize and depict a database system; learn the fundamental concepts of SQL queries; understand the concept of designing a database with the necessary attributes; know the methodology of Accessing, Modifying and Updating data & information from the relational databases; learn database design as well as to design user
interface and how to connect with database.

Course Outcome:

CO1: To understand the basic concepts regarding database, SQL queries
CO2: To explain the concepts of PL/SQL
CO3: To differentiate between DBMS and advanced DBMS
CO4: To analyze database system concepts and apply normalization to the database
CO5: To apply and create different transaction processing and concurrency control applications

Course Content:

1. Experiments on fundamentals of database systems Creating a Database Creating a Table Specifying Relational Data Types Specifying Constraint Creating Indexes

[2days]

2. Experiments on database Tables and Record handling INSERT statement Use of SELECT and INSERT together DELETE, UPDATE, TRUNCATE statements DROP, ALTER statements

[2days]

3. Experiments on retrieving data from database The SELECT statement Use of the WHERE clause Use of the Logical Operators in the WHERE clause Use of IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING Clause Use of the
Aggregate Functions Combining tables using JOINS Sub-queries

[3days]

4. Experiments on Miscellaneous Database Management Creating Views Creating Column Aliases Creating Database Users Use of GRANT and REVOKE

[1day]

5. Experiments on PL/SQL
Use of decision making statement, different loop structures to solve simple programs (e.g., sum of few numbers, pattern prints, etc.). Inserting values into tables, reading data from a table. Basic working with CURSORS

[1day]

6. Innovative Experiments
Case study of handling complex databases (e.g., College Management System, Hospital management System, Library management System, Pay roll management System, etc.)

[3days]

Text/Reference Books:

1. H. F. Korth and A. Silberschatz ,“ Database System Concepts ”,McGraw Hill.
2. E.Ramez and S.Navathe, “Fundamentals of Database Systems”, Benjamin Cummings Publishing Company.
3. C. J. Date, “Introduction to Database Management”, Vol.I, II, III, Addison Wesley.
4. G.Jim and R.Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman.
5. J. D. Ullman, “Principles of Database Systems”, Galgottia Publication.
6. I.Bayross , “ SQL, PL/SQL the Programming Language of Oracle” ,BPB Publications.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA4102			
Course Title	JAVA Laboratory			
Category	ENGG Major			
LTP& Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Basic Programming			

Learning Objective:

Understand fundamentals of programming such as variables conditional and iterative execution, methods, etc. Understand fundamentals of object oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.

Course Outcome:

CO1: Create the procedure of communication between Objects, classes & methods.
CO2: Understand the elementary facts of Object Orientation with various characteristics as well as several aspects of Java.
CO3: Analyze distinct features of different string handling functions with various I/O operations.
CO4: Discuss simple Code Reusability notion w.r.t. Inheritance, Package and Interface.
CO5: Apply Exception handling, Multithreading and Applet (Web programming java) programming concept in Java.

Course Content:

Suggestive List of Experiments:

1. Simple Java programming using operators, control statements & loops, array.

[2day(s)]

2. Programming on class, object, and method, access specifier,
3. Programming on constructor, method/constructor-overloading.

[2day(s)]

4. Programming on this keyword, call by value & call by reference,static variables-&-methods,inner-classes.

[2day(s)]

5. Programming to show the use of String class methods charAt(), compareTo(), equals(),equal- sIgnoreCase(), indexOf(), length() , substring(), toCharArray(), toLowerCase(), toString(), toUpperCase(),trim(),valueOf()methods.

[2day(s)]

6. Programming to show the use of String Buffer class methods - append(),capacity(),charAt(),delete(),deleteCharAt(),ensureCapacity(),getChars(),indexOf() ,insert(),length(),setCharAt(), setLength(), substring(), toString() methods.

2 day(s)]

7. Programming using keyboard input by implementing Buffered Reader & Scanner classes.

[2 day(s)]

8. Programming on Simple Inheritance, super and final keywords, super()method

[2day(s)]

9. Programming on method overriding, dynamic method dispatch, abstract classes & methods, multiple inheritance by using interface.

[2day(s)]

10. Programming on importing system package, creating user-defined package, importing user- defined package, using protected access specifier, sub classing an imported class of a package, using same names for classes of different packages, adding multiple public classes to a package.

[2 day(s)]

11. Programming on exception handling using try-catch block, implementing throw and throws keywords, using finally block, creating user-defined exception.

[2day(s)]

12. Programming on creating child threads i) by extending thread class ii) by implementing runnable interface, creating child threads by assigning thread priorities.

[2day(s)]

13. Programming on creating simple applet to display some message, creating applet two add 2 integers, creating applet to do GUI based programming.

[2day(s)]

Text/Reference Books:

1. H. Schildt ," Java: The Complete Reference ",TMH
2. E. Balagurusamy , "Programming With Java: A Primer ",,TMH.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA4103			
Course Title	Computer Organization and Architecture Laboratory			
Category	ENGG Minor			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a)Digital Circuits Laboratory			

Learning Objective:

In this laboratory course, the students will be conducting experiments using a MIPS instruction set simulator. They will also learn how to model various hardware blocks using the hardware description language Verilog. They shall be designing various functional units like adder, multiplier, processor, etc. using a Verilog.

Course Outcome:

CO1: To understand how to write assembly language programs in MIPS
CO2: To design various combinational and sequential circuits using Verilog
CO3: To design and analyze various CPU functional units using Verilog
CO4: To apply a pipelined processor using Verilog
CO5: To explain and classify various input/output data transfer techniques

Course Content:

1. Familiarization with MIPS assembly language programming using some instruction set Simulator like QtSPIM.

   a. Reading and displaying an arbitrary string, and an integer.

   b.Store numbers sequentially in memory and find the minimum, maximum, and sum.

   c. Sort a set of numbers stored in memory. **[2 days]**

2. Familiarization of function calls with MIPS assembly language programming.

   a. Write a function to compute the factorial of a given number.

   b. Write a function to compute the GCD of two numbers.

   Write a function to compute the N-th Fibonacci number.

   [2 days]

3. Familiarization with a Verilog simulator like iVerilog, and write simple combinational and sequential modules using behavioral and structural modeling with Verilog.

a. Write a module to implement an arbitrary Boolean function

(e.g. F = A'BC + C'D).

b. Write a module to implement a full adder, and hence a 4-bit ripple carry adder.

c. Write a module to implement a D flip-flop, and hence a 4-bit shift register. **[2 days]**

4. Write a module to implement an 8-bit up-down counter with asynchronous clear. **[2 days]**

5. Write Verilog modules to implement functional blocks used in computer organization.

   a. Write a module to implement a 16-bit arithmetic and logic unit with 8 functions.

   b. Write a module to implement read/write operations in a 1024 x 16 memory system.

[2days]

6. Implement the MIPS 5-stage pipeline in Verilog, using a subset of 16 instructions.

   The design has to be tested by writing a test bench containing sample machine language programs stored in a memory module.

[4 days]

Text/Reference Books:

1. qtSPIM simulator, http://spimsimulator.sourceforge.net/
2. MIPS overview, https://tams.informatik.uni-hamburg.de/applets/hades/webdemos/mips.html
3. M. M. Mano and M. D. Ciletti, "Digital Design: with an Introduction to Verilog HDL (5th Ed.)", Pearson Education.
4. J. Bhasker, "Verilog HDL Synthesis: A Practical Primer", B. S. Publications.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

3rd Year 5th Semester

Course Code	YCA 5001			
Course Title	Computer Networking			
Category	ENGG ,Major			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course, the students will learn about the fundamental concepts of computer networking, with detailed understanding about the TCP/IP protocol suite that drives the Internet. In addition, various important network applications shall be discussed. The course will be very helpful for the students in understanding how data flows through a real network and the various issues involved therein.

Course Outcome:

CO1: To explain the fundamental concepts of data communication

CO2: To illustrate how the various protocols at the data link layer level work

CO3: To explain the functionalities of the various protocols at the network and transport layer level

CO4: To demonstrate how various internetworking devices can be used to connect several different networks together

CO5: To learn about various network applications with particular emphasis on security.

Course Content:

Module 1: [12L]

Data Communication, Analog-Digital Signals. TCP/IP and OSI Model, Client, Server and Peers, Client / Server architecture, Wired & Wireless transmission, Guided-Unguided Media, Bus, Star, Ring, Mesh, Hybrid, LAN, MAN, WAN, Simplex, Half duplex and Full duplex, Asynchronous and Synchronous Transmission, Parallel and Serial Transmission Baseband and Broadband transmission.

Module 2 : [12L]

Different networking devices, IEEE 802.3, IEEE 802.4, IEEE 802.5, FDDI, DQDEB,ATM, Physical Addressing, Logical Addressing, Port Addresses, IPV4, IPV6, Classfull- Classless Addressing, Subnetting and Masking, NAT, DHCP, BOOTP, ARP, RARP, ICMP

Module 3: [12L]

Different Encoding Techniques, FDM, TDM, Circuit Switching, Packet Switching,Message Switching. Routing, Routing Protocols: Distance Vector, Link State, Congestion Control: Leaky Bucket and Token Bucket Algorithm, ISDN

Module 4: [12L]

TCP, UDP, Firewalls, Proxy Router, DNS, FTP, TFTP, SMTP, TELNET, NFS, WWW, E-mail, HTTPS, Cable Network, Telephone Network

Text/Reference Books:

1. A.S.Tanenbaum,"Computer Networks, 3rdEdition", PHI.
2. 1.B.Fourauzan,"Data Communications and Networking",,TataMcGraw-Hill

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YBB5001			
Course Title	Management and Accounting			
Category	HUM, Minor			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	None/If Any			

Learning Objective:

To develop, understand the importance of Financial Accounting, Cost Accounting and Management accounting in Business. To develop ability to analyze and interpret Financial Statements, the cost elements and the decision making aspects.

Course Outcome:

CO1: To learn preparation of financial statements in accordance with appropriate accounting standards.

CO2: To learn and implement the knowledge of accounting while preparing journal, ledger accounts using double entry book keeping system

CO3: To learn the cost elements and different types of cost incur red in the production process

CO4: To implement the cost related information like material, labour & overhead for planning and control

CO5: To enhance the knowledge about the about the decision making aspects of Management Accounting

Course Content:

Module 1: Financial Accounting [14L]

1. Basic Concept of Accounting
2. Concepts and Conventions of Accounting
3. Journal Entries and Ledger Posting
4. Trial Balance.
5. Financial Statement

Module 2: Cost Accounting [14L]

1. Basic Concept of Cost
2. Classification of Cost
3. Cost Sheet
4. Materials - EOQ, LIFO and FIFO
5. Labor-Wage payment System (Piece Rate, Time Rate, Halsey and Rowan Scheme)
6. Overheads - Meaning and Distribution (Primary Distribution)

Module 3: Management Accounting [20L]

1. Basics of Management (Planning, Scheduling, Organizing, Staffing, Directing and Controlling)

2. Sources of Finance-long-term and Short-term
3. Cost-Volume-Profit Analysis
4. Capital Budgeting
5. Budget and Budgetary Control (Cash and Flexible Budget)
6. Investment of Funds [Conceptual Framework of Mutual Fund and
7. Systematic Investment Plan (SIP)]

Text/Reference Books:

1. P.Chatterjee,"Economics for Engineers",Vrinda Publications Pvt. Ltd

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA 5002			
Course Title	Web technology			
Category	ENGG,Major			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	None/If Any			

Learning Objective:

To impart the design, development and implementation of Static and Dynamic Web Pages. To develop programs for Web using Scripting Languages and .net framework to give an over view of Server Side Programming in Web. This is to teach students the basics of server side scripting using PHP. To explain web application development procedures. To impart servlet technology for writing business logic. To facilitate students to Connect to databases using JDBC. To familiarize various concepts of application development using JSP

Course Outcome:

CO1: To understand the notions of World Wide Web (www), Internet, HTTP Protocol, Web Browsers, Client-Server etc.
CO2: To develop interactive web pages using HTML, DHTML and CSS.
CO3: To procure the knowledge of different information interchange formats

like XML.

CO4: To design web applications using scripting languages like JavaScript, CGI, and PHP.

CO5: To acquire the server side programming concepts using servlet, JSP and . Net framework.

Module 1: **[12L]**

Web Basics and Overview: Introduction to Internet, World Wide Web, Web Browsers, URL, MIME, HTTP, Web Programmers Toolbox. HTML Common tags: List, Tables, images, forms, frames, Cascading Style Sheets (CSS) & its Types. Introduction to Java Script, Declaring variables, functions, Event handlers (on click, on submit, etc.,) and Form Validation.

Module 2: **[10L]**

Introduction to XML: Document type definition, XML Schemas, Presenting XML , Introduction to XHTML, Using XML Processors: DOM and SAX. PHP: Declaring Variables, Data types, Operators, Control structures, Functions.

Module 3: **[10L]**

Web Servers and Servlets: Introduction to Servlets, Lifecycle of a Servlet, JSDK, Deploying Servlet, The Servlet API, The javax. Servlet Package, Reading Servlet parameters, Reading Initialization parameters. The javax.servlet HTTP package, Handling Http Request & Responses, Cookies and Session Tracking.

Module 4: **[8L]**

Database Access: Database Programming using JDBC, JDBC drivers, Studying Javax.sql.* package, Connecting to database in PHP, Execute Simple Queries, Accessing a Database from a Servlet. Introduction to struts frameworks.

Module 5: **[8L]**

JSP Application Development: The Anatomy of a JSP Page, JSP Processing. JSP Application Design and JSP Environment, JSP Declarations, Directives, Expressions, Scripting Elements, implicit objects. Java Beans: Introduction to Beans, Deploying java Beans in a JSP page.

Text/Reference Books:

1. Web Programming, building internet applications, Chris Bates 2nd edition, WILEY Dreamtech (UNITs 1, 2)
2. Core SERVLETS ANDJAVASERVER PAGES VOLUME 1: CORE TECHNOLOGIES By Marty Hall and Larry Brown Pearson (UNITs 3, 4,5)
3. Programming world wide web-Sebesta, Pearson Education,2007.
4. Internet and World Wide Web – How to program by Dietel and Nieto PHI/ Pearson

Education Asia.
5. Jakarta Struts Cookbook, Bill Siggelkow, S P D O'Reilly for chap8.
6. March's beginning JAVA JDK 5, Murach,SPD
7. An Introduction to WEB Design and Programming –Wang-Thomson
8. PHP: The Complete Reference Steven Holzner Tata McGraw-Hill.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA5101			
Course Title	Computer Networking Laboratory			
Category	Major			
LTP& Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None/If Any			

Learning Objective:

In this laboratory course, the students will be learning network programming using the socket API system calls, and also analyze packets flowing over the network. Also, a number of algorithms at the data link and network layers shall be simulated and the results analyzed.

Course Outcome:

CO1: Understand and implement network programming using socket API system calls in C.
CO2: Analyze network packets using packet capturing and analysis tools like Wireshark.
CO3: Simulate and analyze the performance of stop-and-wait and sliding-window protocols
in both error-free and error-prone environments.
CO4: Simulate a router in C to filter IP packets based on a given specification.
CO5: Implement the distance vector algorithm to build routing tables in a network of routers.

Course Content:

Suggestive List of Experiments:

1. Familiarization with Berkeley socket interface system calls in C,and writing programs to communicate between two machines using both connection-oriented(TCP)and connection-less (UDP) protocols. **[3 days]**
2. Write program in C to simulate the stop-and-wait and sliding-window protocols, and carry out performance analyses both in the absence of errors and also in presence of errors.**[2 days]**
3. Familiarization with a packet capturing and analysis tool (like Wireshark), and analyze packets as captured under various data transfer scenarios over the network. **[2days]**
4. Write a program in C to simulate a router for filtering IP packets (make the specification of the problem as realistic as possible).. **[3days]**
5. Write programs to implement the distance vector algorithm for building up the routing tables in a network of routers.. **[2days]**

Text/Reference Books:

1. W.Stallings,"DataandComputerCommunication(5thEd.)",PHI/PearsonEducation.
2. B.A.Forouzan,"DataCommunicationandNetworking(3rdEd.)",Tata-McGrawHill.
3. W.R. Stevens,"UNIX NetworkProgramming (3rdEd.), Prectice-Hall,Addision-Wesley.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA5102			
Course Title	Web Technology Laboratory			
Category	Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a) Data Structures and Algorithms b) Operating Systems c) Data Base Management System d) Computer Networks			

Learning Objective:

In this laboratory course, the students will be carrying out various software assignments on web page designing using html, creating standard document structure using xml, client side scripting using JavaScript and java applet, and server side scripting using perl, php, java servlet and jsp. Also, assignments for creating client-server application using TCP/IP sockets.

Course Outcome:

CO1: To design web page using HTML and customizing their appearance using CSS

CO2: To learn how to create standard document structure using XML and validating documents using XML schema.

CO3: To learn how to write java scripts and java applets for web pages to carry out dynamic tasks on a web page.

CO4: To create web pages dynamically on request, authenticating user access and managing information access from a database.

CO5: To create and simulate client-server application using TCP/IP sockets.

Course Content:

Suggestive List of Experiments:

1. Design web pages using HTML using various components for user inputs (text field, password field, text area, selection box, check box, radio button, reset button and submit button), representing data in tabular form, changing appearance of web pages, incorporating audio, image, etc. linking to the resources (web pages/images)and sections. [**4 days]**
2. Create document structure using XML and use DTD and style sheet to validate documents and change their appearance **[4 days]**
3. Write client side scripts that includes java scripts and java applet and embed the min web pages. **[4 days]**
4. Write cgi scripts using pearl to generate web pages dynamically. **[2 days]**

5. Create dynamic web pages, managing user's session, storing information in a data base using php, Servlet and jsp. **[8 days]**
6. Implement client-server applications running on different systems connected via a network us- ing TCP/IP socket programming. **[2 days]**

Text/Reference Books:

1. Robert.W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Educa- tion, 2007
2. MartyHallandLarryBrown,"CoreWebProgramming"-SecondEdition-VolumeIandII, Pearson Education, 2001.
3. A.Ravichandran,"InternetandWebTechnology",KhannaBookPublishingCompany,2013
4. C.Xavier,"WebTechnologyandDesign",NewAge,2018.
5. M.Bach, "Design ofthe Unix Operating System",Prentice-Hall of India.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

3rd Year 6th Semester

Course Code	YCA601A			
Course Title	Mobile Computing			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning objective:

Describe the basic concepts and principles in mobile computing. To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices. Understand positioning techniques and location-based services and security issues.

Course Outcome:

CO1: Analyze the working of modern communication technologies.

CO2: Demonstrate the various routing algorithms for both infrastructure based and adhoc networks.

CO3: Develop mobility and bandwidth management in cellular network

CO4: Design and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies

CO5: Identify the technical issues related to recent mobile computing environment.

Course Content:

Module1: [6L]

Evolution of different types of wireless communication devices; Effects of mobility of devices; Cellular mobile networks – mobility management (call setup, handoff, interoperability and inter networking), bandwidth management, energy management,security;Brief introduction about different generations of wireless communication technology– 1G, 2G, 3G, 4G, 5G.

Module 2:Mobile Data Communication [5L]

Mobile Data Communication,WLANs (Wireless LANs) IEEE 802.11 standard, Blue-tooth technology, Bluetooth Protocols, Ad hoc networks initialization, leader election, location identification, communication protocols, energy and security.

Module 3: Mobility Management in Cellular Networks [5L]

Call set up in PLMN (location update, paging),GPRS, Call set up in mobile IP networks; Hand off management; Mobility models-random walk, random way point, map-based, group-based.

Module 4: Bandwidth Management in Cellular Mobile networks [4L]

Mathematical formulation of the channel assignment problem(CAP);CAP and generalized graph coloring; Benchmark instances; Lower bound on bandwidth.

Module 5:Localization of Nodes in a mobile Network [4L]

Different approaches, Indoor and outdoor localizations,LOS and NLOS signals, Out-door localization techniques–triangulation(TOA-based,AOA-based),errors due to inaccuracies in coordinates of beacon nodes and in measurements.

Module 6:Message Communication in Ad Hoc Networks [4L]

Collision avoidance mechanism (different schemes for a deterministic transmission schedule),collision resolution mechanism–successive partitioning approach; Time slot assignment based on location information, Point-to-point routing in adhoc networks– proactive, reactive and hybrid approaches, different protocols-DSDV,DSR,AODV, TORA, ZRP.

Module 7:Energy-efficient Communication [4L]

Energy efficiency at various layers- Physical layer, MAC layer, Network layer, Application layer, performance analysis in noisy channel environment.

Module 8: Secure Wireless Communication [4L]

Introduction-different types of attacks, internal attacks, external attacks; measures against attacks (authentication, intrusion detection, encryption); RC4 algorithm.

Text/Reference Books:

1. K.Sinha,S.Ghosh,B.P.Sinha,"WirelessNetworksandMobileComputing",CR CPress:New York, 2015.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0

CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA601B			
Course Title	Artificial Intelligence			
Category	ENGG Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, the students will learn the basic concepts, theories and techniques of artificial intelligence and also help students to learn the application of machine learning / AI algorithms indifferent fields of Computer Engineering.

Course Outcome:

CO1: To explain the basic concept of Artificial Intelligence and its applications

CO2: To classify and analyze various AI tools and techniques

CO3: To learn and evaluate various AI algorithms

CO4: To apply the basic understanding of artificial intelligence in real world applications

CO5: To design and implement AI solutions for real-world problems using appropriate algorithms and techniques, and to evaluate their performance.

Course Content:

Module 1: Introduction to Artificial Intelligence (AI) [8L]

Overview: foundations, scope, problems, and approaches of AI. Intelligent agents: reactive,deliberative,goal-driven,utility-driven,and learning agents.

Module2: AI techniques [10L]

Artificial intelligence programming techniques, Problem-solving through search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A^*, AO^*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

Module 3: Planning and Representation in AI [6L]

Planning: planning as search, partial order planning, construction and use of planning graphs, Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, and sample applications.

Module4: Decision making **[6L]**

Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.

Module5: Kknowledge Aacquisition **[6L]**

Machine learning and knowledge acquisition: learning from memorization, examples, explanation and exploration. Learning nearest neighbor, naïve bayes, and decision tree classifiers, Q-learning for learning action policies, applications.

Text/reference books:

1. S.Kaushik, "Logic and prolog programming.newage", 2002.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA601C			
Course Title	Machine Learning			
Category	ENGG Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning objective:

It covers some of the important regression, classification, clustering, rule-based and probabilistic models and algorithms iincluded linear and logistic regression, regularization, decision trees, probabilistic, svms and neural networks, clustering and reduction in feature dimensionality.

Course outcome:

CO1: To explain and formulate machine learning problems corresponding to different applications

CO2: To classify machine learning algorithms and analyze their strengths and weaknesses

CO3: To explain the basic theory underlying machine learning

CO4: To apply machine learning algorithms to solve problems of moderate complexity

CO5: To design and implement machine learning models to address real- world problems, considering factors such as data availability, model complexity, and interpretability, and to evaluate their performance using appropriate metrics.

Course content:

Module 1:Introduction to Machine-based Learning[6L]

Applications and problems, learning scenarios, concepts of tasks (problems to be solved by machine learning), models (output of machine learning) and features (workhorses of machine learning),geometric models, probabilistic models, logical models.

Module 2:Binary and Multi-class Classification[6L]

Binary classification, assessing and visualizing performance of classification ,scoring and ranking, turning rankers into classifiers, class probability estimation.Multi class classification , multi classs cores and probabilities, regression ,unsupervised and descriptive learning, predictive and descriptive clustering.

Module 3:Rule Learning and Decision Trees[6L]

Decision trees, ranking and probability estimation trees, tree learning as variance reduction, regression trees, learning ordered rule lists, learning unordered rule sets, descriptive rule learning, rule learning for sub group discovery,association rule mining, first-order rule learning, Least squares method, multivariate linear regression, regularized regression.

Module 4:Linear Models for Classification and Clustering [8L]

Perceptron, support vector machine, soft margin svm, probabilities from linear classifiers, beyond linearity with kernel methods, Nearest neighbor classification, distance [- based clustering-means algorithm, Hierarchical clustering, Normal distribution, probabilistic models for categorical data, naïve Bayes model for classification, probabilistic models with hidden variables, Gaussian mixture model, compression based model.

Module5:Feature Processing [6L]

Types of features, calculation on features, categorical, ordinal and quantitative features, structured features, thresholding and discretization, normalization and calibration, in-complete features, feature selection-matrix transformations and decompositions.

Module 6:Other Machine Learning Topics of Interest [4L]

Bagging and random forests, boosted rule learning, mapping the ensemble landscape – bias, variance and margins, meta learning. What to measure, how to measure, how to interpret, interpretation of results over multiple data sets.

Text/Reference Books:

1. P. Flach,"Machine Learning:The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press.
2. M.Mohri, A.rostamiza dehanda. Talwalkar, "foundations of machine learning", mitpress.
3. K.P.Murphy,"machine learning: a probabilistic perspective",mitpress.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA602A			
Course Title	PHP/MySQL			
Category	ENGG Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning objective:

In this course, The students will learn about web server programming using php and database Programming to access and manipulate data in a mysql database. This course will cover the Basic PHP Statements, Client Request, Server Response, Session, Cookies And Error Handling. This course will also cover database management in mysql and manipulating data using php. After the completion of this course, The students will better understand the development of Web Applications.

Course outcome:

CO1: To explain the server side scripting language to construct web applications

CO2: To know how requests are processed and responses are generated using php

CO3: To Know The Interaction Between PHP And Mysql Database For Data Manipulation

CO4: To design web applications as one-,Two-And three-Tier architectures

CO5: To integrate advanced PHP concepts, including Object-Oriented Programming (OOP), error handling, jQuery for dynamic web page interactions, and AJAX for asynchronous data exchange, in the development of web applications.

Course content:

Module1:Php language [8L]

Basics of html: Forms, GET, POST. Php requisites, Xampp and wampp installation, Syntax, Data types: Variables, Strings, Constants, Operators, Images, Date And Time, Strings And Array Functions, Regular Expressions, Control structures: If...Else...Else if and switch. Loops: For, For each, While , User defined functions

Module2: MySql database [6L]

Introduction to database, Ddl queries: Create, Alter,Delete, And drop tables. DML Queries:Select, Insert, Update, Delete Table Data Clause and operators: And, Or, In, Between, Like, Distinct, Orderby, Groupby, Union, Sub-Queries, Left Join, Right Join, Inner Join.

Module 3:PHP And Mysql Integration[6L]

Connecting to mysql database: Mysql, Mysqli (Object oriented and procedural), And PDO. Searching database and rendering webpage,Insert,Update and delete records. Data base architecture: One tier, Two tier and three tier. Data prevention and sql Injection.

Module 4: File, Session And Cookies [6L]

Functions for file inclusion include, Includence, Require, Recurrence File upload/Download, File Variables,Create,Modify and destroy.

Module 5:Advanced PHP[10L]

OOP's Concept: Classes and objects, Inheritance, Static methods, Method overloading, Abstract Class And Interface. Error Handling:Exception,Try-Catch-Throw, Filters. Jquery: Syntax, Selectors, Events, Effects, Show/Hide, Fade,Slide,Animate,Stop. Ajax:Jquery ajax example, Ajax data base programming with PHP,Pagination, Query String.

Text/Reference books:

1. R. Nixon,"Learning PHP, Mysql And Javascript:With Jquery, CSS And HTML5", O'Reilly, 2018.
2. D.Reiersol,M.Baker,C.Shiflett,"Phpinaction:Objects,Design,Agility",Manning,2007.
3. B. Brinzarea-Iamandi, C. Darie, A. Hendrix,"AJAX And PHP: Building Modern Web Appli- Cations", Packt, 2009

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA601B			
Course Title	Python Programming			
Category	ENGG Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

The Python programming language which is one of the most popular programming languages world wide. The course shows you how to use the free open-source Python to write basic programs and high level applications using concepts such as Class, list, tuple, dictionary, functions, variables, If Else statements, For loops, While loops, iterative and recursive programs and the students will be made familiar with the concepts of various modules, packages and python libraries used for various applications.

Course Outcome:

CO1: Understand and explain the basic principles of Python programming language and object oriented concept.

CO2: Define and demonstrate the use of built-in data structure along with the help of condition checking and looping structures.

CO3: Understand and apply various applications of different modules and packages in Python.

CO4: Learn to handle exceptions and files in Python.

CO5: Develop basic applications using Python programming language to solve real-world problems.

Course Content:

Module 1:Parts of Python Programming Language [12L]

Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language, Control Flow Statements, The if Decision Control Flow Statement, The if...else Decision Control Flow Statement, The if...elif...else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Catching Exceptions Using try and except Statement, Functions, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Command Line Arguments.

Module2:Strings in Python[6L]

Creating and Storing Strings,Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings,Lists, Creating Lists,Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement.

Module3:Data Structures in Python[6L]

Dictionaries, Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, Tuples and Sets, Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists,Relation between Tuples and Dictionaries, Tuple Methods, Using zip()Function,Sets,Set Methods, Traversing of Sets, Frozen set.

Module 4:Modules and File Handling in Python [6L]

Types of Files, Creating and Reading Text Data,File Methods to Read and Write Data, Reading and Writing Binary Files,The Pickle Module,Reading and Writing CSV Files,Python os and os.path Modules, Regular Expression Operations,Using Special Characters,Regular Expression Methods,Named Groups in Python Regular Expressions, Regular Expression with glob Module.

Module 5: OOPs Features in Python [6L]

Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method,Classes with Multiple Objects, Class Attributes versus Data At- tributes, Encapsulation, Inheritance, The Polymorphism.

Text/Reference Books:

1. T.R.Padmanabhan,"ProgrammingwithPython(1stEd.)",Springer.
2. R. Thareja, "Python Programming:using Problem Solving Approach (1st Ed.)", Oxford Uni- versity Press.
3. W.McKinney,"PythonDataAnalysis(2ndEd.)",O.Reilly.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA601C			
Course Title	Cyber Law and Security			
Category	ENGG Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, the students will understand, explore and acquire a critical understanding of laws and regulations that existing cyberspace.Topics like IT Act 2000,legal issues in e-business, and case studies will be discussed.

Course Outcome:

CO1: To explain the fundamental concepts of Cyber Law and their implications

CO2: To analyze the essential concepts under IT Act2000

CO3: To explain and analyze the rules and regulations that exists in cyber space

CO4: To analyze case studies related to cybercrimes, including harassment over emails, email spoofing, cyber pornography, and cyber stalking, to understand the legal implications and enforcement measures.

CO5: To evaluate emerging trends and challenges in cyber law and security, and propose effective legal and regulatory measures to address them.

Course Content:

Module 1:Introduction to Cyber Law [8L]

Evolution of information technology: emergence of cyberspace, cyber jurisprudence, jurisprudence and law, doctrinal approach, consensual approach. Cyber ethics, cyber jurisdiction, hierarchy of courts, civil and criminal jurisdictions, cyber space: web space ,web hosting and web development agreement, legal and technological significance of domain names, Internet as a tool for global access.

Module 2: Information Technology Act [8L]

0veterview of IT Act 2000, amendments and limitations of IT Act, digital signatures, drawbacks of public key and private key cryptography, electronic governance, legal recognition of electronic records, legal recognition of digital signature certifying authorities, cyber crime and offences, network service providers liability, cyber regulations appellate tribunal, penalties and adjudication.

Module 3 : Cyber Law and Related Legislation [8L]

Patent law, trademark law, copyright, software piracy, domain names and copyright disputes, electronic database and its protection, civil procedure code, IT act and criminal procedural code. Relevant sections of : Indian evidence act, bankers book evidence act, Indian Penal Code, Reserve Bank of India Act. Law relating to employees and Internet, alternative dispute resolution, online disputes resolution.

Module 4: Electronic Business and Legal Issues [6L]

Evolution and development in E-commerce, paper versus paperless contracts. E-Commerce models:B2B, B2C, E-security. Application area: business,taxation,electronic payments ,supply chain,E-markets, emerging trends.

Module5: Case Studies on Cyber Crime [6L]

Harassment over emails, email spoofing, cyber-pornography, cyber stalking.

Text/Reference Books:

1. K.Kumar, “Cyber Laws:Intellectual Property and E-Commerce Security”,Dominant Pub lisher.

2. R.D.Ryder, “Guide to Cyber Laws”,Wadhwa and Company.
3. NIIT, “Information Security:Policies and Implementation Issues”,Prentice-Hall of India.
4. V.Sharma,“Hand book of Cyber Laws”,Prentice-Hall of India.
5. Lawmann’s,“TheInformationTechnologyAct2000”,Law Literature Publication, Kamal Publishers.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YBB6001			
Course Title	Values and Ethics in Profession			
Category	HS Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, the students will learn to be awareness on professional ethics and human values.

Course Outcome:

CO1: To explain the core values that shape the ethical behavior of an engineer
CO2: To understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories
CO3: To analyze various social issues, industrial standards, code of ethics, and role of professional ethics in engineering field
CO4: To explain the responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer
CO5: To acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principle store solve situations that arise in their professional lives

Course Content:

Module1: Introduction [6L]

Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, and Social.

Module 2: Psycho-social theories of moral development [6L]

View of Kohlberg; Morality and Ideology, Culture and Morality, Morality in everyday Context.

Module 3: Ethical Concerns [6L]

Work Ethics and Work Values, Business Ethics, Human values in organizations: Values Crisis in contemporary society. Nature of values: Value Spectrum of a good life.

Module 4: Ethics of Profession [6L]

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Module 5: Self Development [6L]

Character strengths and virtues, Emotional Intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).

Module 6: Effects of Technological Growth [6L]

Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development Energy Crisis: Renewable Energy Resources, Environmental

degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics.Appropriate Technology, Movement of Schumacher; Problems of man, machine, interaction.

Text/Reference Books:

1. S. H. Unger,"Controlling Technology:Ethics and the Responsible Engineers",John Wiley & Sons.
2. D. Johnson,"Ethical Issuesin Engineering",Prentice Hall.
3. A. N. Tripathi, "Human Values in the Engineering Profession", Monograph published by IIM, Calcutta, 1996.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA612A			
Course Title	PHP/MySQL Laboratory			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

PHP and MySQL are open-source server-side programming languages used to create dynamic websites. They provide flexibility, as they can be used and manipulated on any operating system. PHP and MySQL work together to provide fast web page response times even with slow internet and data speed.

Course Outcome:

CO1: Develop program using control statement
CO2: Perform operation based on arrays and graphics.
CO3: Develop programs by applying various object oriented concepts.
CO4: Use form controls with validation to collect user's input.
CO5 Perform database operations in PHP..

Suggestive List of Experiments:

1. Get name of the user from a form and show greeting text.
2. Write a php program to check whether given number is palindrome or not.
3. Write a php program to check whether given number is Armstrong or not.
4. Write a php program to find largest values of two numbers using nesting of function.
5. Write a Mathematical calculator program.
6. Write a Age calculator program.
7. Write a php program to check whether given number is String palindrome or not.
8. Write a php program using function.
9. Create a PHP page for login page without sql connection.
10. Write a php program to Array manipulation.
11. Write a php program to design personal information
12. Create a PHP page for login page with sql connection.
13. Write a php program to Read from existing file.
14. Write a php program to Write a file
15. Write a php program to calculate Date and Time function .
16. Write a php program to design Curriculum Vitae.
17. Write a php program hit counter using cookies.
18. Create a web page to advertise a product of the company using images and audio.
19. Create a web page for Travel agency.
20. Create a web page for software company wesites. 21.Create a PHP page for login system using session

Text/Reference Books:

1. T. R. Padmanabhan ,“ Programming with Python(1stEd.)”,Springer.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3

CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA612B				
Course Title	Python Programming Laboratory				
Category	ENGG Major				
LTP & Credits	L	T	P	Credits	
	0	0	3	1.5	
Total Contact Hours	36				
Pre-requisites	None				

Learning Objective:

In this practical course, the students will be learning Python programming basics and paradigm. python looping, control statements and string manipulations. Students will be made familiar with the concepts of various modules ,packages and python libraries used for various applications (Machine learning, Deep learning etc,).

Course Outcome:

CO1: Understand and explain the basic principles of Python programming language and object oriented concept.
CO2: Define and demonstrate the use of built-in data structures along with the help of condition checking and looping structures.
CO3: Understand and apply various applications of different modules and packages in Python.
CO4: Learn to handle exceptions and files in Python.
CO5: Develop and implement Python programs to solve real-world problems, demonstrating proficiency in applying Python programming concepts, data structures, and libraries to create functional and efficient solutions.

Suggestive List of Experiments:

1. History, Features, Setting up path, working with Python, Basic Syntax, Variable and Data Types, Operator. **[2days]**
2. ConditionalStatements:If,If-else,Nestedif-else,Looping,For,While,Nestedloops,Control Statements:Break,Continue,Pass. **[3days]**
3. String Manipulation: Accessing Strings, Basic Operations on Strings, String slices, Function and Methods. Lists: Introduction, Accessing list, Operations, Working with lists, Function and Methods. **[3days]**
4. Tuple:Introduction,Accessingtuples,Operations,Working,FunctionsandMethods.Dictionaries:Introduction,Accessingvaluesindictionaries,Workingwithdictionaries,Properties, Tuplevs.Dictionaries. **[3days]**
5. Functions: Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables. **[3days]**

6. Modules:Importingmodule,Mathmodule,Randommodule,Packages,Composition,Input-OutputPrintingonscreen,Readingdatafromkeyboard,Openingandclosingfiles,Reading andwritingfiles,Functions. **[4days]**
7. exception and File Handling: Exception, Exception Handling, Except clause, Try & finally clause,UserDefinedExceptions. **[4days]**
8. A case study on using a computer game for teaching data structures on stacks and queues. The computer game is developed to help students visualize the data structures and data access operations on stacks and queues. This game-based learning is engaging, fun and, more importantly,abstract concepts in data structures can be visualized and learnt through game playing skills. **[2days]**

Text/Reference Books:

2. T. R. Padmanabhan ,“ Programming with Python(1stEd.)”,Springer.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCA612C			
Course Title	Artificial Intelligence Laboratory			
Category	ENGG Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, students will learn the basic principles, techniques, and applications of Artificial Intelligence and Machine Learning for problem-solving, inference, perception, knowledge representation, and puzzles design.

Course Outcomes:

CO1: Explain the working principles of PROLOG/LISP and apply LIST structure of PROLOG.

CO2: Apply reasoning and inference principles to real-world problems and design programs to solve various puzzles.

CO3: Design simple algorithms for data classification in Python/R and test them with benchmark datasets.

CO4: Design simple algorithms for data clustering in Python/R and test them with benchmark datasets.

CO5: Analyze and evaluate algorithms for estimation/prediction using regression.

Course Content:

Suggestive List of Experiments:

In this laboratory, students will be familiarized with PROLOG/LISP language. The experiments are structured into four modules.

Module 1 (4 days):

- Introduction to PROLOG facts & rules using a simple family tree.
- Explanation of how goals are given in PROLOG and simple queries on the family tree.
- Formation of recursive definitions and how PROLOG executes goals.
- Implementation of Graph Search algorithms like DFS, BFS.
- Implementation of well-known puzzles like the 8-queens problem, Towers-of-Hanoi problem, etc.

Module 2 (4 days):

- Implementation of Classifiers: KNN, Naive Bayes Classifier, Decision Tree, SVM, Perceptron, Multi-Layer Perceptron, Random Forest, etc., on Python/R platform and test them on benchmark datasets.
- Familiarization with ML Tools: Excel, WEKA, R, Python for classification.

Module 3 (3 days):

- Implementation of data clustering algorithms: K-Means, DBSCAN, Hierarchical (AGNES/DIVISIVE), etc., on Python/R platform and test them on benchmark datasets.
- Familiarization with ML Tools: Excel, WEKA, R, Python for clustering.

Module 4 (1 day):

- Implementation of Regression (single and Multiple Variables) linear and non-linear, Logistic regression for prediction tasks.

Text/Reference Books:

1. I. Bratko, "Prolog programming for artificial intelligence", Pearson Education.
2. S. Kaushi, "Logic and Prolog Programming", New Age International Publishers.

3. B. Lantz, "Machine learning with R", PACKT Publishing.
4. C. M. Andreas and S. Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly Media.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
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CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3