PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636011

DEGREE OF BACHELOR OF SCIENCE
CHOICE BASED CREDIT SYSTEM

Syllabus for

BACHELOR OF COMPUTER APPLICATIONS ( BCA )

( SEMESTER PATTERN )
( For Candidates admitted in the Colleges affiliated to Periyar University from 2017-2018 onwards )
REGULATIONS

1. ELIGIBILITY FOR ADMISSION

A candidate who has passed in Higher Secondary Examination with Mathematics or Business Mathematics or Computer Science or Statistics (Academic stream or Vocational stream) as one of the subject under Higher Secondary Board of Examination, Tamilnadu as per norms set by the Government of Tamilnadu or an Examination accepted as equivalent there to by the syndicate, subject to such conditions as may be prescribed there to are permitted to appear and qualify for the Bachelor of Science in Information Science degree examination of this university after a course of study of three academic years.

2. DURATION OF THE COURSE

The course shall extend over a period of three years comprising of six semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

3. COURSE OF STUDY

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time. The syllabus for various subjects shall be clearly demarcated into five units in each subject. Part -I, Part-II, Part – III, Part – IV and Part-V subjects are as prescribed in the scheme of examination.

4. EXAMINATIONS

The theory examination shall be three hour duration for each paper at the end of every semester. The candidate failing in any subject(s) will be permitted to appear in the subsequent examination. The practical examinations for core subjects should be conducted at the end of the every semester.

4. (a) Submission of Record Note Books for Practical Examinations

Candidates appearing for practical examinations should submit bonafide Record Note Books prescribed for practical examinations, otherwise the candidates will not be permitted to appear for the practical examinations. However, in genuine cases where the students who could not submit the record note books, they may be permitted to appear for the practical examinations, provided the concerned Head of the Department certified that the candidate has performed the experiments prescribed for the course. For such candidates zero (0) marks will be awarded for record note books.

5. REVISION OF REGULATIONS AND CURRICULUM

The University may revise/amend/ change the Regulations and Scheme of Examinations, if found necessary.
6. PASSING MINIMUM MARKS

Theory

The candidate shall be declared to have passed the examination if the candidate secure not less than 40 marks put together out of 100 marks (CIA + EA). Minimum 40% should be secured (30 out of 75) in EA of each theory subject.

Practical

The candidate shall be declared to have passed the examination if the candidate secure not less than 40 marks put together out of 100 marks (CIA + EA). Minimum 40% should be secured (24 out of 60) in EA of each Practical subject.

7. MARKS DISTRIBUTION AND QUESTION PAPER PATTERN FOR BCA

7.1 Theory – Marks Distribution

Maximum Marks : 100 Marks

External [EA] : 75 Marks

Internal [CIA] : 25 Marks


PART – A (10 x 2 = 20 Marks)

(Answer ALL questions), (Two questions from each unit)

PART – B (5 x 5 = 25 Marks)

(Answer ALL questions) & (One question from each unit with Internal Choice)

PART – C (3 x 10 = 30 Marks)

(Answer ANY THREE questions) & (Open Choice – 3 out of 5 questions)

7.1 (b). Theory - Internal Marks Distribution (Total Marks: 25)

Attendance : 5 Marks

Assignment : 5 Marks

Test : 15 Marks
7.2. Practical – Marks Distribution

Maximum Marks : 100 Marks

External [EA] : 60 Marks
Internal [CIA] : 40 Marks

7.2 (a). Practical - External Marks Distribution (Total Marks: 60)

For each practical question the marks should be awarded as follows (External)

i) Algorithm / Flowchart - 20%
ii) Writing the program in the main answer book - 30%
iii) Test and debug the program - 30%
iv) Display the correct output - 20%

(Marks may be proportionately reduced for the errors committed in each of the above)

Practical Question Paper Pattern

Student should attend two questions (either or pattern)

Note:

(i) Practical I to Practical VI and SBEC Practical has same pattern
(ii) Core Practical Examination must be conducted at the end of every Semester

7.2 (b). Practical - Internal Marks Distribution (Total Marks: 40)

Record : 15 Marks
Internal Practical examinations : 25 Marks

8. COMMENCEMENT OF THIS REGULATION:

These regulations shall take effect from the academic year 2017-2018, i.e, for students who are to be admitted to the first year of the course during the academic year 2017-18 and thereafter.
## BCA

**SCHEME OF EXAMINATIONS FROM THE ACADEMIC YEAR 2017-2018**

**CREDITS DISTRIBUTION AS PER THE UNIVERSITY NORMS.**

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* Allied Practical Examination will be conducted at the end of even semester.
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## ELECTIVE SUBJECTS

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<td></td>
<td></td>
<td></td>
<td>SBEC - V : Practical-Android Programming</td>
<td>-</td>
<td>3</td>
<td>2</td>
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<td></td>
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<td></td>
<td>SBEC-VI : Shell Programming</td>
<td></td>
<td></td>
<td>2</td>
<td>25</td>
</tr>
</tbody>
</table>

### Non Major Elective Course – (NMEC)

Extra Disciplinary Subjects offered by the Department of Computer Science

The department can offer any one of the subjects to the other major subject students in each semester.

<table>
<thead>
<tr>
<th>Part</th>
<th>Semester</th>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Lect.</th>
<th>Credits</th>
<th>Marks</th>
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<tbody>
<tr>
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<td>CIA</td>
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<tr>
<td>III</td>
<td></td>
<td></td>
<td>NMEC I: Basics of Computers</td>
<td>2</td>
<td>2</td>
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<tr>
<td>III</td>
<td></td>
<td></td>
<td>NMEC I: System Administration and Maintenance</td>
<td>2</td>
<td>2</td>
<td>25</td>
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<tr>
<td>IV</td>
<td></td>
<td></td>
<td>NMEC II: Office Automation</td>
<td>2</td>
<td>2</td>
<td>25</td>
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<tr>
<td>IV</td>
<td></td>
<td></td>
<td>NMEC II: Basics of Internet</td>
<td>2</td>
<td>2</td>
<td>25</td>
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</tbody>
</table>
### Allied Subjects for any Degree offered by the Department of Computer Science

**SYLLABUS - CBCS PATTERN**  
**EFFECTIVE FROM THE ACADEMIC YEAR 2017-2018**

All Papers should be handled and valued by Computer Science Department only. For University practical examinations both Internal and External examiners should be appointed from Computer Science Department.

**FIRST OPTION (Allied Computer Science)**  
First Year / Second Year (Select any one of the Subject with Practical)

<table>
<thead>
<tr>
<th>Part</th>
<th>Semester</th>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Hours</th>
<th>Credits</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td>Lect.</td>
<td>Lab</td>
<td>CIA</td>
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<tr>
<td>I / II</td>
<td></td>
<td>Allied – I C Programming</td>
<td>4 - 2</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>I / II</td>
<td></td>
<td>Allied Practical – I Programming in C</td>
<td>- 3</td>
<td>2</td>
<td>40</td>
<td>60</td>
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<tr>
<td>II/IV</td>
<td></td>
<td>Allied – II C++ Programming</td>
<td>4 - 3</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<tr>
<td>II/IV</td>
<td></td>
<td>Allied Practical–II Programming in C++</td>
<td>- 3</td>
<td>2</td>
<td>40</td>
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**SECOND OPTION (Allied Computer Science)**  
First Year / Second Year (Select any one of the Subject with Practical)

<table>
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<tr>
<th>Part</th>
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<th>Subject Title</th>
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<td>Lect.</td>
<td>Lab</td>
<td>CIA</td>
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<tr>
<td>I / III</td>
<td></td>
<td>Allied – I Database Systems</td>
<td>4 - 3</td>
<td>25</td>
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<tr>
<td>I / II</td>
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<td>Allied Practical – I MS-Access</td>
<td>- 3</td>
<td>2</td>
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<tr>
<td>II/IV</td>
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<td>Allied II E–Commerce Techniques</td>
<td>4 - 3</td>
<td>25</td>
<td>75</td>
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<tr>
<td>II/IV</td>
<td></td>
<td>Allied Practical – II HTML Programming</td>
<td>- 3</td>
<td>2</td>
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</table>
THIRD OPTION (Allied Computer Science)
First Year / Second Year (Select any one of the Subject with Practical)

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<th>Marks</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>I/ III</td>
<td></td>
<td>Allied – I Computer Applications in Office</td>
<td>4</td>
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<tr>
<td></td>
<td>I / II</td>
<td></td>
<td>Allied Practical – I Office Automation</td>
<td>-</td>
<td>3</td>
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<tr>
<td>III</td>
<td>II/IV</td>
<td></td>
<td>Allied – II Image Editing Tool</td>
<td>4</td>
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<td></td>
<td>II/IV</td>
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<td>Allied Practical–II Image Editing Software</td>
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FOURTH OPTION (Allied Computer Science)
First Year / Second Year (Select any one of the Subject with Practical)

<table>
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<tr>
<td></td>
<td>I/ III</td>
<td></td>
<td>Allied – I PHP Scripting Language</td>
<td>4</td>
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<tr>
<td></td>
<td>I / II</td>
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<td>Allied Practical – I PHP Programming</td>
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<td>3</td>
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<tr>
<td>III</td>
<td>II/IV</td>
<td></td>
<td>Allied – II Basics of Computer and Financial Computing</td>
<td>4</td>
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<tr>
<td></td>
<td>II/IV</td>
<td></td>
<td>Allied Practical – II Financial Computing Software</td>
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<td>3</td>
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### Allied Papers for B.Sc. Computer Science offered by other Departments

I - YEAR (Allied – I: First Option)

<table>
<thead>
<tr>
<th>Part</th>
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<th>Subject Title</th>
<th>Hours</th>
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<td>Lect.</td>
<td>Lab</td>
<td>CIA</td>
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<tr>
<td>III</td>
<td>I</td>
<td></td>
<td>Allied I : Paper–I: Algebra and Fourier series</td>
<td>6</td>
<td>-</td>
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<tr>
<td></td>
<td>II</td>
<td></td>
<td>Allied I : Paper–II: Differential Equations and Laplace Transforms</td>
<td>4</td>
<td>-</td>
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<td>II</td>
<td></td>
<td>Allied I : – III : Practical</td>
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I - YEAR (Allied – I: Second Option)

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<td>Lab</td>
<td>CIA</td>
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<td>III</td>
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<td>Allied I : Paper – I: Discrete Mathematics</td>
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<td>II</td>
<td></td>
<td>Allied I : Paper – II: Numerical Methods</td>
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<td>Allied I : Paper – III : Graph Theory</td>
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I-Year (Allied – I: Statistics –Third Option)

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<td>Lab</td>
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<tr>
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<td>Allied I :Paper–I: Allied Statistics –I</td>
<td>6</td>
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<td>Allied I :Paper–I: Allied Statistics –II</td>
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<td>II</td>
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<td>Allied I :Paper–I: Allied Statistics –III (Practical)</td>
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### II - YEAR (Allied – II: COMMERCE -First Option)

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<th>Hours</th>
<th>Credits</th>
<th>Marks</th>
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<tbody>
<tr>
<td>III</td>
<td>III</td>
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<td>Allied II : Paper – I: Principles of Accounting</td>
<td>6</td>
<td>-</td>
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<td>IV</td>
<td></td>
<td>Allied II : Paper – II: Cost and Management Accounting</td>
<td>5</td>
<td>-</td>
<td>4</td>
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<tr>
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<td>III/IV</td>
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<td>Allied II : Practical Lab -1: Allied Commerce Practical</td>
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### II - YEAR (Allied – II: ELECTRONICS - Second Option)

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<th>Marks</th>
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<tbody>
<tr>
<td>III</td>
<td>III</td>
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<td>Allied II: Paper – I: Applied Electronics-I</td>
<td>6</td>
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<td></td>
<td>IV</td>
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<td>Allied II:Paper – II: Applied Electronics-II</td>
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<td>III/IV</td>
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<td>Allied II: Practical Lab -1: Allied Electronics Lab –I</td>
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### II - YEAR (Allied – II: PHYSICS - Third Option)

<table>
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<tr>
<th>Part</th>
<th>Semester</th>
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<th>Subject Title</th>
<th>Hours</th>
<th>Credits</th>
<th>Marks</th>
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<tr>
<td>III</td>
<td>III</td>
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<td>Allied II : Paper – I: Allied Physics – I</td>
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<td>IV</td>
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<td>Allied II : Paper – II: Allied physics – II</td>
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<td>III/IV</td>
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<td>Allied II : Practical Lab -1: Allied Physics Practical</td>
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</tbody>
</table>
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER I

CORE I - COMPUTER APPLICATIONS FOR AUTOMATION

UNIT – I

Introduction to Computers: Introduction- Importance- History- Anatomy

UNIT II


UNIT – III

MS-Excel: Basics – Do's and Don'ts – Menus – Commands – Tool Bars – Icons

UNIT – IV


UNIT – V


TEXT BOOK


REFERENCE BOOKS


BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER I

CORE PRACTICAL I - OFFICE AUTOMATION

WORD PROCESSOR

1. i) Create a document, save it and edit the document as follows:
   a. Cut, Copy, Paste options.
   b. Find and Replace options.
   c. Undo and Redo options.

   ii) Format the document:
   b. Change Character style and size.
   c. Formatting paragraph: Center, Left aligns & Right align
   d. Changing paragraph and line spacing, Using Bullets and Numbering in Paragraphs.
   e. Creating Hanging Paragraphs

2. Enhance the documents using Header, Footer, Page Setup, Border, Page number, watermarking, Orientation and Print Preview.

3. Insert tables and pictures in a document as follows
   a. Creating Tables in a document, Selecting Rows & Column sort the record
   b. Insert a picture – edit size and add name of the picture above it.
   c. Also do basic text formatting like – bold, italic, underline, alignments etc in table.

4. Using mail merge, send an invitation/notice (by creating the invitation/notice) for the following situation (at least 5 addresses to be entered) (Any one of the following)
   a. For opening a new branch
   b. Inauguration function
   c. Informing about new scheme or offer
BCA

SPREADSHEET

5. a. Create a worksheet, moving/ copying/ inserting/ deleting rows and columns (usage of cut, paste, commands, copying a single cell, copying a range of data, filling up a cell. Undo command, inserting a row, column, deleting rows and columns).

b. Formatting worksheets

Bold, Italic, Font size changing, Auto fill, date format, Currency format

6. Open an excel and create fields as follows:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the student</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>Total</th>
<th>Avg</th>
<th>Result</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

i. Enter S.No, Name, marks for 10 students

ii. Find total and average using formula.

iii. Find Result whether the student is pass or fail and also assign grade as per our university norms.

iv. Insert a column chart showing the comparison of marks in different subjects of different students.

7. i) Creating and running a macro.

ii) Assigning button to a defined macro.

iii) Editing a macro.

PRESENTATION

8. Create a presentation with apply background/Themes, apply custom animation on text, insert images/word art and animate the images with effects.

9. Create “My album” use photos, audio, and videos with necessary Transition Effects

10. Making an Organization Structure in Power Point

    Starting an organization chart, Entering names and Titles, Adding Members, Formatting the Boxes, Text and Lines, Rearranging the Org Chart, Finishing the Chart
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER II

CORE II - C PROGRAMMING

UNIT– I


UNIT– II


UNIT – III


UNIT – IV


UNIT – V


TEXT BOOK


REFERENCE BOOKS

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER II

CORE PRACTICAL II - PROGRAMMING IN C

1. Write a simple C program to find the total and average percentage obtained by a student for 6 subjects.
2. Write a simple C program to check whether a given character is vowels or not using Switch – Case Statement
3. Write a simple C program to print the numbers 1 to 10 along with their squares
4. Write a simple C program to find the sum of ’n’ numbers using for do-while statement
5. Write a simple C program to find the factorial of a given numbers using Function
6. Write a simple C program to swap two numbers using call by values and call by reference
7. Write a simple C program to find the smallest and largest element in an array
8. Write a simple C program to perform matrix multiplication
9. Write a simple C program to find the sum of an integer array using pointers
10. Write a C program to copy the contents of one file into another
UNIT – I

UNIT – II

UNIT - III

UNIT - IV

UNIT - V

TEXT BOOK

REFERENCES
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER IV

CORE IV - STRUCTURED SYSTEM ANALYSIS AND DESIGN

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

TEXT BOOK

REFERENCE BOOKS
UNIT -I

UNIT -II

UNIT -III

UNIT -IV

UNIT -V

TEXT BOOKS

REFERENCE BOOKS
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER III

CORE PRACTICAL III - DATA STRUCTURES USING C

1. Implement Push and Pop Operations of a Stack using Array
2. Write a program to perform factorial calculation using recursion.
3. Implement Add and Delete Operations on Queue using Pointer
4. Implement Add and Delete Operations on Circular Queue
5. Write a Program to convert an Infix Expression to Postfix Expression using Arrays.
6. Write a Program to add Two Polynomials using Pointers.
7. Perform Tree Traversals for a Binary Tree using Recursion.
8. Write a program to perform Binary Search.
9. Sort the given list of numbers using Heap Sort.
10. Sort the given list of numbers using Quick Sort
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER IV

CORE VI - RELATIONAL DATABASE MANAGEMENT SYSTEMS

UNIT – I


UNIT – II


UNIT-III


UNIT – IV


UNIT-V


TEXT BOOK


REFERENCE BOOKS


BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER I

CORE VII - OPERATING SYSTEM

UNIT – I

Introduction – History of operating system- Different kinds of operating system – Operation system concepts - System calls-Operating system structure.

UNIT – II


UNIT – III

Scheduling - Memory Management: Memory Abstraction – Virtual Memory - page replacement algorithms.

UNIT – IV


UNIT – V


TEXT BOOK


REFERENCE BOOKS


BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER IV

CORE VIII - OBJECT ORIENTED PROGRAMMING WITH C++

'UNIT – I


UNIT – II


UNIT – III


UNIT – IV


UNIT – V:

Templates: Class Templates – Class Templates with Multiple Parameters – Function Templates – Function Templates with Multiple Parameters – Overloading of Template Functions – Member Function Templates – Non-Type Template Arguments, Exception Handling: Basics - Exception Handling Mechanism – Throwing Mechanism – Catching Mechanism – Rethrowing an Exception – Specifying Exceptions.
TEXT BOOK


REFERENCE BOOKS


   Note: This paper should be handled and valued by Computer Science Department.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER I

CORE PRACTICAL IV - PROGRAMMING IN C++

1. Write a C++ program to create a class ARITHMETIC which consists of a FLOAT and an INTEGER variable. Write member functions ADD(), SUB(), MUL(), DIV() to perform addition, subtraction, multiplication, division respectively. Write a member function to get and display values.

2. Write a C++ program to create a class FLOAT that contains one float data member. Overload all the four Arithmetic operators so that they operate on the object FLOAT.

3. Write a C++ program to create a class STRING. Write a Member Function to initialize, get and display strings. Overload the operators ++ and == to concatenate two Strings and to compare two strings respectively.

4. Write a C++ program to create class, which consists of EMPLOYEE Detail like E_Number, E_Name, Department, Basic, Salary, Grade. Write a member function to get and display them. Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending on the grade.

5. Write a C++ program to create a class SHAPE which consists of two VIRTUAL FUNCTIONS Calculate_Area() and Calculate_Perimeter() to calculate area and perimeter of various figures. Derive three classes SQUARE, RECTANGLE, TRIANGLE from class Shape and Calculate Area and Perimeter of each class separately and display the result.

6. Write a C++ program using Function Overloading to read two Matrices of different Data Types such as integers and floating point numbers. Find out the sum of the above two matrices separately and display the sum of these arrays individually.

7. Write a program to convert an Infix Expression to Postfix Expression using Arrays.

8. Write a C++ program to create a class to implement the data structure STACK. Write a constructor to initialize the TOP of the STACK. Write a member function PUSH() to insert an element and member function POP() to delete an element. Check for overflow and underflow conditions.

9. Write a C++ program to check whether the given string is a palindrome or not using Pointers.

10. Write a C++ program to merge two files into a single file
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER V

CORE IX - WEB TECHNOLOGIES

UNIT – I


UNIT – II


UNIT – III


UNIT – IV


UNIT – V


TEXT BOOK:


REFERENCE BOOKS:


BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER V

CORE X - PROBLEM SOLVING TECHNIQUES

UNIT I


UNIT II

Analysis of Algorithm: Fundamental Algorithms - Exchanging the values of Two Variables - Counting - Summation of a set of Numbers - Factorial Computation-Sine function computation - Generation of the Fibonacci sequence - Reversing the Digits of an Integer - Base Conversion Character to Number Conversion.

UNIT III

Factoring Methods: Finding The Square Root Of A Number - The Greatest Common Divisor Of Two Integers - Generating Prime Numbers - Generation of Pseudo-random Numbers - Raising a Number to a Large Power.

UNIT IV

Array Techniques: Array Order Reversal-Array Counting or Histogramming - Finding the Maximum Number in a Set - Removal of Duplicates from an Ordered Array - Partitioning an Array – Finding the kth Smallest Element.

UNIT V

Merging, Sorting and Searching: Two ways merge - sorting by selection, insertion, diminishing increment and partitioning –Binary search.

TEXT BOOK


REFERENCE BOOK

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER V

CORE XI - JAVA PROGRAMMING

UNIT – I


UNIT – II


UNIT – III


UNIT – IV

UNIT V


TEXT BOOK


REFERENCE BOOKS

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER V

PRACTICAL V - PROGRAMMING IN JAVA

1. Write a program to find the Area of Square, Rectangle and Circle using Method Overloading.

2. Write a program to sort the list of numbers using Command Line Arguments.

3. Write a program to multiply the given two matrices.

4. Write a program to design a class to represent a bank account. Include the following:
   Data Members: Name of the depositor, Account number, Type of account, and Balance amount in the account.
   Methods: To assign initial values, To deposit an amount, To withdraw an amount after checking balance, and To display the name and balance.

5. Write a program that import the user defined package and access the Member variable of classes that contained by Package.

6. Write a program to handle the Exception using try and multiple catch blocks.

7. Write a program to illustrate the use of multi threads.

8. Write a program to create student registration form using applet with Name, Address, Sex, Class, Email-id.

9. Write a program to draw the line, rectangle, oval, text using the graphics method.

10. Write a program to create a sequential file that could store details about five products. Details include product code, cost, and number of items available and are provided through the keyboard. Compute and print the total value of all the five products.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER VI

CORE XII - GUI PROGRAMMING

UNIT – I


UNIT – II


UNIT – III


UNIT – IV


UNIT – V

Accessing Database Files: Visual basic and Database Files – Using Data Control – Viewing a Database File – Navigating the Database in Code – Using List Boxes and Combo boxes as Data-Bound Controls.

TEXT BOOK:


REFERENCE BOOKS:


BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER VI

CORE XIII - COMPUTER NETWORKS

UNIT – I


UNIT – II


UNIT – III


UNIT – IV


UNIT – V


TEXT BOOK


REFERENCE BOOKS

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER VI

CORE PRACTICAL VI - PROGRAMMING IN VB

1. Construction of an Arithmetic Calculator (Simple)

2. Writing simple programs using loops and decision making statements.
   a. Generate Fibonacci series.
   b. Find the sum of N numbers.
   c. To display the numbers/symbols in triangle format.

3. Write a program to create a menu and MDI Forms.

4. Write a program to create a simple input screen with four basic controls to read input and write it to a file.

5. Write a program to display files in a directory using DriveListBox, DirListBox and FileListBox control and open, edit and save text file using Rich text box control

6. Write a program to illustrate Common Dialog Control and to open, edit and save text file

7. Write a program to develop windows based installation file with Student Registration form and Login form using database access.

8. Develop a program to Insert, update, delete a Record in database using ADO

9. Write a program to implement Personal Information System using MDI and Standard ADODC controls and reports.

10. Write a program to implement animation using timers.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER V

ELECTIVE I - PAPER I - E-COMMERCE TECHNOLOGIES

UNIT I


UNIT II


UNIT III


UNIT IV


UNIT V


TEXTBOOK


REFERENCE BOOK

BACHELOR OF COMPUTER APPLICATION (B.C.A.)  
SEMESTER V  
ELECTIVE I - PAPER II - SYSTEM SOFTWARE  

Unit-I  
System software and machine architecture – The Simplified Instructional Computer (SIC) - Machine architecture - Data and instruction formats - addressing modes - instruction sets - I/O and programming.

Unit-II  

Unit-III  

Unit-IV  

Unit-V  
Text editors - Overview of the Editing Process - User Interface – Editor Structure. - Interactive debugging systems - Debugging functions and capabilities – Relationship with other parts of the system – User-Interface Criteria.

TEXT BOOK  

REFERENCE BOOKS  
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER V

ELECTIVE I - PAPER III - COMPUTER GRAPHICS

UNIT – I


UNIT – II


UNIT – III


UNIT – IV


UNIT – V


TEXT BOOK:


REFERENCE BOOK:

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

TEXT BOOK

REFERENCE BOOKS
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER VI

ELECTIVE II - PAPER II - PARALLEL PROCESSING

UNIT - I

UNIT-II

UNIT -III

UNIT -IV

UNIT-V
TEXT BOOK


REFERENCE BOOK

1. Behrooz Parhami, “Introduction to Parallel Processing – Algorithms and Architectures”
   Plenum series, 2002.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER VI

ELECTIVE II - PAPER III - MULTIMEDIA

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

TEXT BOOK

REFERENCE BOOK
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER VI

ELECTIVE III - PAPER I - DATA MINING AND WAREHOUSING

UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V
Data warehousing: Introduction – Operational data sources- data warehousing - Data warehousing design – Guidelines for data warehousing implementation - Data warehousing metadata - Online analytical processing (OLAP): Introduction – OLAP characteristics of OLAP system – Multidimensional view and data cube - Data cube implementation - Data cube operations OLAP implementation guidelines.

TEXTBOOK

REFERENCE BOOK
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER VI

ELECTIVE III - PAPER II - IMAGE PROCESSING

UNIT - I


UNIT - II


UNIT - III


UNIT - IV


UNIT - V


TEXT BOOK


REFERENCE BOOKS

UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V

TEXTBOOK

REFERENCE BOOKS
UNIT - I


UNIT – II


UNIT - III

Introduction to HTML: Designing a home page – HTML documents – Anchor tag – Hyper Links.

UNIT – IV

Traditional text and formatting – tables - images - frames

UNIT - V

Case Study: Online Passport – Online Gas Services – Online Train Reservation – Tamilnadu government services

TEXTBOOKS


REFERENCE WEBSITES

3. https://www.irctc.co.in
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER IV

SKILL BASED ELECTIVE COURSE (SBEC) - II

HTML AND JAVA SCRIPT

UNIT – I

UNIT II

UNIT III

UNIT IV

UNIT V
JavaScript Functions: The Purpose of Functions in Programming - Defining JavaScript Functions - Using JavaScript Functions with HTML Forms - Global Methods and EventHandlers - Recursive Functions - Passing Values from One Document to Another - Revisiting the JavaScript sort() Method

TEXT BOOK
1. David R. Brooks, "An Introduction to HTML and JavaScript for Scientists and Engineers," New age international (P) Ltd., 2010

REFERENCE BOOKS
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER V

SKILL BASED ELECTIVE COURSE (SBEC) - III

PRACTICAL - IMAGE EDITING TOOL

1. Design a greeting card for birthday using different text effects.
2. Apply various filter effects to an image.
3. Design the front page of the college calendar using gradient.
4. Create a pattern using pattern stamp tool and clone stamp tool.
5. Design a web page layout.
6. Design a bunch of flowers.
7. Perform/Simulate Plastic Surgery on any part of the face.
8. Create See-through texts
9. Convert Black and White Photo to Color Photo
10. Fill a text with an appropriate image (Example: The word “Flower” should be filled with some flower images)
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER V

SKILL BASED ELECTIVE COURSE (SBEC) - IV

MULTI SKILL DEVELOPMENT

UNIT- I

Communication: Question tag – Gerund and Infinitives – Spotting the errors – Vocabulary – Synonyms – Antonyms - Prepositions – Articles – One word substitution – Sentence completion.

UNIT - II


UNIT - III


UNIT- IV


UNIT- V

Group Discussion – Importance – Types of GD – GD Skills – GD Etiquette – Essential Elements of a GD – Movements and Gestures to be avoided in a GD

TEXT and REFERENCE BOOKS

2. R.S. Aggarwal, “Quantitative Aptitude”, S.Chand 2010. (Unit - II)
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER VI

SKILL BASED ELECTIVE COURSE (SBEC) - V

PRACTICAL - ANDROID PROGRAMMING

1. Sample Application about Android Resources
2. Sample Application about Layouts
3. Sample Application about Intents
4. Sample Application about user interfaces
5. Sample Application about Animations
6. Sample Application about SQLite I
7. Create Calculator App in Android
8. Create Simple Android Camera Application
9. Create Basic List View Demo in Android
10. Create Google Map in Android
UNIT – I


UNIT – II


UNIT-III


UNIT - IV


UNIT – V


TEXT BOOK:


REFERENCE BOOK:

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER III

NON MAJOR ELECTIVE COURSE (NMEC) - I

BASICS OF COMPUTERS

UNIT-I


UNIT – II

Number System: Introduction – Decimal Number System – Binary Number System – Binary-Decimal
Conversion – Decimal Binary Conversion – Binary Addition – Binary Subtraction – Complements – 9's
Complement – 10's Complement – 1's Complements – 2's Complements – BCD - Bits, Bytes, Words –
Octal – Hexadecimal Number System.

UNIT-III

Anatomy of Digital Computer : Functions and Components of Computer – Central Processing Unit –
Control Unit – Arithmetic – Logic Unit – Memory – Registers – Addresses. Memory Units: RAM, ROM,
PROM, EPROM, EEPROM, And Flash Memory.

UNIT-IV

Monitor – Classification of Monitors – Monochrome – Gray Scale – Color – Digital Monitor – Analog
Monitor – Characteristics of monitor – Printers.

UNIT – V

Language – Assembly Language – High level language – Types of High Level Language. Data
Processing: Data VS Information – File Processing – Sequential File Processing – Direct Access file
Processing.
TEXTBOOK:

REFERENCE BOOKS:
BACHELOR OF COMPUTER APPLICATIONS (B.C.A.)

SEMESTER III

NON MAJOR ELECTIVE COURSE (NMEC) - I

SYSTEM ADMINISTRATION AND MAINTENANCE

UNIT – I


UNIT – II


UNIT – III


UNIT – IV


UNIT – V

TEXTBOOK


REFERENCE BOOK

UNIT- I

UNIT- II

UNIT- III
Error Corrections: Correct Spelling and Grammatical Errors – Finalize a Document. -Changing the Look - Quickly Format Text and Paragraphs – Manually Change the Look of Characters. – Manually Change the Look of Paragraphs.

UNIT- IV
Bulleted and Numbered Lists: - Create and Modify Lists - Presenting Information in Columns. Creating Table: Create a Tabular List – Present Information in a Table.

UNIT- V
Formatting a Table: Format Table Information – Perform Calculation in a Table – Use a Table to Control Page Layout.

TEXT BOOK

REFERENCE BOOK
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER IV

NON MAJOR ELECTIVE COURSE (NMEC) - II

BASICS OF INTERNET

UNIT - I

UNIT – II

UNIT - III
Introduction to HTML: Designing a home page – HTML documents – Anchor tag – Hyper Links.

UNIT – IV
Traditional text and formatting – tables - images - frames

UNIT - V
Case Study: Online Passport – Online Gas Services – Online Train Reservation – Tamilnadu government services

TEXTBOOKS

REFERENCE WEBSITES
3. https://www.irctc.co.in
UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V
TEXTBOOK

REFERENCE BOOKS

Note: This paper should be handled and valued by Computer Science Department.
C Practical Programming List:

1. Create a program to find the Simple Interest and Compound Interest.
2. Create a program to find the mean and standard deviation.
3. To find the largest of a given set of numbers.
4. Create a program to find the given number is Prime or not.
5. Create a program to calculate $\sin(x)$ using series.
6. Create a program to print the Fibonacci series.
7. Create a program to generate Pascal triangle.
8. Create a program to convert Binary to Decimal conversion.
9. Create a program to calculate binomial co-efficient using recursion.
10. Create a program to reverse a string without using string library function.

Note: For University Practical Exam, both Internal and External should be appointed from Department of Computer Science.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER II /IV

ALLIED - II

PROGRAMMING IN C++

UNIT – I


UNIT – II


UNIT – III


UNIT – IV


UNIT – V:

Templates: Class Templates – Class Templates with Multiple Parameters – Function Templates – Function Templates with Multiple Parameters – Overloading of Template Functions – Member Function Templates – Non-Type Template Arguments, Exception Handling: Basics - Exception Handling Mechanism – Throwing Mechanism – Catching Mechanism – Rethrowing an Exception – Specifying Exceptions
TEXT BOOK


REFERENCE BOOKS


Note: This paper should be handled and valued by Computer Science Department.
1. Write a C++ program to create a class ARITHMETIC which consists of a FLOAT and an INTEGER variable. Write member functions ADD(), SUB(), MUL(), DIV() to perform addition, subtraction, multiplication, division respectively. Write a member function to get and display values.

2. Write a C++ program to create a class FLOAT that contains one float data member. Overload all the four Arithmetic operators so that they operate on the object FLOAT.

3. Write a C++ program to create a class STRING. Write a Member Function to initialize, get and display strings. Overload the operators ++ and == to concatenate two Strings and to compare two strings respectively.

4. Write a C++ program to create class, which consists of EMPLOYEE Detail like E_Number, E_Name, Department, Basic, Salary, Grade. Write a member function to get and display them. Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending on the grade.

5. Write a C++ program to create a class SHAPE which consists of two VIRTUAL FUNCTIONS Calculate_Area() and Calculate_Perimeter() to calculate area and perimeter of various figures. Derive three classes SQUARE, RECTANGLE, TRIANGLE from class Shape and Calculate Area and Perimeter of each class separately and display the result.

6. Write a C++ program using Function Overloading to read two Matrices of different Data Types such as integers and floating point numbers. Find out the sum of the above two matrices separately and display the sum of these arrays individually.

7. Write a program to convert an Infix Expression to Postfix Expression using Arrays.

8. Write a C++ program to create a class to implement the data structure STACK. Write a constructor to initialize the TOP of the STACK. Write a member function PUSH() to insert an element and member function POP() to delete an element. Check for overflow and underflow conditions.

9. Write a C++ program to check whether the given string is a palindrome or not using Pointers.

10. Write a C++ program to merge two files into a single file

Note: For University Practical Exam, both Internal and External should be appointed from Department of Computer Science.
UNIT-I


UNIT-II


UNIT-III

The Relational Data Model and SQL - Database Constraints - Relational Model Concepts - Key concepts - Relational Model Constraints and Relational Database Schemas - Update Operations, Transactions, and Dealing with Constraint Violations.

UNIT-IV

Basic SQL - SQL Data Definition and Data Types - Specifying Constraints in SQL - Basic Retrieval Queries in SQL - INSERT, DELETE, and UPDATE Statements in SQL - Additional Features of SQL.

UNIT-V

More SQL: Complex Queries, Triggers, Views, and Schema Modification - More Complex SQL Retrieval Queries - Specifying Constraints as Assertions and Actions as Triggers - Views (Virtual Tables) in SQL.

TEXTBOOK


REFERENCE BOOK


Note: This paper should be handled and valued by Computer Science Department.
1. Create a database for a company and create a table for employee. Add fields emp_no, name, qualification, DOJ, designation and salary for employee table. And save the table in the database.

2. Create another table for customer and add fields cust_no, name, date_of_purchase, products, quantity, and price and save in the same company database.

3. Create table for personal information and add at least 10 records for the table with the following fields no, name, DOB, address, ph_no, email_id, and blood group.

4. Create a new table for students and do table manipulations by adding, deleting, and updating fields to the table.

5. Calculate the sum, average and assign the grade in the student table.

6. Display the students name in ascending and descending order after sorting.

7. Create a home budget table for calculate expenses of house for 4 months with the following fields month, house rent, EB, telephone bill, milk, grocery, vegetables, medical_exp, total_exp
   i) find out the month on which the budget is high
   ii) List out all grocery expenses for all the months.
   iii) Find out the month on which the telephone bill is low.
   iv) Any other relevant filters.

8. For the employee table execute the following queries.
   i) List the manager name under each department using GROUP BY.
   ii) List the employees whose salary is greater than 10000 and less than 20000.
   iii) List out the employee details who is in morning shift.

9. Display the information of home budget table using columnar and tabular form.

10. Generate the report for any one of the above said tables.

**Note:** For University Practical Exam, both Internal and External should be appointed from Department of Computer Science.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER II /IV

ALLIED II

E-COMMERCE TECHNIQUES

UNIT- I


UNIT- II


UNIT- III


UNIT- IV:


UNIT- V:

E-mail: Email – Email Components - use of Email–Email creation–browsing–search engines–downloads.
TEXTBOOKS

REFERENCE BOOKS

Note: This paper should be handled and valued by Computer Science Department.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)
SEMESTER II /IV
ALLIED PRACTICAL - II
HTML PROGRAMMING

1. Write HTML code to develop a web page that contains the different background and foreground color, with various styles.

2. Write HTML code to create a Webpage that contains an Image at its left hand side of the page when user clicks on the image; it should open another web page that displays the details of that image.

3. Create a web Page using HREF tag having the attribute ALINK, VLINK etc.

4. Create a web page, when user clicks on the link it should go to the bottom of the page.

5. Write a HTML code to create a web page of pink color and display moving message in red color.

6. Create a web page, showing an ordered list of name of your five friends and unordered list of any five your hobbies.

7. Create a HTML document containing a nested list showing the content page of any book.

8. Create a student mark list in HTML using Tables.

Note: For University Practical Exam, both Internal and External should be appointed from Department of Computer Science.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMESTER I /III

ALLIED I

COMPUTER APPLICATIONS IN OFFICE

UNIT - I

UNIT - II
Getting Started: Starting a Program - Identifying Common Screen Elements - Choosing Commands - Finding Common Ways to Work - Getting Help with Office

UNIT - III

UNIT - IV
MS-EXCEL: Creating a Simple Spreadsheet - Editing a Spreadsheet - Working with Functions and Formula - Formatting Worksheets - Completing Your Spreadsheet – Creating Charts.

UNIT - V
MS-POWERPOINT: Creating and Viewing Presentations - Editing a Presentation - Working with Presentation Special Effects.

TEXT BOOKS:

REFERENCE BOOKS

Note: This paper should be handled and valued by Computer Science Department.
1. i) Create a document, save it and edit the document as follows:
   a. Cut, Copy, Paste options.
   b. Find and Replace options.
   c. Undo and Redo options.

   ii) Format the document:
   b. Change Character style and size.
   c. Formatting paragraph: Center, Left aligns & Right align
   d. Changing paragraph and line spacing, Using Bullets and Numbering in Paragraphs.
   e. Creating Hanging Paragraphs

2. Enhance the documents using Header, Footer, Page Setup, Border, Page number, watermarking, Orientation and Print Preview.

3. Insert tables and pictures in a document as follows
   a. Creating Tables in a document, Selecting Rows & Column sort the record
   b. Insert a picture – edit size and add name of the picture above it.
   c. Also do basic text formatting like – bold, italic, underline, alignments etc in table.

4. Using mail merge, send an invitation/notice (by creating the invitation/notice) for the following situation (at least 5 addresses to be entered) (Any one of the following)
   a. For opening a new branch
   b. Inauguration function
   c. Informing about new scheme or offer
SPREADSHEET

5. a. Create a worksheet, moving/ copying/ inserting/ deleting rows and columns (usage of cut, paste, commands, copying a single cell, copying a range of data, filling up a cell. Undo command, inserting a row, column, deleting rows and columns).

b. Formatting worksheets

Bold, Italic, Font size changing, Auto fill, date format, Currency format

6. Open an excel and create fields as follows

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the student</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>Total</th>
<th>Avg</th>
<th>Result</th>
<th>Grade</th>
</tr>
</thead>
</table>

i. Enter S.No, Name, marks for 10 students

ii. Find total and average using formula.

iii. Find Result whether the student is pass or fail and also assign grade as per our university norms.

iv. Insert a column chart showing the comparison of marks in different subjects of different students.

7. i) Creating and running a macro.

ii) Assigning button to a defined macro.

iii) Editing a macro.

PRESENTATION

8. Create a presentation with apply background/Themes, apply custom animation on text, insert images/word art and animate the images with effects.

9. Create “My album” use photos, audio, and videos with necessary Transition Effects

10. Making an Organization Structure in Power Point

Starting an organization chart, Entering names and Titles, Adding Members, Formatting the Boxes, Text and Lines, Rearranging the Org Chart, Finishing the Chart

Note: For University Practical Exam, both Internal and External should be appointed from Department of Computer Science.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)

SEMMESTER II /IV

ALLIED II

IMAGE EDITING TOOL

UNIT-1


UNIT-2


UNIT-3


UNIT-4

Working with Layer Styles and Filter Effects: Understanding Layer Styles - Working with Smart Objects - Understanding Filters.

UNIT-5

Animation, 3D, and Printing in Photoshop CS5: Working with Actions - Working with Automate Commands - Exploring 3D in Photoshop - Working with Animation in Photoshop CS5 - Printing in Photoshop CS5.
TEXTBOOK

REFERENCE BOOKS
2. Lisa Danae Dayley, Brad Dayley, “Adobe Photoshop Cs6 Bible”, Wiley India Pvt Ltd.
3. Edward Bailey, “Photoshop: 7 Ways to Use Adobe Photoshop Like a Pro”, Create space Independent Publishing Platform

Note: This paper should be handled and Valued by Computer Science Department.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)
SEMESTER II /IV
ALLIED PRACTICAL II
IMAGE EDITING SOFTWARE

1. Design a greeting card for birthday using different text effects.
2. Apply various filter effects to an image.
3. Design the front page of the college calendar using gradient.
4. Create a pattern using pattern stamp tool and clone stamp tool.
5. Design a web page layout.
6. Design a bunch of flowers.
7. Create Plastic Surgery for the Nose
8. Create See-through texts
9. Convert Black and White Photo to Color Photo
10. Fill a text with an appropriate image (Ex: Write Flower and fill it with some flower images)

Note: For University Practical Exam, both Internal and External should be appointed from Department of Computer Science.
UNIT – I
Basic of Coding in PHP: Mixing PHP and HTML – Introducing Variables and Operators – PHP Variables.

UNIT – II

UNIT – III
Establishing a connection – Creating a Database Table – Inserting Data into the Table – Selecting and Displaying Data.

UNIT – IV
System Planning - Adding Contacts Modifying Contacts - Deleting Contacts - Working with Contacts.

UNIT – V
Managing a Simple Mailing List: Mailing List Software – Developing Subscription Mechanism, Mailing Mechanism. Creating Custom Logs and Reports.

TEXTBOOK

REFERENCE BOOKS

Note: This paper should be handled and valued by Computer Science Department.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)
SEMESTER I /III
ALLIED PRACTICAL I
PHP PROGRAMMING

1. Write a PHP program to find the factorial of a number using forms.
2. Write a PHP program to design a login form using Conditional Statements.
3. Write a PHP program to design a visiting card.
4. Design a simple web page to generate multiplication table for a given number using PHP.
5. Design a web page that should compute one's age on a given date using PHP.
6. Write a PHP program to download a file from the server.
7. Write a PHP program to store the current date and time in a COOKIE and display 'Last Visited' date and time on the web page.
8. Write a PHP program to store page views count in SESSION, to increment count on each refresh and to show the count on web page.
9. Write a PHP program to design a calendar for the current year.
10. Write a PHP Program to create a time table for the current semester.

Note: For University Practical Exam, both Internal and External should be appointed from Department of Computer Science.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)
SEMESTER II /IV
ALLIED II
BASICS OF COMPUTER AND FINANCIAL COMPUTING

UNIT – I


UNIT-II


UNIT-III


UNIT-IV


UNIT-V


TEXTBOOKS


2. A complete Reference - “Tally 9.0”, Tally Solutions (P) Limited

REFERENCE BOOK


Note: This paper should be handled and Valued by Computer Science Department.
BACHELOR OF COMPUTER APPLICATION (B.C.A.)
SEMESTER II /IV
ALLIED PRACTICAL II
FINANCIAL COMPUTING SOFTWARE

1. Company Information
   a. Company creation
   b. Select Company
   c. Alter Company
   d. Split Company Data

2. Gateway of Tally
   a. Accounts info
      i) Groups
      ii) Ledgers
      iii) Voucher Types
   b. Inventory info
      i) Stock Group
      ii) Stock Category
      iii) Stock item
      iv) Unit of Measures
      v) Godown
   c. Accounting Vouchers
   d. Inventory Vouchers

3. Statutory and Taxation
   a. Value Added Tax (VAT)
   b. Tax Deducted at Source (TDS)
   c. Tax Collected at Source (TCS)
   d. Service Tax

4. Display
   a. Trial Balance
   b. Day Book
   c. Accounts Book
   d. Statement of Accounts
   e. Inventory Books
   f. Statement of Inventory

Note: For University Practical Exam, both Internal and External should be appointed from Department of Computer Science.