



*॥ तमसो मा ज्योतिर्गमय ॥*

### VISION

To provide equal opportunities for value based global education for creating an Enlightened Society

### MISSION

To establish and facilitate educational institutions in the region for providing affordable value based global education to all who aspire to study and to create opportunities to educators, social workers and philanthropists to serve society



**SARVAJANIK**  
UNIVERSITY

INCLUSIVE | INTEGRATED | INNOVATIVE

*creating an enlightened society...*

### UNIVERSITY OFFICE

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## CURRICULUM FOR

**“BACHELOR OF  
SCIENCE (HONS)” /  
“BACHELOR OF  
SCIENCE (HONS  
WITH RESEARCH)”**

**B.Sc. (Hons)(Computer  
Science)**

**B.Sc. (Hons with Research)  
(Computer Science)**

**SEM – 7**

**SEM – 8**

w.e.f. Academic Year 2026-27

Constituent Institute:

**Shree Ramkrishna Institute of  
Computer Education and Applied  
Sciences (SRKI)**

**Course Curriculum**  
**BACHELOR OF SCIENCE (Hons) / BACHELOR OF SCIENCE (Hons with Research)**  
**(COMPUTER SCIENCE) Sem-7 and 8**

The Course Curriculum of Bachelor of Science (Computer Science) was proposed and drafted by **Academic and Curriculum Committee of Computer Science** under the Faculty of Computer Science and Applications in the meeting held on **11-09-2026** and recommended to '**BOARD OF STUDIES**' for approval.

|                                                                                                                         |                                                                           |                    |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------|
| <b>Mr. Jayesh Pushtiwala</b><br><b><u>Chairman, Academic</u></b><br><b>&amp; Curriculum Committee</b><br><b>Science</b> | <b>Place of the meeting</b><br><b><u>Sarvajanik University Office</u></b> | <b><u>Sign</u></b> |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------|

The proposed Course Curriculum was approved by **Board of Studies; Computer Science** under the Faculty of Computer Science and Applications in the meeting held on **14-09-2026** and was recommended to the '**FACULTY**' for approval.

|                                                                                                 |                                                                           |                    |
|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------|
| <b>Dr. Shripal Shah</b><br><b><u>Chairman,</u></b><br><b>Board of Studies- Computer Science</b> | <b>Place of the meeting</b><br><b><u>Sarvajanik University Office</u></b> | <b><u>Sign</u></b> |
|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------|

The Course Curriculum approved by the **Faculty of Computer Science and Applications** in the meeting held on **14-09-2026** and was recommended to '**ACADEMIC COUNCIL**' for approval.

|                                                                                                                                |                                                                           |                    |
|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------|
| <b>Dr. Shripal Shah</b><br><b><u>Chairman &amp; Dean,</u></b><br><b>Faculty of Computer Science and</b><br><b>Applications</b> | <b>Place of the meeting</b><br><b><u>Sarvajanik University Office</u></b> | <b><u>Sign</u></b> |
|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------|

The Course Curriculum approved by the '**Academic Council of Sarvajanik University**' in the meeting held on **16-09-2026**.

|                                                                                                                                                              |                                                                           |                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------|
| <b>Mr. Ashish Desai</b><br><b><u>Member Secretary,</u></b><br><b>Academic Council</b><br><b>&amp; I/c. Registrar,</b><br><b><u>Sarvajanik University</u></b> | <b>Place of the meeting</b><br><b><u>Sarvajanik University Office</u></b> | <b><u>Sign</u></b> |
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*The approved curriculum of Bachelor of Science (Hons) / Bachelor of Science (Hons with Research) (Computer Science) Sem-7 and 8 is with effect from the Academic year 2026-27*

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**FACULTY OF COMPUTER SCIENCE AND APPLICATIONS**  
**B.Sc. (Honours) (Computer Science) /**  
**B.Sc. (Honours with Research) (Computer Science)**  
**Semester - VII and Semester - VIII**



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# **Faculty of Computer Science and Applications**

**B. Sc. (Honours) (Computer Science)**

**B.Sc. (Honours with Research)  
(Computer Science)**

**DETAILED CURRICULUM**  
**(W.E.F. 2026-27)**

**SARVAJANIK UNIVERSITY**  
**FACULTY OF COMPUTER SCIENCE AND APPLICATIONS**  
**B.Sc. (Honours) (Computer Science) /**  
**B.Sc. (Honours with Research) (Computer Science)**  
**Semester - VII and Semester - VIII**

**Semester wise course group wise credit allocation for Under Graduate Programme**  
**(Annexure I)**

| Semester       | Major               |              |                |         |             |                     | Minor         |         | Skill Enhancement |         | Ability Enhancement |         | Multidiscipline. |         | Value Added |   | Total Credits |
|----------------|---------------------|--------------|----------------|---------|-------------|---------------------|---------------|---------|-------------------|---------|---------------------|---------|------------------|---------|-------------|---|---------------|
|                | Major No. of Papers | Theory       |                | Lab     |             | Total Major Credits |               |         |                   |         |                     |         |                  |         |             |   |               |
|                |                     | Theory Hours | Theory Credits | Lab Hrs | Lab Credits |                     | No. of Papers | Credits | No. of Papers     | Credits | No. of Papers       | Credits | No. of Papers    | Credits |             |   |               |
| 1              | 2                   | 3+3          | 3+3            | 2+2     | 1+1         | 8                   | 1             | 4       | 1                 | 2       | 1                   | 2       | 1                | 4       | 1           | 2 | 22            |
| 2              | 2                   | 3+3          | 3+3            | 2+2     | 1+1         | 8                   | 1             | 4       | 1                 | 2       | 1                   | 2       | 1                | 4       | 1           | 2 | 22            |
| 3              | 3                   | 3+3+3        | 3+3+3          | 2+2+2   | 1+1+1       | 12                  | 0             | 0       | 1                 | 2       | 1                   | 2       | 1                | 4       | 1           | 2 | 22            |
| 4              | 3                   | 3+3+3        | 3+3+3          | 2+2+2   | 1+1+1       | 12                  | 1             | 4       | 1                 | 2       | 1                   | 2       |                  |         | 1           | 2 | 22            |
| 5              | 3                   | 3+3+3        | 3+3+3          | 2+2+2   | 1+1+1       | 12                  | 2             | 8       | 1                 | 2       |                     |         |                  |         |             |   | 22            |
| 6              | 3                   | 3+3+3        | 3+3+3          | 2+2+2   | 1+1+1       | 12                  | 1             | 4       | Intr nsp          | 4       | 1                   | 2       |                  |         |             |   | 22            |
| Total after 3y | 16                  |              |                |         |             | 64                  | 6             | 24      | 5+I               | 10+4    | 5                   | 10      | 3                | 12      | 4           | 8 | 132           |
| 7 (Honors)     | 4                   | 3+3+3+3      | 3+3+3+3        | 2+2+2+2 | 1+1+1+1     | 16                  | 1             | 4       | 1                 | 2       |                     |         |                  |         |             |   | 22            |
| 8 (Honors)     | 4                   | 3+3+3+3      | 3+3+3+3        | 2+2+2+2 | 1+1+1+1     | 16                  | 1             | 4       | 1                 | 2       |                     |         |                  |         |             |   | 22            |
| 7 (Research)   | 3                   | 3+3+3        | 3+3+3          | 2+2+2   | 1+1+1       | 12                  | 1             | 4       | RP                | 6       |                     |         |                  |         |             |   | 22            |
| 8 (Research)   | 3                   | 3+3+3        | 3+3+3          | 2+2+2   | 1+1+1       | 12                  | 1             | 4       | RP                | 6       |                     |         |                  |         |             |   | 22            |
| Total after 4y | 24/22               |              |                |         |             | 96/88               | 8             | 32      | 7+I               | 18/26   | 5                   | 10      | 3                | 12      | 4           | 8 | 176           |

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**Semester - VII and Semester - VIII**

| <b>Evaluation Scheme for B.Sc. (Hons) Semester VII and VIII</b> |                           |                                                      |                   |                   |                  |                                       |                    |
|-----------------------------------------------------------------|---------------------------|------------------------------------------------------|-------------------|-------------------|------------------|---------------------------------------|--------------------|
| <b>Semester</b>                                                 | <b>Course Category</b>    | <b>Continuous and Comprehensive Evaluation (CCE)</b> |                   |                   | <b>Total CCE</b> | <b>Semester End Examination (SEE)</b> | <b>Grand Total</b> |
|                                                                 |                           | <b>CCE</b>                                           | <b>Assignment</b> | <b>Attendance</b> |                  |                                       |                    |
| VII                                                             | Major                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Major                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Major                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Major                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Minor                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Skill Enhancement Courses | 15                                                   | 5                 | 5                 | 25               | 25                                    | 50                 |
| VIII                                                            | Major                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Major                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Major                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Major                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Minor                     | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                 | Skill Enhancement Courses | 15                                                   | 5                 | 5                 | 25               | 25                                    | 50                 |

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**Semester - VII and Semester - VIII**

| <b>Evaluation Scheme for B.Sc. (Hons with Research) Semester VII and VIII</b> |                        |                                                      |                   |                   |                  |                                       |                    |
|-------------------------------------------------------------------------------|------------------------|------------------------------------------------------|-------------------|-------------------|------------------|---------------------------------------|--------------------|
| <b>Semester</b>                                                               | <b>Course Category</b> | <b>Continuous and Comprehensive Evaluation (CCE)</b> |                   |                   | <b>Total CCE</b> | <b>Semester End Examination (SEE)</b> | <b>Grand Total</b> |
|                                                                               |                        | <b>CCE</b>                                           | <b>Assignment</b> | <b>Attendance</b> |                  |                                       |                    |
| VII                                                                           | Major                  | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                               | Major                  | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                               | Major                  | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                               | Minor                  | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                               | Research Project       | 45                                                   | 20                | 10                | 75               | 75                                    | 150                |
| VIII                                                                          | Major                  | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                               | Major                  | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                               | Major                  | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                               | Minor                  | 30                                                   | 15                | 5                 | 50               | 50                                    | 100                |
|                                                                               | Research Project       | 45                                                   | 20                | 10                | 75               | 75                                    | 150                |

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**Semester - VII and Semester - VIII**

Semester wise course group wise Teaching Scheme (AY: 2026-27)

|                                                             | Group                                 | Subject Code | TITLE OF SUBJECT                              | CREDIT | TH (Hrs)   | PR (Hrs)   | Total credit |
|-------------------------------------------------------------|---------------------------------------|--------------|-----------------------------------------------|--------|------------|------------|--------------|
| <b>SEMESTER-7 (CS) Hons/Hons with Research minor in CSF</b> | Major                                 | BSCS11701    | Web Programming-I (TH)                        | 3      | 3          | -          | 3            |
|                                                             | Major                                 | BSCS11702    | Web Programming-I (PR)                        | 1      | -          | 2          | 1            |
|                                                             | Major                                 | BSCS11703    | Fundamental of Data Science (TH)              | 3      | 3          | -          | 3            |
|                                                             | Major                                 | BSCS11704    | Fundamental of Data Science (PR)              | 1      | -          | 2          | 1            |
|                                                             | Major                                 | BSCS11705    | Emerging Database Technologies (TH)           | 3      | 3          | -          | 3            |
|                                                             | Major                                 | BSCS11706    | Emerging Database Technologies (PR)           | 1      | -          | 2          | 1            |
|                                                             | Major                                 | BSCS11708    | Software Engineering Lab-I / Internship / OJT | 4      | -          | 8          | 4            |
|                                                             | Minor                                 | BSCS12702    | Information and Cyber Security - III          | 4      | 4          | -          | 4            |
|                                                             | SEC (Hons)                            | BSCS15702    | System Integration and Deployment             | 2      | 2          | -          | 2            |
|                                                             | Research Project (Hons with Research) | BSCS18701    | Research Project - I (TH)                     | 2      | 2          | -          | 2            |
|                                                             |                                       | BSCS18702    | Research Project - I (PR)                     | 4      | -          | 8          | 4            |
|                                                             |                                       |              | <b>Total Credit</b>                           |        |            |            | <b>22</b>    |
|                                                             |                                       |              | <b>Total Hours (15 Weeks)</b>                 |        | <b>225</b> | <b>210</b> |              |

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**Semester - VII and Semester - VIII**

|                                                              | Group                                 | TITLE OF SUBJECT | CREDIT                                      | CREDIT | TH (Hrs)   | PR (Hrs)   | Total credit |
|--------------------------------------------------------------|---------------------------------------|------------------|---------------------------------------------|--------|------------|------------|--------------|
| <b>SEMESTER-7 (CS) Hons/Hons with Research minor in AIDS</b> | Major                                 | BSCS11707        | Problem Solving in AI                       | 4      | 4          | -          | 4            |
|                                                              | Major                                 | BSCS11703        | Fundamental of Data Science (TH)            | 3      | 3          | -          | 3            |
|                                                              | Major                                 | BSCS11704        | Fundamental of Data Science (PR)            | 1      | -          | 2          | 1            |
|                                                              | Major                                 | BSCS11705        | Emerging Database Technologies (TH)         | 3      | 3          | -          | 3            |
|                                                              | Major                                 | BSCS11706        | Emerging Database Technologies (PR)         | 1      | -          | 2          | 1            |
|                                                              | Major                                 | BSCS11708        | Software Engineering Lab-I/Internship / OJT | 4      | -          | 8          | 4            |
|                                                              | Minor                                 | BSCS12701        | Distributed and Parallel Computing          | 4      | 4          | -          | 4            |
|                                                              |                                       | BSCS12703        | Web Programming-I (TH)                      | 3      | 3          | -          | 3            |
|                                                              |                                       | BSCS12704        | Web Programming-I (PR)                      | 1      | -          | 2          | 1            |
|                                                              | SEC (Hons)                            | BSCS15702        | System Integration and Deployment           | 2      | 2          | -          | 2            |
|                                                              | Research Project (Hons with Research) | BSCS18701        | Research Project - I (TH)                   | 2      | 2          | -          | 2            |
|                                                              |                                       | BSCS18702        | Research Project - I (PR)                   | 4      | -          | 8          | 4            |
|                                                              |                                       |                  | <b>Total Credit</b>                         |        |            |            | <b>22</b>    |
|                                                              |                                       |                  | <b>Total Hours (15 weeks)</b>               |        | <b>225</b> | <b>210</b> |              |

**SARVAJANIK UNIVERSITY**  
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**Semester - VII and Semester - VIII**

|                                                                | Group                                 | Subject Code | TITLE OF SUBJECT                               | CREDIT | TH (Hrs)   | PR (Hrs)   | Total credit |
|----------------------------------------------------------------|---------------------------------------|--------------|------------------------------------------------|--------|------------|------------|--------------|
| <b>SEMESTER-8 (CS) Hons/Honours with Research minor in CSF</b> | Major                                 | BSCS11801    | Web Programming-II (TH)                        | 3      | 3          | -          | 3            |
|                                                                | Major                                 | BSCS11802    | Web Programming-II (PR)                        | 1      | -          | 2          | 1            |
|                                                                | Major                                 | BSCS11803    | Advanced Cloud Programming (TH)                | 3      | 3          | -          | 3            |
|                                                                | Major                                 | BSCS11804    | Advanced Cloud Programming (PR)                | 1      | -          | 2          | 1            |
|                                                                | Major                                 | BSCS11805    | Advanced Mobile Application Development (TH)   | 3      | 3          | -          | 3            |
|                                                                | Major                                 | BSCS11806    | Advanced Mobile Application Development (PR)   | 1      | -          | 2          | 1            |
|                                                                | Major                                 | BSCS11811    | Software Engineering Lab-II / Internship / OJT | 4      | -          | 8          | 4            |
|                                                                | Minor                                 | BSCS12801    | Information and Cyber Security - IV            | 4      | 4          | -          | 4            |
|                                                                | SEC (Hons)                            | BSCS15802    | AI-Driven Development                          | 2      | 2          | -          | 2            |
|                                                                | Research Project (Hons with Research) | BSCS18801    | Research Project - II (TH)                     | 2      | 2          | -          | 2            |
|                                                                |                                       | BSCS18802    | Research Project - II (PR)                     | 4      | -          | 8          | 4            |
|                                                                |                                       |              | <b>Total Credit</b>                            |        |            |            | <b>22</b>    |
|                                                                |                                       |              | <b>Total Hours (15 weeks)</b>                  |        | <b>225</b> | <b>210</b> |              |

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**Semester - VII and Semester - VIII**

| <b>SEMESTER-8 (CS) Hons/Honours with Research minor in AIDS</b> | <b>Group</b>                          | <b>TITLE OF SUBJECT</b> | <b>CREDIT</b>                                  | <b>CREDIT</b> | <b>TH (Hrs)</b> | <b>PR (Hrs)</b> | <b>Total credit</b> |
|-----------------------------------------------------------------|---------------------------------------|-------------------------|------------------------------------------------|---------------|-----------------|-----------------|---------------------|
|                                                                 | Major                                 | BSCS11807               | Generative AI (TH)                             | 3             | 3               | -               | 3                   |
|                                                                 | Major                                 | BSCS11808               | Generative AI (PR)                             | 1             | -               | 2               | 1                   |
|                                                                 | Major                                 | BSCS11803               | Advanced Cloud Programming (TH)                | 3             | 3               | -               | 3                   |
|                                                                 | Major                                 | BSCS11804               | Advanced Cloud Programming (PR)                | 1             | -               | 2               | 1                   |
|                                                                 | Major                                 | BSCS11809               | Machine Learning (TH)                          | 3             | 3               | -               | 3                   |
|                                                                 | Major                                 | BSCS11810               | Machine Learning (PR)                          | 1             | -               | 2               | 1                   |
|                                                                 | Major                                 | BSCS11811               | Software Engineering Lab-II / Internship / OJT | 4             | -               | 8               | 4                   |
|                                                                 | Minor                                 | BSCS12804               | Web Programming-II (TH)                        | 3             | 3               | -               | 3                   |
|                                                                 |                                       | BSCS12805               | Web Programming-II (PR)                        | 1             | -               | 2               | 1                   |
|                                                                 | SEC (Hons)                            | BSCS15802               | AI-Driven Development                          | 2             | 2               | -               | 2                   |
|                                                                 | Research Project (Hons with Research) | BSCS18801               | Research Project - II (TH)                     | 2             | 2               | -               | 2                   |
|                                                                 |                                       | BSCS18802               | Research Project - II (PR)                     | 4             | -               | 8               | 4                   |
|                                                                 |                                       |                         | <b>Total Credit</b>                            |               |                 |                 | <b>22</b>           |
|                                                                 |                                       |                         | <b>Total Hours (15 weeks)</b>                  |               | <b>225</b>      | <b>210</b>      |                     |

**SARVAJANIK UNIVERSITY**  
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**B.Sc. (Honours) (Computer Science) /**  
**B.Sc. (Honours with Research) (Computer Science)**  
**Semester - VII and Semester - VIII**



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# **Faculty of Computer Science and Applications**

**B. Sc. (Honours) (Computer Science)**

**B.Sc. (Honours with Research)  
(Computer Science)**

## **SEMESTER- 7**

**DETAILED CURRICULUM**  
**(W.E.F. 2026-27)**

**SARVAJANIK UNIVERSITY**  
**FACULTY OF COMPUTER SCIENCE AND APPLICATIONS**  
**B.Sc. (Honours) (Computer Science) /**  
**B.Sc. (Honours with Research) (Computer Science)**  
**Semester - VII and Semester - VIII**

|                                                                                        |                                   |              |                                |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|--------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                        | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                        | 1                                                              |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From                 | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11701                         | Course Name  | Major: Web Programming -1 (TH) |                                                                |                                 |       |
|                                                                                        |                                   |              |                                |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                  | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 3                                                                                      | 3                                 | 0            | -                              | 50                                                             | 50                              | 100   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of the course is to equip students to develop professional web applications using the latest tools and technologies.                                                                                                                                                                                                                                                                                                                                            |
| Course Objective  | To provide an in-depth knowledge of the most recent server-side programming technology                                                                                                                                                                                                                                                                                                                                                                                      |
| Pre-requisite     | Basic understanding of Web, HTTP, HTML, JavaScript, and Basic Web Programming                                                                                                                                                                                                                                                                                                                                                                                               |
| Course Outcome    | After completion of this course, the student will be capable of developing.                                                                                                                                                                                                                                                                                                                                                                                                 |
| Course Content    | <p><b>Unit 1: MVC Architecture</b></p> <p>1.1 Introduction to MVC Framework</p> <p>1.2 Building an MVC page</p> <p>1.3 Web Page Routing</p> <p>1.4 Controller, Model, and View</p> <p>1.5 Data Access and Modelling</p> <p>1.6 CRUD operation in MVC</p> <p>1.7 Entity framework – ORM model</p> <p><b>Unit 2: Database Concepts</b></p> <p>2.1 Working with external Database</p> <p>2.2 Introduction to LINQ</p> <p>2.3 Lambda Expression</p> <p>2.4 Query Expression</p> |

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**Semester - VII and Semester - VIII**

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>2.5 Data Access with LINQ<br/>2.5.1 Introduction of LINQ<br/>2.5.2 LINQ to Dataset<br/>2.5.3 LINQ to SQL</p> <p><b>Unit 3: Web Application Security</b><br/>3.1 Authentication<br/>    3.1.1 Forms Authentication<br/>    3.1.2 Windows Authentication<br/>3.2 Authorization<br/>3.3 Role-Based Security<br/>3.4 SQL injection</p> <p><b>Unit 4: Working with E-mail</b><br/>4.1 Introduction<br/>4.2 SmtpClient Class<br/>    4.2.1 SmtpClient Class properties<br/>4.3 MailMessage Class<br/>4.4 Attachment Class</p> <p><b>Unit 5 Web Services</b><br/>5.1 Basic of Web Services<br/>5.2 Discovering Web Services Using UDDI<br/>5.3 Creating a Web Service<br/>5.4 Web Service Consumers<br/>5.5 Web Service using RESTful, Web Service SOAP</p> <p><b>Unit 6: Working with Web API</b><br/>6.1 Introduction to Web API<br/>6.2 Web API Controller<br/>6.3 Web API Routing<br/>6.4 Implementing Http Get Request, Http Put Request, Http Post Request,<br/>    and Http Delete Request</p> |
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|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Text and Reference Literature | <ol style="list-style-type: none"><li>1. Professional ASP.NET MVC 5 by Jon Galloway, Wrox, 2014</li><li>2. Pro ASP.NET MVC 5 Platform by Adam Freeman, Apress</li><li>3. Professional C# 7 and .NET Core 2.0 by Christian Nagel, Wrox / Wiley, 2018</li><li>4. C# 7 and .NET Core Cookbook by Dirk Strauss, O'Reilly / Packt Publishing Limited, 2017</li><li>5. Learning ASP.NET Core 2.0 by Jason De Oliveira and Michel Bruchet, Packt Publishing Ltd, 2017</li><li>6. Mastering ASP.NET Core 2.0 by Ricardo Peres, Packt Publishing Limited, 2017</li></ol> |
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|                                                                                               |                                   |                     |                                       |                                                                |                                        |              |
|-----------------------------------------------------------------------------------------------|-----------------------------------|---------------------|---------------------------------------|----------------------------------------------------------------|----------------------------------------|--------------|
| <b>Name of College:</b> Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |                     |                                       |                                                                |                                        |              |
| <b>Faculty</b>                                                                                | Computer Science and Applications |                     | <b>Program</b>                        | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                        |              |
| <b>Year</b>                                                                                   | 2026-27                           |                     | <b>Version</b>                        | 1                                                              |                                        |              |
| <b>Semester</b>                                                                               | 7                                 |                     | <b>Effective From</b>                 | June 2026                                                      |                                        |              |
| <b>Course Code</b>                                                                            | BSCS11702                         | <b>Course Name</b>  | <b>Major:</b> Web Programming -1 (PR) |                                                                |                                        |              |
|                                                                                               |                                   |                     |                                       |                                                                |                                        |              |
| <b>Teaching Scheme</b>                                                                        |                                   |                     |                                       | <b>Examination Scheme</b>                                      |                                        |              |
| <b>Credits</b>                                                                                | <b>Lecture (L)</b>                | <b>Tutorial (T)</b> | <b>Practical (P)</b>                  | <b>Continuous and Comprehensive Evaluation (CCE)</b>           | <b>Semester end examinations (SEE)</b> | <b>Total</b> |
| 1                                                                                             | 0                                 | 0                   | 2                                     | 25                                                             | 25                                     | 50           |

|                   |                                                                                                                                        |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of the course is to make students capable of developing professional web applications using latest tools and technologies. |
| Course Objective  | To provide an in-depth knowledge of most recent server-side programming technology                                                     |
| Pre-requisite     | Basic understanding of Web, HTTP, HTML, JavaScript, Basic Web Programming                                                              |
| Course Outcome    | After completion of this course, the student will be capable of developing.                                                            |
| Course Content    | The students will be required to carry out practical on ASP.NET with MVC and WebAPI concepts.                                          |
| Practical         | List of practical will be prepared at the beginning of each semester                                                                   |
| Reference Books   | As per paper Major – Web Programming-1                                                                                                 |

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|                                                                                        |                                  |              |                                          |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|----------------------------------|--------------|------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                  |              |                                          |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Application |              | Program                                  | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                          |              | Version                                  | 1                                                              |                                 |       |
| Semester                                                                               | 7                                |              | Effective From                           | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11703                        | Course Name  | Major: Fundamentals of Data Science (TH) |                                                                |                                 |       |
|                                                                                        |                                  |              |                                          |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                  |              |                                          | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                      | Tutorial (T) | Practical (P)                            | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 3                                                                                      | 3                                | 0            | -                                        | 50                                                             | 50                              | 100   |

|                          |                                                                                                                |
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| <b>Purpose of Course</b> | The purpose of the course is to make students capable for understanding fundamental knowledge of data science. |
|--------------------------|----------------------------------------------------------------------------------------------------------------|

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objective</b> | <ul style="list-style-type: none"> <li>◆ To learn about fundamentals of data science</li> <li>◆ To study various case studies of and implementation about data science.</li> </ul>                                                                                                                                                                                                                                                                                           |
| <b>Pre-requisite</b>    | Basic Concepts of Python Programming and Data Mining                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Outcome</b>   | After completion of this course, the student will be capable to develop models and implement predictive analytics on social media platforms                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Content</b>   | <b>Unit 1 Introduction to Data Science and Data-Analytics</b> <ul style="list-style-type: none"> <li>1.1 Problems, Data Opportunities and Solutions</li> <li>1.2 Data Science, Engineering, and Data-Driven Decision Making</li> <li>1.3 Data Processing and “Big Data”</li> <li>1.4 Data-Analytic Thinking</li> <li>1.5 Data Mining and Data Science</li> <li>1.6 Overview of the data science process</li> <li>1.7 Business Perspective of Data Science Project</li> </ul> |

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|  | <p><b>Unit 2 Data in Data Science</b></p> <ul style="list-style-type: none"><li>2.1 Defining Data Science</li><li>2.2 Facets of Data<ul style="list-style-type: none"><li>2.2.1. Structured data</li><li>2.2.2. Unstructured data</li><li>2.2.3. Natural language</li><li>2.2.4. Machine-generated data</li><li>2.2.5. Graph-based or network data</li><li>2.2.6. Audio, image, and video</li></ul></li><li>2.3 Understanding Data<ul style="list-style-type: none"><li>2.3.1 Types of Data Sources</li><li>2.3.2 Data Sampling</li><li>2.3.3 Types of Data Elements</li><li>2.3.4 Data quality checks</li></ul></li></ul> <p><b>Unit 3 Data Pre-processing</b></p> <ul style="list-style-type: none"><li>3.1 Data Extraction- text, excel, csv</li><li>3.2 Cleansing, integrating, and transforming data, Cleansing data</li><li>3.3 Missing values, outlier detection and treatment</li><li>3.4 Combining data from different data sources</li><li>3.5 Transforming data</li></ul> <p><b>Unit 4 Exploratory Data Analysis</b></p> <ul style="list-style-type: none"><li>4.1 Defining Descriptive Statistics for Numeric Data</li><li>4.2 Analyzing Categorical Data</li><li>4.3 Co-relation Analysis</li><li>4.4 Modifying Data Distribution</li></ul> <p><b>Unit 5 Data Visualization and Analytics</b></p> <ul style="list-style-type: none"><li>5.1 Application of Visual Analytics</li><li>5.2 Understanding graphs<ul style="list-style-type: none"><li>5.2.1 Heat Maps</li><li>5.2.2 Time Series Plots</li><li>5.2.3 Box Plots</li><li>5.2.4 Network Graphs</li><li>5.2.5 Spatial Data Mapping</li></ul></li></ul> <p><b>Unit 6 Data Modelling</b></p> <ul style="list-style-type: none"><li>6.1 Introduction to Predictive Models</li><li>6.2 Types of Predictive Models<ul style="list-style-type: none"><li>6.2.1 Classification Model</li><li>6.2.2 Regression Model</li></ul></li></ul> |
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|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | 6.2.3 Time Series Model<br>6.2.4 Cluster Model<br>6.3 Modeling Process<br>6.4 Real-world application                                                                                                                                                                                                                                                                                                                                                                                       |
| Text and Reference Literature | <ol style="list-style-type: none"><li>1. Introducing Data Science - Big data, machine learning, and more, using Python tools</li><li>2. Analytics in a Big Data World - Bart Baesens, Wiley Publications</li><li>3. Python Data Science FOR Dummies - John Paul Mueller, Luca Massaron - Wiley Publication</li><li>4. Data Science for Business, Tom Fawcett, Foster Provost , O'relly Publication</li><li>5. Python Data Science Handbook, Jake VanderPlas, O'relly Publication</li></ol> |

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|                                                                                        |                                   |              |                                          |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                          |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                  | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                  | 1                                                              |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From                           | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11704                         | Course Name  | Major: Fundamentals of Data Science (PR) |                                                                |                                 |       |
|                                                                                        |                                   |              |                                          |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                          | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                            | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 1                                                                                      | 0                                 | 0            | 2                                        | 25                                                             | 25                              | 50    |

|                   |                                                                                                                                                                                                                                                      |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | To provide students with a fundamental understanding of data science concepts, techniques, and their applications in data-driven problem solving.                                                                                                    |
| Course Objective  | To introduce the fundamental concepts of data science, develop analytical skills, and enable students to apply basic data science techniques using appropriate tools.                                                                                |
| Pre-requisite     | Basic knowledge of Python Programming.                                                                                                                                                                                                               |
| Course Outcome    | After successful completion of this course, the student will be able to understand the fundamental concepts of data science, analyze and interpret data, and apply basic data science techniques to solve real-world problems.                       |
| Course Content    | The course covers the fundamentals of data science, including the data science process, data types, data preprocessing, exploratory data analysis, data visualization, and introductory predictive modelling techniques with practical applications. |
| Practical         | List of practical will be prepared at the beginning of each semester                                                                                                                                                                                 |
| Reference Books   | As per paper Major – Fundamental of Data Science (Th)                                                                                                                                                                                                |

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|----------------------------------------------------------------------------------------|-----------------------------------|--------------|--------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                            |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                    | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                    | 1                                                              |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From                             | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11705                         | Course Name  | Major: Emerging Database Technologies (TH) |                                                                |                                 |       |
|                                                                                        |                                   |              |                                            |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                            | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                              | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 3                                                                                      | 3                                 | 0            | -                                          | 50                                                             | 50                              | 100   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of the course is to give students practical, up-to-date exposure to the databases used in modern web application development and AI/data applications — spanning relational, document, key-value, and vector databases — along with the ORMs/ODMs developers use in production.                                                                                                                                                                                                                                                                                                                            |
| Course Objective  | To provide fundamental, hands-on knowledge of modern databases: designing schemas, storing and querying data, connecting databases to applications through ORMs/ODMs, using cloud/managed database services, and understanding how AI applications use vector databases.                                                                                                                                                                                                                                                                                                                                               |
| Pre-requisite     | Basic understanding of database concepts and elementary programming (JavaScript/Node.js familiarity is helpful but not mandatory).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Course Outcome    | <p>After completing this course, a learner will be able to:</p> <ul style="list-style-type: none"> <li>• Choose the right type of database (relational, document, key-value, or vector) for a given requirement.</li> <li>• Perform CRUD operations on PostgreSQL, MongoDB, Redis, and a vector database.</li> <li>• Connect databases to a web application using Sequelize (ORM) and Mongoose (ODM).</li> <li>• Use cloud/managed database services where appropriate (MongoDB Atlas, Redis Cloud).</li> <li>• Build a simple AI application (Retrieval-Augmented Generation) backed by a vector database.</li> </ul> |

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|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Content | <p><b>Unit 1: Database Foundations &amp; the Modern Database Landscape</b></p> <p>1.1 Types of Database Systems: Relational and Non-relational (NoSQL)</p> <p>1.2 Why NoSQL Emerged: Scalability, flexible data models, and modern web applications</p> <p>1.3 CAP Theorem: Consistency, Availability, and Partition Tolerance</p> <p>1.4 ACID vs. BASE: Strong consistency and eventual consistency</p> <p>1.5 Choosing the Right Database</p> <p>1.6 Modern Database Landscape: Local databases, MongoDB Atlas, Redis Cloud, and Firebase</p> <p>1.7 Emerging Database Technologies: Neo4j, InfluxDB, and Elasticsearch</p> <p>1.8 Common Data Formats: JSON, key-value, documents, and vectors</p> <p><b>Unit 2: Modern Relational Databases with PostgreSQL</b></p> <p>2.1 Introduction to PostgreSQL: Open-source architecture, powerful features, and web-ready capabilities</p> <p>2.2 SQL Refresher: CREATE, INSERT, SELECT, JOIN, WHERE, and GROUP BY</p> <p>2.3 Keys and Relationships: Primary key, foreign key, one-to-many, and many-to-many relationships</p> <p>2.4 PostgreSQL Features: JSON and JSONB data types</p> <p>2.5 PostgreSQL Installation and Setup: Installing PostgreSQL, using psql and pgAdmin, and connecting to a local database</p> <p>2.6 Sequelize ORM (Node.js): ORM concepts, models, migrations, associations (hasMany and belongsTo), and CRUD operations</p> <p><b>Unit 3: Document Databases with MongoDB</b></p> <p>3.1 The Document Data Model: Collections, documents, BSON, and JSON</p> <p>3.2 Advantages of Document Databases: Flexible schema, nested data, and rapid Prototyping</p> <p>3.3 MongoDB Atlas: Working with the free cloud tier</p> <p>3.4 CRUD Operations: Insert, find with filters, update, and delete</p> <p>3.5 Indexing: Improving query performance</p> <p>3.6 Data Modelling: Embedding and referencing</p> <p>3.7 Mongoose ODM (Node.js): Schemas, models, validation, and CRUD Operations</p> <p><b>Unit 4: Key-Value Stores and Caching with Redis</b></p> <p>4.1 Introduction to Key-Value Stores</p> <p>4.2 Redis In-Memory Architecture</p> |
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|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <p>4.3 Redis Data Types: Strings, hashes, lists, and sets</p> <p>4.4 Essential Redis Commands: SET, GET, EXPIRE, and DEL</p> <p>4.5 Applications of Redis: Caching, session storage, rate limiting, and counters</p> <p>4.6 Redis as a Cache Layer</p> <p>4.7 Redis Cloud: Basic deployment and usage</p> <p><b>Unit 5: AI-Era Databases – Vector Databases</b></p> <p>5.1 AI and Semantic Search</p> <p>5.2 Vectors and Embeddings: Representation of text and images as numerical Vectors</p> <p>5.3 Embeddings in Practice</p> <p>5.4 Distance Metrics: Cosine similarity, Euclidean distance, and dot product</p> <p>5.5 Vector Indexing: Brute-force search, Approximate Nearest Neighbour (ANN), and HNSW (awareness only)</p> <p><b>Unit 6: Working with Vector Databases</b></p> <p>6.1 Hands-on with Chroma: Creating collections, storing embeddings, similarity search, and metadata filtering</p> <p>6.2 Mini Project – Chat with Your PDF (RAG): Loading a PDF, chunking, embedding, storing in Chroma, retrieval, and response generation</p> |
| Text and Reference Literature | <ol style="list-style-type: none"> <li>1. PostgreSQL: Up and Running — Regina Obe &amp; Leo Hsu, O'Reilly</li> <li>2. MongoDB: The Definitive Guide — Bradshaw, Brazil &amp; Chodorow, O'Reilly</li> <li>3. NoSQL for Mere Mortals® — Dan Sullivan, O'Reilly</li> <li>4. Official documentation: PostgreSQL, MongoDB Atlas, Redis, Sequelize, Mongoose, Chroma</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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|----------------------------------------------------------------------------------------|-----------------------------------|--------------|--------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                            |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                    | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                    | 1                                                              |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From                             | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11706                         | Course Name  | Major: Emerging Database Technologies (PR) |                                                                |                                 |       |
|                                                                                        |                                   |              |                                            |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                            | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                              | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 1                                                                                      | 0                                 | 0            | 2                                          | 25                                                             | 25                              | 50    |

|                   |                                                                                                                                                                                                                                                                  |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of this course is to provide practical knowledge of advanced database technologies, enabling students to design, analyze, visualize, and implement data-driven solutions using modern database and analytics techniques.                             |
| Course Objective  | To introduce relational, NoSQL, in-memory, and vector databases, and enable students to understand their architecture, features, and practical applications in modern software development.                                                                      |
| Pre-requisite     | Basic knowledge of Database Management Systems (DBMS) and SQL.                                                                                                                                                                                                   |
| Course Outcome    | After successful completion of this course, the student will be able to understand modern database technologies, select appropriate database solutions for different applications, and implement basic operations using relational, NoSQL, and vector databases. |
| Course Content    | The course covers the fundamentals of modern database technologies, including relational and NoSQL databases, document and key-value stores, PostgreSQL, MongoDB, Redis, vector databases, and their applications in scalable systems and AI-driven solutions.   |
| Practical         | List of practical will be prepared at the beginning of each semester                                                                                                                                                                                             |
| Reference Books   | As per paper Major – Emerging Database Technologies (TH)                                                                                                                                                                                                         |

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|----------------------------------------------------------------------------------------|-----------------------------------|--------------|------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                              |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                      | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                      | 1                                                              |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From               | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11707                         | Course Name  | Major: Problem Solving in AI |                                                                |                                 |       |
|                                                                                        |                                   |              |                              |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                              | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 4                                                                                      | 4                                 | 0            | -                            | 50                                                             | 50                              | 100   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | To identify problems, formulate state spaces, problem solving strategies and familiar with knowledge inference, handling uncertain knowledge.<br>Also familiar with various decision making framework, AI Ethics, Advanced AI and various emerging applications of AI                                                                                                                                                                                                                                                   |
| Course Objective  | <ul style="list-style-type: none"> <li>● To enable the student to understand techniques of capturing and generating knowledge.</li> <li>● To enable the student to understand knowledge representation methodologies and Handling Uncertain Knowledge.</li> <li>● To enable the student to understand Knowledge integration techniques in AI</li> <li>● To enable the student to understand Emerging Applications of AI</li> <li>● To enable the student to understand overview of AI Ethics and Advanced AI</li> </ul> |
| Pre-requisite     | Awareness about basic math, programming skills, and data handling.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Course Outcome    | identify problems, formulate state spaces, problem solving strategies and familiar with knowledge inference, handling uncertain knowledge.<br>Also familiar with various decision making framework, AI Ethics, Advanced AI and various emerging applications of AI                                                                                                                                                                                                                                                      |

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| Course Content | <p><b>Unit 1: Introduction to AI</b></p> <ul style="list-style-type: none"> <li>1.1 Fundamentals of AI: Definitions, history, key concepts</li> <li>1.2 Decision-making frameworks: Rationality, bounded rationality, intuition</li> <li>1.3 The role of AI in decision making: Opportunities and challenges</li> <li>1.4 Sensors, Actuators, Agent Program</li> <li>1.5 Learning Agents</li> </ul> <p><b>Unit 2: Problem Solving Strategies</b></p> <ul style="list-style-type: none"> <li>2.1 Search based Problem Solving</li> <li>2.2 Constraint Satisfaction Problems (CSP)</li> <li>2.3 Optimization and Search Approaches: Linear Programming, Genetic Algorithms, and Simulated Annealing</li> <li>2.4 Game-Playing and Adversarial Search</li> </ul> <p><b>Unit 3: Knowledge Inference</b></p> <ul style="list-style-type: none"> <li>3.1 Role of Knowledge and Reasoning - Logical Agent</li> <li>3.2 Knowledge Base, Models, and Knowledge-Based Agents;</li> <li>3.3 Propositional Logic Knowledge Representation Language - Syntax and Semantics</li> <li>3.4 Logical Reasoning: Entailment and Inference (soundness, completeness)</li> </ul> <p><b>Unit 4: Handling Uncertain Knowledge</b></p> <ul style="list-style-type: none"> <li>4.1 Understanding Uncertain Domains</li> <li>4.2 Representing and Reasoning with Uncertain Knowledge</li> <li>4.3 Probability, connection to logic, independence, Bayes rule,</li> <li>4.4 Bayesian networks and probabilistic inference</li> <li>4.5 Fuzzy Logic and Approximate Reasoning</li> <li>4.6 Overview of Advanced Uncertainty Frameworks - Dempster-Shafer Theory, Belief Network</li> </ul> <p><b>Unit 5: Knowledge integration techniques in AI</b></p> <ul style="list-style-type: none"> <li>5.1 Ontologies, Semantic Networks</li> <li>5.2 Knowledge Graphs</li> <li>5.3 Conceptual Graphs</li> <li>5.4 New Techniques - RAG, Neuro Symbolic AI</li> <li>5.5 Continuous Learning (Incremental Knowledge), Ensemble Methods</li> </ul> <p><b>Unit 6: Decision Making Frameworks and Theories</b></p> <ul style="list-style-type: none"> <li>6.1 Model-Based and Algorithmic Frameworks</li> </ul> |
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|                               | <p>6.2 Human-in-the-Loop (HITL) Frameworks<br/> 6.3 Agentic AI &amp; Rules-Based Frameworks<br/> 6.4 Governance &amp; Ethical Frameworks<br/> 6.5 Basics of utility theory, decision theory, sequential decision problems,</p> <p><b>Unit 7: Emerging Applications of AI</b><br/> 7.1 AI in healthcare: Diagnosis, treatment, and medical imaging,<br/> 7.2 AI in finance: Fraud detection, algorithmic trading, and risk assessment,<br/> 7.3 AI in transportation: Autonomous vehicles and traffic optimization,<br/> 7.4 AI in customer service and chatbots, AI in education<br/> 7.5 Personalized learning and intelligent tutoring systems</p> <p><b>Unit 8 : AI Ethics and Advanced AI</b><br/> 8.1 Fairness in AI<br/> 8.2 Explainability in AI<br/> 8.3 Strategic AI<br/> 8.4 Knowledge Mining and Responsible AI</p>                                                                                                               |
| Text and Reference Literature | <ol style="list-style-type: none"> <li>1. A First Course in Artificial Intelligence by Deepak Khemani, McGrawHill, ISBN :978-1-25-902998-1</li> <li>2. Introduction to Artificial Intelligence and Expert System by Dan W. Patterson, PHI, ISBN : 978-93-325-5194-7</li> <li>3. Artificial Intelligence –A Modern Approach (2nd Edition 2004) by Stuart J. Russell and Peter Norvig, Pearson Education, ISBN: 978-81-775-8367-0</li> <li>4. Introduction to Artificial Intelligence by Rajendra Akerkar, PHI, ISBN : 978- 81-203-2864-8</li> <li>5. Artificial Intelligence -Structures and Strategies for Complex Problem Solving (4thEdition 2004) by George F. Luger, Pearson Education</li> <li>6. Foundation of Artificial Intelligence and Expert Systems by V.S. Janakiraman, K.Sarukesi, P. Gopalakrishnan, Mc Millan (2002)</li> <li>7. “Artificial Intelligence For Dummies (2nd Edition)”, Luca Massaron, John Mueller</li> </ol> |

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|----------------------------------------------------------------------------------------|-----------------------------------|--------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                                       |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                               | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                               | 1                                                              |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From                                        | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS15701                         | Course Name  | Major: Software Engineering Lab – I/ Internship / OJT |                                                                |                                 |       |
|                                                                                        |                                   |              |                                                       |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                                       | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                                         | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 4                                                                                      | 0                                 | 0            | 8                                                     | 50                                                             | 50                              | 100   |

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| Purpose of Course | To provide hands-on experience in analysing real-world problems and systematically developing appropriate computing solutions through requirement analysis, modelling, design, development, testing, integration, and deployment/evaluation. The course enables students to apply suitable software engineering, data, artificial intelligence, security, and system/architecture concepts according to the nature of the selected problem.                                                                                                                                                                                                                                                                                                                                                                                     |
| Course Objective  | <ul style="list-style-type: none"> <li>To analyse real-world problems and identify their requirements, scope, constraints, and objectives.</li> <li>To select and justify appropriate models, methodologies, frameworks, architectures, and tools for a given problem.</li> <li>To design requirements, data, interfaces, system components, and behavioural models using appropriate modelling techniques.</li> <li>To develop and configure basic and detailed solutions using suitable programming languages, software platforms, tools, and frameworks.</li> <li>To apply appropriate testing, validation, evaluation, and performance assessment techniques to the developed solution.</li> <li>To integrate, package, and deploy/implement the developed solution and evaluate its system-level functionality.</li> </ul> |

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| Pre-requisite  | <p>Students should have basic knowledge of programming fundamentals and problem-solving techniques.</p> <p>fundamentals of database and data management, basic software engineering and system development concepts, basic knowledge of computer networks and operating systems, fundamental concepts of data analysis, artificial intelligence, or security, as applicable to the selected problem.</p> <p>Familiarity with basic development and modelling tools.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Course Outcome | <p>After successful completion of the course, students will be able to:</p> <ul style="list-style-type: none"> <li>Analyse a real-world problem and identify its requirements, scope, constraints, and objectives.</li> <li>Select and justify suitable models, methodologies, frameworks, architectures, and techniques for solving a given problem.</li> <li>Design requirements, data, interfaces, system components, and behavioural models using appropriate tools and techniques.</li> <li>Develop and configure appropriate software solutions, computational models, AI models, security solutions, or system architectures based on the identified requirements.</li> <li>Perform unit testing, model validation, system evaluation, integration testing, and other appropriate testing techniques.</li> <li>Integrate, implement, and evaluate the developed solution based on relevant functional, performance, usability, accuracy, security, or other quality requirements.</li> </ul> |
| Course Content | <p><b>Practical 1: Problem Statement and Process Selection (4 hrs)</b><br/> <b>Aim:</b> To analyse a real-world problem statement and select a suitable model with proper justification.<br/> <b>Description:</b><br/> a) Define a requirement/ problem (e.g., Online Library Management System, Mover Recommendation System, Security detection and protection, cloud or network system &amp;/or architecture etc.).<br/> b) Document the scope, operational constraints, and objectives. Choose appropriate models (SDLC models, ML Models, Security models, frameworks, architectures etc) and justify why a specific approach fits the chosen problem.</p> <p><b>Practical 2: Requirement Specification (8 hrs)</b><br/> <b>Aim:</b> To prepare a complete Requirement document for the chosen problem.<br/> <b>Description:</b></p>                                                                                                                                                            |

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|  | <p>a) Prepare detailed requirement list, gaps, model limitations and prepare a complete requirement document (Data Flow Diagrams, ER Diagrams, Use Case Diagrams, Class Diagrams, comparative study of existing frameworks, models and methods/techniques etc.) using appropriate software tools.</p> <p><b>Practical 3: Data Design and Interface Design (8 hrs)</b><br/> <b>Aim:</b> To design data and Human interaction appropriate to problem and requirements.<br/> <b>Description:</b><br/> a) Design Database (tables, relationships, constraints, keys etc.) /Data source (dataset, attributes, features, EDA etc.) using appropriate software tools.<br/> b) Design interface (Inputs, Outputs, Dashboards, Data Visualizations, interaction panels etc.) using appropriate Software Tools.</p> <p><b>Practical 4: Designing Interaction and Behavioural Models (8 hrs)</b><br/> <b>Aim:</b> To design various models indicating system component interactions and behaviour appropriate for the problem and requirements.<br/> <b>Description:</b><br/> Design various system diagrams (like Sequence Diagram, Activity Diagram, StateChart Diagram, Deployment Diagrams, System Flowchart etc.) / component interactions in models/framework/system/architecture using appropriate software Tools.</p> <p><b>Practical 5: Basic Solution design &amp;/or development Software Coding of core functionality/ Model Development/System/Architecture Design) (20-24 hrs)</b><br/> <b>Aim:</b> Design &amp;/or Development &amp;; testing (of Core functionalities/Admin Modules or Training, evaluation &amp;; configuration of Core AI / Security model or system &amp;/or architecture design etc.) of the basic/initial solution appropriate for the problem and requirements.<br/> <b>Description:</b><br/> a) Design &amp;/or Development (of Core functionalities/Admin Modules or Training, evaluation &amp;; configuration of Core AI / Security model or system &amp;/or architecture design etc.) of the required solution appropriate for the problem and requirements using appropriate software platforms, tools, programming &amp;/or scripting language etc.<br/> b) Perform Unit Testing/model validation/architecture evaluation etc. of the basic/initial solution.</p> <p><b>Practical 6: Detailed Solution design &amp;/or development Software Coding of core functionality/ Model Development/System/Architecture Design) (40-45 hrs)</b></p> |
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|  | <p><b>Aim:</b> Design &amp;/or Development &amp;; testing/evaluation (of Core functionalities/Admin Modules or Training, evaluation &amp;; configuration of Core AI / Security model or system &amp;/or architecture design etc.) of the detailed solution appropriate for the problem and requirements.</p> <p><b>Description:</b></p> <p>a) Design &amp;/or Development &amp; testing (of Detailed functionalities/Admin Modules or Training, evaluation &amp;; configuration of detailed AI / Security model or system &amp;/or architecture design etc.) of the required solution appropriate for the problem and requirements. using appropriate software platforms, tools, programming &amp;/or scripting language etc.</p> <p>b) Perform Unit Testing/model validation/architecture evaluation etc. of the detailed solutions.</p> <p><b>Practical 7: Integration and Detailed Testing/evaluation (8-12 hrs.)</b></p> <p><b>Aim:</b> To integrate already designed &amp;/or developed components (e.g. software modules, models, framework, system, architecture etc.) and perform integration testing / evaluation.</p> <p><b>Description:</b></p> <p>a) Integrate already designed &amp;/or developed components (e.g. software modules, models, framework, system, architecture etc.).</p> <p>b) Perform Integration Testing of already designed &amp;/or developed components (e.g. software modules, models, framework, system, architecture etc.).</p> <p><b>Practical 8: Packaging, Deployment and system level testing (8-12 hrs.)</b></p> <p><b>Aim:</b> To deploy/host/upload/ implement the developed solution (software/ webapp /mobile app, model, framework, architecture, system etc) and test the deployment.</p> <p><b>Description:</b></p> <p>a) To deploy/host/upload/ implement the developed solution (software/ webapp /mobile app, model, framework, architecture, system etc) in user/client/ customer environment.</p> <p>b) Perform system and User - acceptance testings/ evaluation (like security testing, load testing, stress testing, usability testing, accuracy, precision etc.)</p> |
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|----------------------------------------------------------------------------------------|-----------------------------------|--------------|---------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                             |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                     | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                     | 1                                                              |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From                              | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS12702                         | Course Name  | Minor: Information and Cyber Security - III |                                                                |                                 |       |
|                                                                                        |                                   |              |                                             |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                             | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                               | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 4                                                                                      | 4                                 | 0            | -                                           | 50                                                             | 50                              | 100   |

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| Purpose of Course | Conceptualize the students with the theoretical concepts of Cyber Security                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Course Objective  | Familiarization with different objectives of cyber security components like identity theft, different hacking techniques used for different purposes. Different mobile and cloud security components are also covered.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Pre-requisite     | Basic knowledge of Information security, computer network and operating systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Course Outcome    | <ol style="list-style-type: none"> <li>1. Get familiar with different terminologies of cyber security</li> <li>2. Get aware with different techniques of identity theft</li> <li>3. Gaining detail knowledge to support activities associated with mobile and cloud security</li> </ol>                                                                                                                                                                                                                                                                                                                                                   |
| Course Content    | <p><b>Unit 1: Introduction</b></p> <ol style="list-style-type: none"> <li>1.1 Introduction &amp; defining the cyber security challenges</li> <li>1.2 Ethical hacking</li> <li>1.3 Frauds in IT, Banking, Mobile network, telecommunications</li> <li>1.4 Frauds in Software development and management</li> <li>1.5 Types of Areas in Cyber Security</li> </ol> <p><b>Unit 2: Basics of cyber security</b></p> <ol style="list-style-type: none"> <li>2.1 Pathway of Cyber Security</li> <li>2.2 Classification of cyber crime</li> <li>2.3 Provision of IT Act -2000 and its amendment</li> <li>2.4 Careers in cyber security</li> </ol> |

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|  | <p><b>Unit 3: Identity theft</b></p> <p>3.1 Phishing</p> <p>3.1.1 Phishing</p> <p>3.1.2 Methods and techniques of phishing</p> <p>3.1.3 Types of phishing scam</p> <p>3.1.4 Phishing counter measures</p> <p>3.1.5 Mishing, smishing and vishing</p> <p>3.2 Identity theft</p> <p>3.2.1 Assumption of Identity</p> <p>3.2.2 Credit Identity theft</p> <p>3.2.3 Virtual Identity theft</p> <p>3.2.4 Criminal Record Identity theft/fraud</p> <p>3.3 Physical Method of Identity theft</p> <p>3.3.1 Mail theft</p> <p>3.3.2 Dumpster diving</p> <p>3.3.3 Theft of computer</p> <p>3.3.4 Bag operations</p> <p>3.3.5 Child Identity theft</p> <p>3.3.6 Insiders</p> <p>3.3.7 Fraudulent or fictitious companies</p> <p>3.3.8 Card skimming, ATM manipulation and fraudulent machines</p> <p>3.4 Theft of Intellectual Property</p> <p>3.4.1 Software piracy</p> <p>3.4.2 Film and music piracy</p> <p><b>Unit 4: Different attack</b></p> <p>4.1 Password cracking</p> <p>4.1.1 Online and offline attack</p> <p>4.1.2 Brute force attack</p> <p>4.1.3 Strong, weak and random password</p> <p>4.1.4 Dictionary attack</p> <p>4.2 Key logger and spywares</p> <p>4.2.1 Hardware and software loggers</p> <p>4.2.2 Anti key logger</p> <p>4.2.3 Spywares</p> <p><b>Unit 5. Different attack techniques</b></p> <p>5.1 DOS and DDOS attacks</p> <p>5.1.1 Classification of DOS attacks</p> <p>5.1.2 Types / levels of DOS attacks</p> |
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|                               | <p>5.1.3 Tools used to launch DOS attacks</p> <p>5.1.4 DDOS attacks</p> <p>5.1.5 Protect from DOS Attacks</p> <p>5.2 SQL Injection</p> <p>5.2.1 Steps for SQL Injection</p> <p>5.2.2 How to prevent from SQL Injection attacks</p> <p>5.2.3 Tools used for SQL server penetration.</p> <p>5.2.4 Buffer overflow - types and minimize the attack.</p> <p>5.3 Botnets and Zombie armies</p> <p>5.4 Cyber terrorism and organized crime</p> <p><b>Unit 6: Introduction to Computer forensics</b></p> <p>6.1 Computer forensic</p> <p>6.2 Computer forensic applications</p> <p>6.3 Forensic services</p> <p>6.4 Types of forensic technology</p> <p>6.5 Benefits of professional forensic methodology</p> <p><b>Unit 7: Electronic evidence collection</b></p> <p>7.1 Alternative methods for accessing data</p> <p>7.2 Collecting digital evidence data</p> <p>7.3 Digital evidence processing and investigation</p> <p>7.4 Evidence preservation</p> <p><b>Unit 8: Electronic evidence processing</b></p> <p>8.1 Evidence data analysis</p> <p>8.2 Evidence data documentation</p> <p>8.3 Database forensic</p> <p>8.4 Web attack forensic</p> <p>8.5 Evidence presentation</p> |
| Text and Reference Literature | <ol style="list-style-type: none"> <li>1. Cyber security, Nina Godbole, Sunit Belapure, Wiley</li> <li>2. Computer Forensics – Computer Crime scene investigation by John RVacca, Firewallmedia publication</li> <li>3. Computer forensics and cybercrime – an introduction 3rd edition, Marjie T. Britz, Pearson</li> <li>4. Build your own security lab, Michael Gregg, Wiley India</li> <li>5. Introduction to computer security by Matt Bishop</li> <li>6. Cryptography and network security by William Stalling</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**Name of College:** Shree Ramkrishna Institute of Computer Education and Applied Sciences

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|                 |                                   |              |                                           |                                                                |                                 |       |
|-----------------|-----------------------------------|--------------|-------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Faculty         | Computer Science and Applications |              | Program                                   | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year            | 2026-27                           |              | Version                                   | 1                                                              |                                 |       |
| Semester        | 7                                 |              | Effective From                            | June 2026                                                      |                                 |       |
| Course Code     | BSCS12701                         | Course Name  | Minor: Distributed and Parallel Computing |                                                                |                                 |       |
|                 |                                   |              |                                           |                                                                |                                 |       |
| Teaching Scheme |                                   |              |                                           | Examination Scheme                                             |                                 |       |
| Credits         | Lecture (L)                       | Tutorial (T) | Practical (P)                             | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 4               | 4                                 | 0            | -                                         | 50                                                             | 50                              | 100   |

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| Purpose of Course | To provide students with the fundamental concepts, architectures, and programming techniques of distributed and parallel computing systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Course Objective  | <ul style="list-style-type: none"> <li>Understand the principles and architecture of distributed and parallel systems.</li> <li>Learn resource management, communication, synchronization, and security mechanisms.</li> <li>Explore programming models and applications of distributed and parallel computing.</li> <li>Apply distributed and parallel computing concepts to solve real-world problems.</li> </ul>                                                                                                                                                                                                                                              |
| Pre-requisite     | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Outcome    | At the end of the course, students will be able to understand the concepts of distributed and parallel computing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Course Content    | <p><b>Unit 1: Introduction to Distributed Systems</b></p> <p>1.1 Various Systems and Services – Email and Messaging Services, The World Wide Web (WWW), Social Networking Services, News Services, Remote Login and File Transfer, Multimedia Transfer</p> <p>1.2 Distributed Computation – Distributed Computation Model, Distributed Transaction Processing and E-Commerce, Distributed Real-Time Processing</p> <p>1.3 Issues in Distributed Systems – Naming, Sharing, Availability and Reliability, Replication, Privacy and Security, Communication, Concurrency and Synchronization, Time and Coordination, Fault Tolerance and Recovery, Scalability</p> |

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|  | <p><b>Unit 2: Software and Network Architecture for Distributed Systems</b></p> <p>2.1 Software Architecture</p> <p>2.1.1 Cooperating Processes and Process Groups – Group Membership and Message Delivery</p> <p>2.1.2 Client–Server and Peer-to-Peer Communication</p> <p>2.1.3 Component Models, Components and Frameworks</p> <p>2.1.4 Web Services</p> <p>2.2 Network Architecture</p> <p>2.2.1 Functions of Layers in the OSI Reference Model</p> <p>2.2.2 Interconnection Networks for Computer Clusters – Time-Shared or Common Bus, Crossbar Switch, Multistage Networks, Nearest Neighbour Mesh, Cube Network</p> <p><b>Unit 3: Managing Distributed Resources</b></p> <p>3.1 Resource Naming and Addressing – Name Servers, Domain Name System (DNS) and Directory Services</p> <p>3.2 Resource Sharing – Sharing Primary Memory, Distributed Shared Memory (DSM), Page-Based DSM, Logical DSM</p> <p>3.3 Managing Resource Availability and Reliability – Concerns in LAN and WAN, Processor and Memory Upgrades, Software Design</p> <p>3.4 Resource Replication – Replicas as Members of a Group, Reliability of Message Delivery, Message Ordering</p> <p>3.5 Managing Privacy and Security – Cryptography, Kerberos and Other Security Mechanisms</p> <p><b>Unit 4: Accessing Distributed Resources</b></p> <p>4.1 Communication over Distributed Resources – Remote Procedure Call (RPC), ] Message Passing, Sockets and Streams</p> <p>4.2 Concurrency while Accessing Distributed Resources – Distributed Deadlock and Replica Control</p> <p>4.3 Coordination of Distributed Resources – Logical and Physical Clocks</p> <p>4.4 Fault Tolerance and Recovery – Lost Messages, Failed Nodes, Network Partitioning</p> <p>4.5 Transaction Management – Concurrent Transactions, Atomic Transactions, Nested Transactions, BASE Methodology</p> <p><b>Unit 5: Major Application Areas and Examples</b></p> <p>5.1 Distributed File Systems – File Servers, File Sharing in Peer-to-Peer Systems, Network File System (NFS), Coda File System and Google File System (GFS)</p> <p>5.2 Distributed Database Systems – Need and Problems/Issues, Parameters for</p> |
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|  | <p>Distribution of Database, DDBMS Structure, Queries and Updates in DDBMS, DDBMS Support in Microsoft SQL Server and Oracle</p> <p>5.3 Distributed Operating Systems – Network Operating Systems and Distributed Operating Systems, DOS Goals and Design Issues, DOS Examples – Apache Server and ZooKeeper, Amoeba, Mach and Windows NT Family</p> <p>5.4 Distributed Computation Systems and Grid Computing</p> <p>5.4.1 Concerns Related to Network Platform, Algorithm Design and Implementation, Choice of Programming Languages, Standards and Tools</p> <p>5.4.2 Grid Computing Examples – XSEDE, OptIPuter and TransLight/Global Lambda Integrated Facility</p> <p>5.5 Internet-Driven System Examples – Apache Dynamo and DynamoDB, Apache Cassandra, Google BigTable, BitTorrent, Accessing Replicas in Distributed Systems</p> <p>5.6 Other Distributed Systems</p> <p>5.6.1 Distributed Real-Time Systems</p> <p>5.6.2 Distributed Multimedia Systems</p> <p><b>Unit 6: Parallel Processing Architectures</b></p> <p>6.1 Need and Concept of Parallel Processing, Application Areas of Parallel Processing, Distributed Memory and Shared Memory Processing, Various Dependencies and Algorithm Development for Parallel Processing</p> <p>6.2 Parallelism in Sequential Machines – Multiplicity of Functional Units, Pipelining within the CPU, Overlapped CPU and I/O Operations, Hierarchical Memory Systems, Multiprogramming and Time Sharing</p> <p>6.3 Abstract Model of Parallel Computers – PRAM (Parallel Random Access Machine)</p> <p>6.4 Multiprocessor Architecture, Pipelining and Array Processors, Interconnection Networks</p> <p><b>Unit 7: Parallel Programming Issues</b></p> <p>7.1 Parallel Programming Models and Software Tools</p> <p>7.2 Data Dependency – Types of Dependencies, Loop Dependence and Array Dependence</p> <p>7.3 Program Transformations – Induction Variables, Forward Dependency, Backward Dependency, Breaking out of a Loop, Loop Splitting and Loop Interchange</p> <p>7.4 Overview of Shared Memory Programming and Thread-Based Implementation</p> <p>7.5 MapReduce Model of Parallelism</p> |
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|                               | <p><b>Unit 8: Distributed Computing</b></p> <p>8.1 Message Passing Model for Synchronous and Asynchronous Message Passing</p> <p>8.2 Parallel Virtual Machine (PVM) – PVM Terminology, Architecture of PVM, Programming Model of PVM and Dynamic Process Groups</p> <p>8.3 Remote Procedure Call (RPC) and Java RMI – Parameter Passing and Interface, Locating the Server, RPC Failures and Semantics, Security, Disadvantages of RPC, Java RMI Example – Remote Interface, Server, Client, Running the Code, Garbage Collection and Security</p> <p>8.4 Distributed Computing Environment (DCE) – DCE Architecture, DCE Configuration, DCE Directory Services, Distributed File Service (DFS), DCE Security Service and DCE Time Service</p>                     |
| Text and Reference Literature | <ol style="list-style-type: none"> <li>1. Distributed Systems: Concepts and Design, George Coulouris , JeanDollimore,Tim Kindberg , Gordon Blair , Pearson, ISBN-10 : 01321430112.</li> <li>2. Distributed Computing: Principles, Algorithms, and Systems, byAjayD. Kshemkalyani , Mukesh Singhal, Cambridge University Press, ISBN-13: 978-0521189842</li> <li>3. Distributed Systems Architecture, Authors: Arno Puder Kay Römer FrankPilhofer ISBN: 9780080454702, Imprint: Morgan Kaufmann</li> <li>4. Introduction to Parallel Processing, M.Sasikumar, Dinesh Shikhare, P. RaviPrakash, PHI Publication, ISBN-13 : 978-8120350311</li> <li>5. Fundamentals of Parallel Processing, Harry Jordan, Gita Alaghband, Pearson,ISBN-13 : 978-0139011580</li> </ol> |

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|                                                                                        |                                   |              |                                        |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                        |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                | 1                                                              |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From                         | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS15702                         | Course Name  | SEC: System Integration and Deployment |                                                                |                                 |       |
|                                                                                        |                                   |              |                                        |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                        | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                          | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 2                                                                                      | 2                                 | 0            | 0                                      | 25                                                             | 25                              | 50    |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of the course is to introduce students to version control, collaborative software development, system integration, and deployment using Git, GitHub, and modern CI/CD practices                                                                                                                                                                                                                                                                         |
| Course Objective  | <ul style="list-style-type: none"> <li>Understand the concepts of version control and Git.</li> <li>Use Git and GitHub for source code management and collaboration.</li> <li>Implement basic Continuous Integration (CI) and Continuous Deployment (CD) workflows.</li> </ul>                                                                                                                                                                                      |
| Pre-requisite     | Basic programming skills in any language and Familiarity with command-line operations                                                                                                                                                                                                                                                                                                                                                                               |
| Course Out come   | After completion of this course, the student will be capable of Deploy and maintain software applications using modern DevOps practices.                                                                                                                                                                                                                                                                                                                            |
| Course Content    | <p><b>Unit 1: Introduction to Version Control</b></p> <p>1.1 What is Version Control System (VCS)?</p> <p>1.2 Benefits of version control</p> <p>1.3 Centralized vs Distributed VCS</p> <p><b>Unit 2: Git Fundamentals, Branching and Merging</b></p> <p>2.1 Introduction to Git</p> <p>2.2 Installing and configuring Git</p> <p>2.3 Git architecture and workflow</p> <p>2.4 Creating repositories</p> <p>2.5 Working directory, staging area, and repository</p> |

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|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <p>2.6 Basic commands: git init, git clone, git status, git add, git commit, git log</p> <p>2.7 Creating and switching branches - Branch management, merging branches, resolving merge conflicts, best practices for branching strategies</p> <p><b>Unit 3: GitHub Basics</b></p> <p>3.1 Introduction to GitHub</p> <p>3.2 Creating a GitHub account</p> <p>3.3 Creating repositories on GitHub</p> <p>3.4 Connecting local repositories to GitHub</p> <p>3.5 Pushing and pulling changes</p> <p>3.6 Forking repositories</p> <p><b>Unit 4: System Integration &amp; Deployment</b></p> <p>4.1 Integration</p> <p>4.1.1 Continuous Integration (CI) concepts</p> <p>4.1.2 GitHub Actions overview</p> <p>4.1.3 Creating CI workflows</p> <p>4.1.4 Automated testing</p> <p>4.1.5 Build automation</p> <p>4.2 Deployment</p> <p>4.2.1 Continuous Deployment (CD) concepts</p> <p>4.2.2 Deployment pipelines</p> <p>4.2.3 Environment management (Development, Testing, Production)</p> <p>4.2.4 GitHub Actions for deployment</p> <p>4.2.5 Monitoring and rollback strategies</p> |
| Text and Reference Literature | <ol style="list-style-type: none"> <li>1. Pro Git (2nd Edition), by Scott Chacon &amp; Ben Straub</li> <li>2. Version Control with Git (3rd Edition), Jon Loeliger &amp; Matthew McCullough</li> <li>3. Learning Git, by Anna Skoulikari</li> <li>4. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, by Jez Humble &amp; David Farley</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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|                                                                                        |                                   |              |                               |                                               |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|-------------------------------|-----------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                               |                                               |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                       | B.Sc. Honours with Research                   |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                       | 1                                             |                                 |       |
| Semester                                                                               | 7                                 |              | Effective From                | June 2026                                     |                                 |       |
| Course Code                                                                            | BSCS18701                         | Course Name  | RP: Research Project - I (TH) |                                               |                                 |       |
|                                                                                        |                                   |              |                               |                                               |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                               | Examination Scheme                            |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                 | Continuous and Comprehensive Evaluation (CCE) | Semester end examinations (SEE) | Total |
| 2                                                                                      | 2                                 | 0            | -                             | 25                                            | 25                              | 50    |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | This course aims to provide scholars with a comprehensive understanding of research principles, methodologies, data collection and analysis techniques, literature review, and scientific communication, enabling them to plan, conduct, and present high-quality research.                                                                                                                                                                                                                                                             |
| Course Objective  | <ol style="list-style-type: none"> <li>To introduce the fundamental concepts and principles of research.</li> <li>To develop the ability to design robust research methodologies.</li> <li>To understand various tools and techniques for data collection and analysis.</li> <li>To enable effective communication of research findings through academic writing and presentations.</li> </ol>                                                                                                                                          |
| Pre-requisite     | Basic understanding of the subject domain and fundamental computer skills. No prior research experience is required.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Course Outcome    | Upon successful completion of this course, scholars will be able to: <ul style="list-style-type: none"> <li>Identify and formulate research problems clearly and systematically.</li> <li>Design and implement appropriate research methodologies.</li> <li>Collect, analyse, and interpret research data using appropriate tools and techniques. Critically evaluate, synthesize, and present academic literature to support research.</li> <li>Communicate research findings effectively in both written and oral formats.</li> </ul> |
| Course Content    | <b>Unit 1: Introduction to Research</b><br>1.1 Research: Definition and Importance<br>1.2 Types of Research: Basic, Applied, and Development<br>1.3 The Scientific method vs Data-driven research<br>1.3 Industry vs. Academic Research Perspectives<br>1.4 Key Research Domains                                                                                                                                                                                                                                                        |

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|                               | <p>1.5 Emerging Trends and Research Opportunities: AI for Climate, Health, and Social Good, Quantum Computing, Robotics Navigation</p> <p>1.6 Ethical, Legal, and Social Considerations in Computational Research</p> <p><b>Unit 2: Problem Identification and Formulation</b></p> <p>2.1 Research Topic Selection</p> <p>2.2 Gap Analysis &amp; Literature Survey Techniques</p> <p>2.2.1 Literature Search</p> <p>2.2.2 Literature Review</p> <p>2.2.3 Writing about Reviewed Literature</p> <p>2.3 Framing Research Objectives and Hypotheses</p> <p>2.4 Problem Statements in Real-world Scenarios</p> <p><b>Unit 3: Research Design and Methodology</b></p> <p>3.1 Methods of Experimental, Descriptive, and Analytical Research</p> <p>3.2 Quantitative vs. Qualitative Approaches</p> <p>3.3 Case Study, Simulation, and Prototype-based Research</p> <p>3.4 Cross-disciplinary Research Models</p> <p><b>Unit 4: Writing Research Papers and Reports</b></p> <p>4.1 Structure of a Research Paper (Abstract to References)</p> <p>4.2 IEEE, ACM, and Springer Paper Formats</p> <p>4.3 Writing Technical Reports and Dissertations</p> <p>4.4 Common Mistakes in Research Writing</p> <p>4.5 Path to Publication in Conferences and Journals</p> |
| Text and Reference Literature | <ol style="list-style-type: none"> <li>1. Anshuman Mishra, <i>Research Methodology in Artificial Intelligence, Machine Learning, and Data Science: a comprehensive guide for students and researchers (AI Course)</i></li> <li>2. Kothari, C. R. <i>Research Methodology: Methods and Techniques</i>. New Age International Publishers.</li> <li>3. Panneerselvam, R. <i>Research Methodology</i>. 2nd Edition. PHI Learning.</li> <li>4. Merriam, S. B., &amp; Tisdell, E. J. <i>Qualitative Research: A Guide to Design and Implementation</i>. 4th Edition. Jossey-Bass.</li> <li>5. Zobel, J. <i>Writing for Computer Science</i>. Springer-Verlag, New York, 1997.</li> <li>6. Parberry, I. <i>A Guide for New Referees in Theoretical Computer Science</i>.</li> <li>7. Parberry, I. <i>How to Present a Paper in Theoretical Computer Science</i>.</li> <li>8. Chapman, D. (Ed.). <i>How to Do Research in the MIT AI Lab</i>.</li> <li>9. Comer, D. <i>How to Write a Thesis in an Experimental Area of Computer Science</i>.</li> </ol>                                                                                                                                                                                                         |

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|-----------------------------------------------------------------------------------------------|-----------------------------------|---------------------|--------------------------------------|------------------------------------------------------|----------------------------------------|--------------|
| <b>Name of College:</b> Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |                     |                                      |                                                      |                                        |              |
| <b>Faculty</b>                                                                                | Computer Science and Applications |                     | <b>Program</b>                       | B.Sc. Honours with Research                          |                                        |              |
| <b>Year</b>                                                                                   | 2026-27                           |                     | <b>Version</b>                       | 1                                                    |                                        |              |
| <b>Semester</b>                                                                               | 7                                 |                     | <b>Effective From</b>                | June 2026                                            |                                        |              |
| <b>Course Code</b>                                                                            | BSCS18802                         | <b>Course Name</b>  | <b>RP:</b> Research Project – I (PR) |                                                      |                                        |              |
|                                                                                               |                                   |                     |                                      |                                                      |                                        |              |
| <b>Teaching Scheme</b>                                                                        |                                   |                     |                                      | <b>Examination Scheme</b>                            |                                        |              |
| <b>Credits</b>                                                                                | <b>Lecture (L)</b>                | <b>Tutorial (T)</b> | <b>Practical (P)</b>                 | <b>Continuous and Comprehensive Evaluation (CCE)</b> | <b>Semester end examinations (SEE)</b> | <b>Total</b> |
| 4                                                                                             | 0                                 | 0                   | 8                                    | 50                                                   | 50                                     | 100          |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | This course aims to develop students' understanding and application of research principles in Computer Science and Applications through identification of a research problem, systematic literature review, formulation of objectives, selection of appropriate research methodology, and preparation of a research/project plan. The course provides the foundation for implementation and experimental work to be undertaken in Research Project-II.                                                                                                                                                                                                                                                                            |
| Course Objective  | <ol style="list-style-type: none"> <li>1. To introduce the fundamental principles and processes involved in computing research.</li> <li>2. To enable students to identify, analyse and formulate a suitable research/project problem.</li> <li>3. To develop skills in conducting and synthesizing relevant literature and identifying research or technical gaps.</li> <li>4. To enable students to formulate research objectives, questions and hypotheses, wherever applicable.</li> <li>5. To develop the ability to select appropriate research methodologies, tools and evaluation approaches.</li> <li>6. To prepare a systematic research/project proposal and plan for implementation in Research Project-I.</li> </ol> |

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| Pre-requisite  | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Course Outcome | <ul style="list-style-type: none"><li>• Identify and formulate a suitable research/project problem in Computer Science and Applications.</li><li>• Conduct and critically analyse relevant technical and research literature to identify research or technical gaps.</li><li>• Formulate appropriate research objectives, research questions and hypotheses, wherever applicable.</li><li>• Select suitable research designs, methodologies, computational techniques and tools for addressing the identified problem.</li><li>• Develop a systematic research/project proposal including methodology, resources, and expected outcomes.</li></ul> |

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# **Faculty of Computer Science and Applications**

## **B. Sc. (Honours) (Computer Science)**

## **B.Sc. (Honours with Research)**

## **(Computer Science)**

# **SEMESTER- 8**

**DETAILED CURRICULUM**

**SARVAJANIK UNIVERSITY**  
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|                                                                                        |                                   |              |                                        |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                        |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                | 1                                                              |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From                         | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11801 / BSC12804              | Course Name  | Major / Minor: Web Programming-II (TH) |                                                                |                                 |       |
|                                                                                        |                                   |              |                                        |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                        | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                          | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 3                                                                                      | 3                                 | 0            | -                                      | 50                                                             | 50                              | 100   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | To provide comprehensive knowledge about JavaScript-based framework built on Google Chrome's JavaScript V8 Engine                                                                                                                                                                                                                                                                  |
| Course Objective  | To provide knowledge on how to develop I/O intensive web applications like video streaming sites, single-page applications, and other web applications using Node.js framework                                                                                                                                                                                                     |
| Pre-requisite     | Basic understanding of JavaScript, HTML, CSS and AJAX                                                                                                                                                                                                                                                                                                                              |
| Course Outcome    | After having completed the course the student will gain: <ul style="list-style-type: none"> <li>• Understanding of Node.js Environment</li> <li>• Knowledge of Node Modules Technical know-hows of Full Stack Node.js based development</li> <li>• Application of Node.js web development of real life application</li> </ul>                                                      |
| Course Content    | Unit 1: Introduction Node.js<br>1.1 Features and Applications<br>1.1.1 Installing Node, Node Hosting Environments<br>1.1.2 Node Building Blocks<br>1.2 Exception Handling.<br>1.3 REPL Terminal<br>1.4 Overview of Node Module System<br>1.5 Overview of Node Package Manager<br>1.6 Overview of Node Version Manager<br>1.7 Axios, bcrypt, jsonwebtokens, multer, nodemon, dotenv |

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|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <p>Unit 2 : Node with the Local System and the Web</p> <p>2.1 Streams and Pipes</p> <p>2.2 Node and the File System- The fs.Stats class, The File System Watcher, File Read and Write, Directory access and Maintenance, File Streams</p> <p>2.3 Resource Access with Path</p> <p>Unit 3: Node and Web Application</p> <p>3.1 Using Apache to proxy Node application</p> <p>3.2 Routing in NodeJS</p> <p>3.3 Routing and Callback function</p> <p>3.4 Modern Deployment Basics: PM2</p> <p>3.5 Hosting overview: Render, Railway, Vercel</p> <p>3.6 What is NGINX</p> <p>Unit 4: Full-Stack Node development</p> <p>4.1 The Express Application Framework</p> <p>4.2 Express Supportive Modules, Body-parser, Method Override</p> <p>4.3 Basic EJS, Folder structure (routes/controllers/models)</p> <p>4.4 Integrating NodeJS, MongoDB and REST APIs</p> <p>Unit 5: NodeJS Application Management</p> <p>5.1 Project Structure, MVC architecture, Folder structuring for APIs</p> <p>5.2 Controllers, Routes, Services, Models</p> <p>5.3 Environment Variables, Using .env file, Config management</p> <p>5.4 Modern JavaScript in Node.js - ES Modules (import/export)</p> <p>5.5 Async/Await, Built-in fetch() in Node, Error Handling - Centralized error handler, Async error handling HTTP response structure</p> <p>Unit 6: Advanced NodeJS Operations</p> <p>6.1 Basic Authentication -JWT basics, bcrypt hashing, Protected routes</p> <p>6.2 Postman / Thunder Client - API testing, Status codes, Sending headers/body/params</p> <p>6.3 NodeJS in Real-time -WebSocket, Socket.IO</p> |
| Text and Reference Literature | <ol style="list-style-type: none"> <li>1. Learning Node Moving to the server side Shelley Powers O'Reilly Literature Publication Building Node Applications with MongoDB and Backbone Mike Wilson O'Reilly SPD Publication.</li> <li>2. GEO, CouchDB &amp; NodeJS Mick Thompson O'Reilly SPD Publication</li> <li>3. Web Development with Node and Express, Ethan Brown, O'Reilly Publication</li> <li>4. Node.js in Action, Alex Young, Bradley Meck, Mike Cantelon</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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**Semester - VII and Semester - VIII**

|                                                                                        |                                   |              |                                        |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                        |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                | 1                                                              |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From                         | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS1180 2/ BSCS1280 4            | Course Name  | Major / Minor: Web Programming-II (PR) |                                                                |                                 |       |
|                                                                                        |                                   |              |                                        |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                        | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                          | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 1                                                                                      | 0                                 | 0            | 2                                      | 25                                                             | 25                              | 50    |

|                   |                                                                                                                                                                                                                                                                                                                               |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | To provide comprehensive knowledge about JavaScript-based framework built on Google Chrome's JavaScript V8 Engine                                                                                                                                                                                                             |
| Course Objective  | To provide knowledge on how to develop I/O intensive web applications like video streaming sites, single-page applications, and other web applications using Node.js framework                                                                                                                                                |
| Pre-requisite     | Basic understanding of JavaScript, HTML, CSS and AJAX                                                                                                                                                                                                                                                                         |
| Course Outcome    | After having completed the course the student will gain: <ul style="list-style-type: none"> <li>● Understanding of Node.js Environment</li> <li>● Knowledge of Node Modules Technical know-hows of Full Stack Node.js based development</li> <li>● Application of Node.js web development of real life application</li> </ul> |
| Course Content    | The course covers the fundamentals of NodeJS, including the NPM, NVM, express framework, EJS, and MVC implementations with practical applications.                                                                                                                                                                            |
| Practical         | List of practical will be prepared at the beginning of each semester                                                                                                                                                                                                                                                          |
| Reference Books   | As per paper Major/Minor – Web Programming-II (Th)                                                                                                                                                                                                                                                                            |

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**Semester - VII and Semester - VIII**

|                                                                                        |                                   |              |                                         |                                                         |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|-----------------------------------------|---------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                         |                                                         |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                 | B.Sc. Honors (Artificial Intelligence and Data Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                 | 1                                                       |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From                          | June 2026                                               |                                 |       |
| Course Code                                                                            | BSCS11803                         | Course Name  | Major : Advanced Cloud Programming (TH) |                                                         |                                 |       |
|                                                                                        |                                   |              |                                         |                                                         |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                         | Examination Scheme                                      |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                           | Continuous and Comprehensive Evaluation (CCE)           | Semester end examinations (SEE) | Total |
| 3                                                                                      | 3                                 | 0            | -                                       | 50                                                      | 50                              | 100   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of course is to establish the foundation of cloud-native application development using micro service architecture.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Objective  | <ul style="list-style-type: none"> <li>◆ To introduce cloud computing fundamentals, architectural models, service models, and deployment environments.</li> <li>◆ To understand the evolution of software architectures and develop cloud-native applications using microservices.</li> <li>◆ To design scalable microservices with REST APIs, business logic layers, and data persistence techniques.</li> <li>◆ To explore cloud capabilities, security, monitoring, and emerging trends such as Edge, Quantum, and AI-driven cloud computing.</li> </ul> |
| Pre-requisite     | Fundamental knowledge of software engineering, programming and networking                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Course Out come   | After completion of the course, a student will be able to: <ul style="list-style-type: none"> <li>● Understand cloud computing concepts, architecture, service &amp; deployment models.</li> <li>● Compare monolithic, SOA, and microservice architectures and apply cloud-native principles.</li> <li>● Design and implement microservices with REST APIs, business logic, and persistence layers.</li> <li>● Apply data management, transactional messaging, and fault-tolerance patterns in MSA.</li> </ul>                                              |
| Course Content    | <b>UNIT 1 – Cloud Computing Fundamentals</b><br>1.1. Evolution of Cloud Computing                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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|  | <ul style="list-style-type: none"> <li>1.2. Characteristics, benefits &amp; challenges</li> <li>1.3. Cloud architectural model</li> <li>1.4. Cloud service models (IaaS, PaaS, SaaS)</li> <li>1.5. Cloud deployment models (Public, Private, Hybrid)</li> </ul> <p><b>UNIT 2 – Evolution of Architectural Styles for Cloud-Native Applications</b></p> <ul style="list-style-type: none"> <li>2.1. Evolution of application architectures <ul style="list-style-type: none"> <li>2.1.1 Monolithic architecture</li> <li>2.1.2 Service oriented architecture</li> <li>2.1.3 Micro service architecture</li> </ul> </li> <li>2.2. Characteristics of cloud-native systems</li> <li>2.3. Need for distributed architectures</li> <li>2.4. Virtualization – Concept, Hypervisor and its Types</li> <li>2.5. Containerization</li> </ul> <p><b>UNIT 3 – Microservices Architecture &amp; Decomposition Strategies</b></p> <ul style="list-style-type: none"> <li>3.1. Microservices architecture: principles &amp; characteristics</li> <li>3.2. Bounded context &amp; domain-driven concepts</li> <li>3.3. Decomposition strategies: <ul style="list-style-type: none"> <li>3.3.1.By business capability</li> <li>3.3.2.By subdomain</li> <li>3.3.3.Self-contained services</li> <li>3.3.4.Service-per-team</li> </ul> </li> <li>3.4. Service communication patterns -REST and Event Driven Design</li> </ul> <p><b>UNIT 4 – Microservice creation and orchestration</b></p> <ul style="list-style-type: none"> <li>4.1 API &amp; Service Layer <ul style="list-style-type: none"> <li>4.1.1. RESTful API development</li> </ul> </li> <li>4.1.2. Resource modelling &amp; URI design</li> <li>4.1.3. JSON-based data exchange</li> <li>4.1.4. Dependency Injection &amp; stateless services</li> <li>4.1.5. Error/exception handling strategies</li> <li>4.1.6. Packaging for deployment</li> <li>4.2 Business Logic Layer <ul style="list-style-type: none"> <li>4.2.1. Designing scalable service logic</li> <li>4.2.2. Stateless components for parallel execution</li> <li>4.2.3. Integration between API → Service → Data layers</li> <li>4.2.4. Designing scalable service logic</li> </ul> </li> <li>4.3 Persistence Layer <ul style="list-style-type: none"> <li>4.3.1. Persistence concepts for microservices</li> <li>4.3.2. Entity modelling &amp; CRUD operations</li> <li>4.3.3. Persistence unit configuration</li> </ul> </li> <li>4.4 Docker Architecture: Images, Containers, Volumes, Networks</li> <li>4.5 Kubernetes Basics: Pods, Deployments, Services, Ingress</li> <li>4.6 Container Orchestration</li> </ul> <p><b>UNIT 5 – Cloud Platform Capabilities, Security &amp; Observability</b></p> <ul style="list-style-type: none"> <li>5.1 Cloud Platform Capabilities for Microservices</li> </ul> |
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|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <p>5.1.1 Compute Services - AWS EC2, Elastic Beanstalk<br/> 5.1.2. Storage Services - AWS S3<br/> 5.1.3. Database Services - AWS RDS, DynamoDB<br/> 5.2 Cloud Security for Distributed Microservices<br/> 5.2.1. Security challenges in distributed systems<br/> 5.2.2. Authentication vs Authorization<br/> 5.2.3. JSON Web Tokens – structure, flow &amp; usage<br/> 5.3 Cloud Observability and Monitoring<br/> 5.3.1. Importance of observability in MSA<br/> 5.3.2. Three pillars: Logging, Metrics, Tracing<br/> 5.3.3. Metrics scraping and Visualization</p> <p><b>Unit 6 - Emerging Trends in Cloud Computing</b><br/> 6.1 Edge Computing &amp; Fog Computing<br/> 6.2 Quantum Cloud Computing<br/> 6.3 AI/ML in Cloud - AWS Sage maker<br/> 6.4 Green Cloud Computing &amp; Sustainability</p>                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Text and Reference Literature | <p>1. Cloud Computing: Principles and Paradigms - R. Buyya et al-Wiley 2010<br/> 2. Cloud Computing Bible - Sosinsky - Wiley - India,2011<br/> 3. Cloud Computing Second Edition Dr. Kumar Saurabh - Wiley - India, 2012<br/> 4. Building Microservices Paperbackby Sam Newman, SPD Press, 2017<br/> 5. Microservices for Java EE Architects: Addendum for The Java EE Architect's Handbook by Derek C. Ashmore, 2017<br/> 6. Kubernetes Microservices with Docker by Deepak Vohra,Apress Publication, 2018<br/> 7. Docker Quick Start Guide: Learn Docker like a boss, and finally own your applications by Earl Waud, PACKT publications, 2018<br/> 8. Apache ZooKeeper Essentials by Saurav Haloi, PACKT publications, 2015<br/> 9. Hazelcast A Complete Guide - 2019 Edition by Gerardus Blokdyk publication: 5STARCOOKS, 2019<br/> 10. Microservices Patterns: With examples in Java by Chris Richardson, Publisher: Manning Publications, 2018<br/> 11. Microservices and Containers 1st Edition by Parminder Singh, Kocher Publisher - Addison-Wesley Professional, 2018<br/> 12. Hands-On Microservices with Kubernetes: Build, deploy, and manage scalable microservices on Kubernetes, by Gigi Sayfan, Packt Publications</p> |

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**Semester - VII and Semester - VIII**

|                                                                                        |                                   |              |                                        |                                                         |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------------------|---------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                        |                                                         |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                | B.Sc. Honors (Artificial Intelligence and Data Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                | 1                                                       |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From                         | June 2026                                               |                                 |       |
| Course Code                                                                            | BSCS11804                         | Course Name  | Major: Advanced Cloud Programming (PR) |                                                         |                                 |       |
|                                                                                        |                                   |              |                                        |                                                         |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                        | Examination Scheme                                      |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                          | Continuous and Comprehensive Evaluation (CCE)           | Semester end examinations (SEE) | Total |
| 1                                                                                      | 0                                 | 0            | 2                                      | 25                                                      | 25                              | 50    |

|                   |                                                                                                                                                                                                                                                                                          |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of course is to establish the foundation of cloud-native application development using micro service architecture.                                                                                                                                                           |
| Course Objective  | <ul style="list-style-type: none"> <li>◆ To understand the evolution of software architectures and develop cloud-native applications using microservices.</li> <li>◆ To design scalable microservices with REST APIs, business logic layers, and data persistence techniques.</li> </ul> |
| Pre-requisite     | Fundamental knowledge of software engineering, programming and networking                                                                                                                                                                                                                |
| Course Outcome    | After completion of the course, a student will be able to implement microservices with REST APIs, business logic, and persistence layers and also be able to use Docker containerization to manage Microservices.                                                                        |
| Course Content    | The students will be required to carry out practical on Microservices and various cloud services concepts.                                                                                                                                                                               |
| Practical         | List of practical will be prepared at the beginning of each semester                                                                                                                                                                                                                     |
| Reference Books   | As per paper Major: Advanced Cloud Programming (Th)                                                                                                                                                                                                                                      |

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**Semester - VII and Semester - VIII**

|                                                                                        |                                   |              |                                                     |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|-----------------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                                     |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                             | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                             | 1                                                              |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From                                      | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11805                         | Course Name  | Major: Advanced Mobile Application Development (TH) |                                                                |                                 |       |
|                                                                                        |                                   |              |                                                     |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                                     | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                                       | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 3                                                                                      | 3                                 | 0            | -                                                   | 50                                                             | 50                              | 100   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | To introduce the most demanding Android open-source technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Course Objective  | <ul style="list-style-type: none"> <li>Understand Android architecture, tools, application components, and project structure.</li> <li>Design intuitive mobile interfaces using layouts, widgets, navigation, and dialogs.</li> <li>Implement data handling through Shared Preferences, SQLite, Firebase, and APIs.</li> <li>Integrate device hardware features and services like camera, audio/video, location, and notifications.</li> <li>Build, package, and deploy Android applications for real-world release.</li> </ul> |
| Pre-requisite     | Fundamentals of Java programming, web technologies and fundamentals related to mobile OS.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Course Outcome    | Students will know about Android, a widely used mobile OS and open-source platform, and its concepts. Various features of Android, like Application Design Essentials, User Interface Design Essentials, Use of Common Android APIs, data storage using SQLite and Firebase, and deploying Android applications                                                                                                                                                                                                                 |
| Course Content    | <b>Unit 1: Introduction to Android and its Tool chain</b><br>1.1 Architecture of Android<br>1.2 Android Development Tools (SDK, Emulator, ADB, Logcat)<br>1.3 Components of Android Application<br>1.4 Android Project Structure (Manifest, Resources, Gradle)<br>1.5 Fundamental of Activities and Fragments and their lifecycle<br><br><b>Unit 2: User Interface and Navigation</b>                                                                                                                                           |

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- 2.1 Android Layouts
- 2.2 Basic UI Elements – EditText, TextView, Button, RadioButton, CheckBox, Spinner, ImageView
- 2.3 Views & Widgets- ScrollView, WebView, ProgressBar
- 2.4 ListView, RecyclerView
- 2.5 Dialogs - AlertDialog, DatePicker, TimePicker
- 2.6 Intents
- 2.7 Menus - Options Menu, Context Menu, Popup Menu
- 2.8 Navigation - TabLayout with ViewPager2, Bottom Navigation

**Unit-3: Data Handling and Storage in Android applications**

- 3.1 Shared Preferences: Purpose and Modes
- 3.2 Reading and Writing Data to and from Shared Preferences
- 3.3 SQLite Database and SQLiteOpenHelper
- 3.4 SQLite Database Operations (ExecSQL, RawQuery, Insert, Update, Delete)
- 3.5 Managing internal and external storage - Files and Directories
- 3.6 Introduction to Firebase
- 3.7 Firebase – Environment Setup
- 3.8 Firebase Authentication
- 3.9 Writing and Reading Data to Firebase

**Unit 4: Sensors and Device Interaction in Android**

- 4.1 Introduction to Sensors
- 4.2 Types of Sensors (Motion, Position, Environmental)
- 4.3 Sensor Framework
- 4.4 Working with Motion Sensor (Accelerometer, Gyroscope, Device orientation)
- 4.5 Sensor-based applications
  - 4.5.1 Displaying accelerometer values (X, Y, Z)
  - 4.5.2 Shake Detection
  - 4.5.3 Device Orientation Detection (Portrait / Landscape)

**Unit 5: API Integration**

- 5.1 Introduction to APIs
- 5.2 API Integration in Android – GET, POST, PUT, DELETE
- 5.3 JSON Handling – Parsing & Serialization (JSONObject, JSONArray)
- 5.4 Handling API Responses and Error Management

**Unit 6: Device Capabilities, Notifications & Deployment**

- 6.1 Runtime Permissions
- 6.2 Geocoding and reverse Geocoding
- 6.3 Audio, Video and Using the Camera
  - 6.3.1. Playing and recording Audio and Video
  - 6.3.2. Working with the Camera
- 6.4 Push Notification
- 6.5 Alarm Manager for scheduled events

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**Semester - VII and Semester - VIII**

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | 6.6 Application Deployment - APK/AAB, signing & release flow                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Text and Reference Literature | <ol style="list-style-type: none"><li>1. Professional Android 4 Application Development, Reto Meier, Wrox Publication, 2015</li><li>2. Android for Programmers: An App-Driven Approach, Deitel, Deitel, Deitel, and Morgano, Pearson Publication-2012</li><li>3. Android Programming Unleashed, Harwani, Pearson Publication-2013</li><li>4. Professional Android Programming-with MONO McClure, Blevins, Croft, Dick, and Hardy, Wiley India-2012</li><li>5. Android application development for Java programmer, James C Sheusi, Cenage Learning-2013</li><li>6. Android Essentials, Chris Haseman, Apress Publication, 2009</li><li>7. Beginning Android, Mark L Murphy, Wiley India Pvt Ltd, 2009</li><li>8. Pro Android, Sayed Y Hashimi and Satya Komatineni, Wiley India Pvt Ltd, Apress-2009</li></ol> |

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**Semester - VII and Semester - VIII**

|                                                                                               |                                   |                     |                                                            |                                                                |                                        |              |
|-----------------------------------------------------------------------------------------------|-----------------------------------|---------------------|------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------|--------------|
| <b>Name of College:</b> Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |                     |                                                            |                                                                |                                        |              |
| <b>Faculty</b>                                                                                | Computer Science and Applications |                     | <b>Program</b>                                             | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                        |              |
| <b>Year</b>                                                                                   | 2026-27                           |                     | <b>Version</b>                                             | 1                                                              |                                        |              |
| <b>Semester</b>                                                                               | 8                                 |                     | <b>Effective From</b>                                      | June 2026                                                      |                                        |              |
| <b>Course Code</b>                                                                            | BSCS11806                         | <b>Course Name</b>  | <b>Major:</b> Advanced Mobile Application Development (PR) |                                                                |                                        |              |
|                                                                                               |                                   |                     |                                                            |                                                                |                                        |              |
| <b>Teaching Scheme</b>                                                                        |                                   |                     |                                                            | <b>Examination Scheme</b>                                      |                                        |              |
| <b>Credits</b>                                                                                | <b>Lecture (L)</b>                | <b>Tutorial (T)</b> | <b>Practical (P)</b>                                       | <b>Continuous and Comprehensive Evaluation (CCE)</b>           | <b>Semester end examinations (SEE)</b> | <b>Total</b> |
| 1                                                                                             | 0                                 | 0                   | 2                                                          | 25                                                             | 25                                     | 50           |

|                   |                                                                                                                                                                                                                                                                                                                                                    |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | To introduce the most demanding and developing mobile app technology. Fundamentals of Android open-source technology                                                                                                                                                                                                                               |
| Course Objective  | <ul style="list-style-type: none"> <li>To make students understand the fundamentals of mobile app technology.</li> <li>To make students understand various built-in features of Android.</li> <li>To make students understand the Android design essentials.</li> <li>To make students understand Android user interface design basics.</li> </ul> |
| Pre-requisite     | Fundamentals of Java programming, web technologies and fundamentals related to mobile OS                                                                                                                                                                                                                                                           |
| Course Outcome    | Students will know about Android, a widely used mobile OS and open-source platform, and its concepts. Various features of Android, like Application Design Essentials, User Interface Design Essentials, Use of Common Android APIs, data storage using SQLite and Firebase, and deploying Android applications.                                   |
| Course Content    | The students will be required to carry out a practical on Android using the methods and tools discussed in their theory.                                                                                                                                                                                                                           |
| Practical         | A list of practical will be prepared at the beginning of each semester                                                                                                                                                                                                                                                                             |
| Reference Books   | As per paper Major - Advanced Mobile Application Development (Th)                                                                                                                                                                                                                                                                                  |

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|                                                                                        |                                   |              |                           |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|---------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                           |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                   | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                   | 1                                                              |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From            | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11807                         | Course Name  | Major: Generative AI (TH) |                                                                |                                 |       |
|                                                                                        |                                   |              |                           |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                           | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)             | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 3                                                                                      | 3                                 | 0            | -                         | 50                                                             | 50                              | 100   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of the course is to equip learners with the knowledge and skills needed to understand, build, and apply generative AI models. Learners are expected to be capable of building generative AI solutions, evaluating their performance, and applying them to solve practical problems creatively and responsibly.                                                                                                                                                                                                                                 |
| Course Objective  | <ol style="list-style-type: none"> <li>To learn about generative artificial intelligence</li> <li>To learn and implement different types of Gen AI Technology in the programming and content generation domain.</li> </ol>                                                                                                                                                                                                                                                                                                                                 |
| Pre-requisite     | Fundamental concepts of Programming, Computerized Tools and Software.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Course Outcome    | After completion of this course, the student will be capable to develop generative AI based solutions.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Course Content    | <b>Unit 1. Defining New Age AI</b> <ol style="list-style-type: none"> <li>Artificial Narrow Intelligence</li> <li>Artificial General Intelligence</li> <li>Artificial Super Intelligence</li> <li>Discriminative Vs Generative AI</li> <li>Applications of Generative AI</li> </ol> <b>Unit 2. Data Representation in Gen AI</b> <ol style="list-style-type: none"> <li>Uses of Generative AI - Text, Images, Video, Music, Code, Voices</li> <li>Encoding, Embedding</li> <li>Text Embedding</li> <li>Image Embedding</li> <li>Video Embedding</li> </ol> |

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**Semester - VII and Semester - VIII**

|                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                      | <p>2.6 Key Technologies behind Gen AI - GAN, VAE, Transformers</p> <p><b>Unit 3 LLM and Prompt Engineering</b></p> <p>3.1 Language Modelling</p> <p>3.2 Large Language Models</p> <p>3.3 Applications of LLMs</p> <p>3.4 Introduction of lightweight LLMs and SLMs</p> <p>3.5 Prompt Designing, Task Formulation using Prompts, Prompt Patterns</p> <p>3.6 Prompt Tuning Techniques</p> <p><b>Unit 4 Retrieval Augmented Generation</b></p> <p>4.1 Introduction to RAG</p> <p>4.2 Vector Embeddings</p> <p>4.3 Creating Knowledge Base</p> <p>4.4 Store embedding in Vector DB</p> <p>4.5 Query Embeddings</p> <p><b>Unit 5 Vector Embeddings &amp; Storage</b></p> <p>5.1 Embedding Models</p> <p>5.2 Vector Databases &amp; Indexing</p> <p>5.3 Similarity Metrics - Cosine Similarity, Euclidean Distance, and Dot Product</p> <p>5.4 Advanced RAG Patterns - Re-Ranking, Parent child RAG, GraphRAG</p> <p><b>Unit 6 AI Agent Frameworks</b></p> <p>6.1 AI Agents</p> <p>6.2 Introduction to Agentic AI</p> <p>6.3 Open source AI agent frameworks</p> <p>6.3.1 Langchain</p> <p>6.3.2 LangGraph</p> <p>6.3.3 Crew AI</p> <p>6.3.4 AutoGen (Microsoft)</p> <p>6.3.5 <a href="#">BabyAGI</a></p> |
| <b>Text and Reference Literature</b> | <ol style="list-style-type: none"> <li>1. A First Course in Artificial Intelligence by Deepak Khemani, McGrawHill, ISBN :978-1-25-902998-1</li> <li>2. Generative AI for Everyone: Deep learning, NLP, and LLMs for creative and practical applications by Karthikeyan Sabesan, Sivagamisundari, et al</li> <li>3. Generative AI for Beginners Playbook by Branson Adams</li> <li>4. Genrative AI for Everyone by Altaf Rehmani</li> <li>5. Generative AI for Software Developers: Future-Proof Your Career with AI- Powered Development and Practical Hands-On Skills by Saurabh Shrivastava , Kamal Arora</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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**Semester - VII and Semester - VIII**

|                                                                                        |                                   |              |                           |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|---------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                           |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                   | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                   | 1                                                              |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From            | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS11808                         | Course Name  | Major: Generative AI (PR) |                                                                |                                 |       |
|                                                                                        |                                   |              |                           |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                           | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)             | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 1                                                                                      | 0                                 | 0            | 2                         | 25                                                             | 25                              | 50    |

|                   |                                                                                                                                                                                                                                                                                                                            |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of the course is to equip learners with the knowledge and skills needed to understand, build, and apply generative AI models. Learners are expected to be capable of building generative AI solutions, evaluating their performance, and applying them to solve practical problems creatively and responsibly. |
| Course Objective  | 1.To learn about generative artificial intelligence<br>2. To learn and implement different types of Gen AI Technology in the programming and content generation domain.                                                                                                                                                    |
| Pre-requisite     | Fundamental concepts of Programming, Computerized Tools and Software.                                                                                                                                                                                                                                                      |
| Course Outcome    | After completion of this course, the student will be capable to develop generative AI based solutions.                                                                                                                                                                                                                     |
| Course Content    | This course covers understanding of LLM intrinsic working, vector representation of data and RAG implementation.                                                                                                                                                                                                           |
| Practical         | List of practical will be prepared at the beginning of each semester                                                                                                                                                                                                                                                       |
| Reference Books   | As per paper Major - Generative AI(TH)                                                                                                                                                                                                                                                                                     |

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**Semester - VII and Semester - VIII**

|                                                                                               |                                   |                     |                                                               |                                                                |                                        |              |
|-----------------------------------------------------------------------------------------------|-----------------------------------|---------------------|---------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------|--------------|
| <b>Name of College:</b> Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |                     |                                                               |                                                                |                                        |              |
| <b>Faculty</b>                                                                                | Computer Science and Applications |                     | <b>Program</b>                                                | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                        |              |
| <b>Year</b>                                                                                   | 2026-27                           |                     | <b>Version</b>                                                | 1                                                              |                                        |              |
| <b>Semester</b>                                                                               | 8                                 |                     | <b>Effective From</b>                                         | June 2026                                                      |                                        |              |
| <b>Course Code</b>                                                                            | BSCS15801                         | <b>Course Name</b>  | <b>Major:</b> Software Engineering Lab – I / Internship / OJT |                                                                |                                        |              |
|                                                                                               |                                   |                     |                                                               |                                                                |                                        |              |
| <b>Teaching Scheme</b>                                                                        |                                   |                     |                                                               | <b>Examination Scheme</b>                                      |                                        |              |
| <b>Credits</b>                                                                                | <b>Lecture (L)</b>                | <b>Tutorial (T)</b> | <b>Practical (P)</b>                                          | <b>Continuous and Comprehensive Evaluation (CCE)</b>           | <b>Semester end examinations (SEE)</b> | <b>Total</b> |
| 4                                                                                             | 0                                 | 0                   | 8                                                             | 50                                                             | 50                                     | 100          |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | To provide hands-on experience in analysing real-world problems and systematically developing appropriate computing solutions through requirement analysis, modelling, design, development, testing, integration, and deployment/evaluation. The course enables students to apply suitable software engineering, data, artificial intelligence, security, and system/architecture concepts according to the nature of the selected problem.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Course Objective  | <input type="checkbox"/> To analyse real-world problems and identify their requirements, scope, constraints, and objectives.<br><input type="checkbox"/> To select and justify appropriate models, methodologies, frameworks, architectures, and tools for a given problem.<br><input type="checkbox"/> To design requirements, data, interfaces, system components, and behavioural models using appropriate modelling techniques.<br><input type="checkbox"/> To develop and configure basic and detailed solutions using suitable programming languages, software platforms, tools, and frameworks.<br><input type="checkbox"/> To apply appropriate testing, validation, evaluation, and performance assessment techniques to the developed solution.<br><input type="checkbox"/> To integrate, package, and deploy/implement the developed solution and evaluate its system-level functionality. |
| Pre-requisite     | Students should have basic knowledge of programming fundamentals and problem-solving techniques.<br>fundamentals of database and data management, basic software engineering and system development concepts, basic knowledge of computer networks and operating systems, fundamental concepts of data analysis, artificial intelligence, or security, as applicable to the selected problem.<br>Familiarity with basic development and modelling tools.                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Outcome | <p>After successful completion of the course, students will be able to:</p> <ul style="list-style-type: none"> <li>Analyse a real-world problem and identify its requirements, scope, constraints, and objectives.</li> <li>Select and justify suitable models, methodologies, frameworks, architectures, and techniques for solving a given problem.</li> <li>Design requirements, data, interfaces, system components, and behavioural models using appropriate tools and techniques.</li> <li>Develop and configure appropriate software solutions, computational models, AI models, security solutions, or system architectures based on the identified requirements.</li> <li>Perform unit testing, model validation, system evaluation, integration testing, and other appropriate testing techniques.</li> <li>Integrate, implement, and evaluate the developed solution based on relevant functional, performance, usability, accuracy, security, or other quality requirements.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Content | <p><b>Practical 1: Problem Statement and Process Selection (4 hrs)</b><br/> <b>Aim:</b> To analyse a real-world problem statement and select a suitable model with proper justification.<br/> <b>Description:</b><br/> a) Define a requirement/ problem (e.g., Online Library Management System, Mover Recommendation System, Security detection and protection, cloud or network system &amp;/or architecture etc.).<br/> b) Document the scope, operational constraints, and objectives. Choose appropriate models (SDLC models, ML Models, Security models, frameworks, architectures etc) and justify why a specific approach fits the chosen problem.</p> <p><b>Practical 2: Requirement Specification (8 hrs)</b><br/> <b>Aim:</b> To prepare a complete Requirement document for the chosen problem.<br/> <b>Description:</b><br/> a) Prepare detailed requirement list, gaps, model limitations and prepare a complete requirement document (Data Flow Diagrams, ER Diagrams, Use Case Diagrams, Class Diagrams, comparative study of existing frameworks, models and methods/techniques etc.) using appropriate software tools.</p> <p><b>Practical 3: Data Design and Interface Design (8 hrs)</b><br/> <b>Aim:</b> To design data and Human interaction appropriate to problem and requirements.<br/> <b>Description:</b><br/> a) Design Database (tables, relationships, constraints, keys etc.) /Data source (dataset, attributes, features, EDA etc.) using appropriate software tools.<br/> b) Design interface (Inputs, Outputs, Dashboards, Data Visualizations, interaction panels etc.) using appropriate Software Tools.</p> |

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**Semester - VII and Semester - VIII**

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|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Practical 4: Designing Interaction and Behavioural Models (8 hrs)</b><br/> <b>Aim:</b> To design various models indicating system component interactions and behaviour appropriate for the problem and requirements.<br/> <b>Description:</b><br/> Design various system diagrams (like Sequence Diagram, Activity Diagram, StateChart Diagram, Deployment Diagrams, System Flowchart etc.) / component interactions in models/framework/system/architecture using appropriate software Tools.</p> <p><b>Practical 5: Basic Solution design &amp;/or development Software Coding of core functionality/ Model Development/System/Architecture Design) (20-24 hrs)</b><br/> <b>Aim:</b> Design &amp;/or Development &amp;; testing (of Core functionalities/Admin Modules or Training, evaluation &amp;; configuration of Core AI / Security model or system &amp;/or architecture design etc.) of the basic/initial solution appropriate for the problem and requirements.<br/> <b>Description:</b><br/> a) Design &amp;/or Development (of Core functionalities/Admin Modules or Training, evaluation &amp;; configuration of Core AI / Security model or system &amp;/or architecture design etc.) of the required solution appropriate for the problem and requirements using appropriate software platforms, tools, programming &amp;/or scripting language etc.<br/> b) Perform Unit Testing/model validation/architecture evaluation etc. of the basic/initial solution.</p> <p><b>Practical 6: Detailed Solution design &amp;/or development Software Coding of core functionality/ Model Development/System/Architecture Design) (40-45 hrs)</b><br/> <b>Aim:</b> Design &amp;/or Development &amp;; testing/evaluation (of Core functionalities/Admin Modules or Training, evaluation &amp;; configuration of Core AI / Security model or system &amp;/or architecture design etc.) of the detailed solution appropriate for the problem and requirements.<br/> <b>Description:</b><br/> a) Design &amp;/or Development &amp; testing (of Detailed functionalities/Admin Modules or Training, evaluation &amp;; configuration of detailed AI / Security model or system &amp;/or architecture design etc.) of the required solution appropriate for the problem and requirements. using appropriate software platforms, tools, programming &amp;/or scripting language etc.<br/> b) Perform Unit Testing/model validation/architecture evaluation etc. of the detailed solutions.</p> <p><b>Practical 7: Integration and Detailed Testing/evaluation (8-12 hrs.)</b><br/> <b>Aim:</b> To integrate already designed &amp;/or developed components (e.g. software modules, models, framework, system, architecture etc.) and perform integration testing / evaluation.<br/> <b>Description:</b><br/> a) Integrate already designed &amp;/or developed components (e.g. software modules, models, framework, system, architecture etc.).<br/> b) Perform Integration Testing of already designed &amp;/or developed components (e.g. software modules, models, framework, system, architecture etc.).</p> |
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|  | <p><b>Practical 8: Packaging, Deployment and system level testing (8-12 hrs.)</b></p> <p><b>Aim:</b> To deploy/host/upload/ implement the developed solution (software/ webapp /mobile app, model, framework, architecture, system etc.) and test the deployment.</p> <p><b>Description:</b></p> <p>a) To deploy/host/upload/ implement the developed solution (software/ webapp /mobile app, model, framework, architecture, system etc.) in user/client/ customer environment.</p> <p>b) Perform system and User - acceptance testing/ evaluation (like security testing, load testing, stress testing, usability testing, accuracy, precision etc.)</p> |
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**Semester - VII and Semester - VIII**

|                                                                                               |                                   |                     |                                     |                                                                |                                        |              |
|-----------------------------------------------------------------------------------------------|-----------------------------------|---------------------|-------------------------------------|----------------------------------------------------------------|----------------------------------------|--------------|
| <b>Name of College:</b> Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |                     |                                     |                                                                |                                        |              |
| <b>Faculty</b>                                                                                | Computer Science and Applications |                     | <b>Program</b>                      | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                        |              |
| <b>Year</b>                                                                                   | 2026-27                           |                     | <b>Version</b>                      | 1                                                              |                                        |              |
| <b>Semester</b>                                                                               | 8                                 |                     | <b>Effective From</b>               | 2026-27                                                        |                                        |              |
| <b>Course Code</b>                                                                            | BSCS11809                         | <b>Course Name</b>  | <b>Major: Machine Learning (TH)</b> |                                                                |                                        |              |
|                                                                                               |                                   |                     |                                     |                                                                |                                        |              |
| <b>Teaching Scheme</b>                                                                        |                                   |                     |                                     | <b>Examination Scheme</b>                                      |                                        |              |
| <b>Credits</b>                                                                                | <b>Lecture (L)</b>                | <b>Tutorial (T)</b> | <b>Practical (P)</b>                | <b>Continuous and Comprehensive Evaluation (CCE)</b>           | <b>Semester end examinations (SEE)</b> | <b>Total</b> |
| 3                                                                                             | 3                                 | 0                   | -                                   | 50                                                             | 50                                     | 100          |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of the course is to make students capable of implementing concepts, methods and tool related to machine learning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Course Objective  | The course aims to develop the ability to design, implement, and evaluate machine learning models for solving real-world problems, with a focus on both theoretical understanding and practical skills using modern tools and techniques.                                                                                                                                                                                                                                                                                                                                                                                                     |
| Pre-requisite     | Understanding of Statistics, Mathematics and Algorithms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Course Out come   | After completion of this course, the student will be able to understand and solve real world ML problems, application areas and state of the art ML concepts which are being used in practical implementation.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Course Content    | <p><b>Unit 1: Introduction to Machine Learning</b></p> <p>1.1 Types of Learning<br/> 1.2 Types of Problem in ML<br/> 1.3 Machine Learning Applications<br/> 1.4 Introduction to Reinforcement Learning,<br/> 1.5 Introduction to Transfer Learning</p> <p><b>Unit 2: Supervised Learning - Regression</b></p> <p>2.1 Linear Regression<br/> 2.2 Polynomial Regression<br/> 2.3 Logistic Regression<br/> 2.4 Evaluation Metrics for Regression</p> <p><b>Unit 3: Supervised Learning – Classification</b></p> <p>3.1 Classification: Examples and Applications NB, SVM. KNN Classifiers<br/> 3.2 Decision Trees: C4.5, ID3, Random Forest,</p> |

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**Semester - VII and Semester - VIII**

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <p>3.3 Ensemble Classifiers<br/> 3.4 Evaluation Metrics for Classification<br/> <b>Unit 4: Artificial Neural Networks-I</b><br/> 4.1 Neurons and biological motivation and Defining ANN<br/> 4.2 Multilayer Perceptron, weights, bias<br/> 4.3 Activation Function, Loss function, Epochs</p> <p><b>Unit 5 Artificial Neural Networks-II</b><br/> 5.1 Linear threshold units. Perceptrons<br/> 5.2 Representational limitation and gradient descent training.<br/> 5.3 Types of Neural Network- Feed Forward Neural Network,<br/> Backpropagation Neural Network, Error calculation in ANN<br/> 5.4 Learning in ANN and Learning Rate</p> <p><b>Unit 6: Model Validation</b><br/> 6.1 ML Techniques overview<br/> 6.2 Validation Techniques (Cross-Validations)<br/> 6.3 Feature Reduction/Dimensionality reduction<br/> 6.4 Principal components analysis (Eigen values, Eigen vectors, Orthogonality)<br/> 6.5 Generalization, Overfitting, and Underfitting, Relation of Model Complexity to Dataset Size</p> |
| Text and Reference Literature | <p>1. AI an Machine Learning, Vinod Chandra SS, Anans Hareendran S. PHI Publication<br/> 2. Machine Learning with Python, Abhishek Vijayvargia, BPB Publication<br/> 3. Machine Learning Hand-On for Developers and Technical Professionals, Jason Bell, Wiley Publication<br/> 4. Machine Learning for Beginners: Learn to Build Machine Learning Systems Using Python, Harsh Bhasin, BPB Publication<br/> 5. Machine Learning - Tom M. Mitchell, McgrewHill Publication</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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|                                                                                               |                                   |                     |                                     |                                                                |                                        |              |
|-----------------------------------------------------------------------------------------------|-----------------------------------|---------------------|-------------------------------------|----------------------------------------------------------------|----------------------------------------|--------------|
| <b>Name of College:</b> Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |                     |                                     |                                                                |                                        |              |
| <b>Faculty</b>                                                                                | Computer Science and Applications |                     | <b>Program</b>                      | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                        |              |
| <b>Year</b>                                                                                   | 2026-27                           |                     | <b>Version</b>                      | 1                                                              |                                        |              |
| <b>Semester</b>                                                                               | 8                                 |                     | <b>Effective From</b>               | June 2026                                                      |                                        |              |
| <b>Course Code</b>                                                                            | BSCS11810                         | <b>Course Name</b>  | <b>Major:</b> Machine Learning (PR) |                                                                |                                        |              |
|                                                                                               |                                   |                     |                                     |                                                                |                                        |              |
| <b>Teaching Scheme</b>                                                                        |                                   |                     |                                     | <b>Examination Scheme</b>                                      |                                        |              |
| <b>Credits</b>                                                                                | <b>Lecture (L)</b>                | <b>Tutorial (T)</b> | <b>Practical (P)</b>                | <b>Continuous and Comprehensive Evaluation (CCE)</b>           | <b>Semester end examinations (SEE)</b> | <b>Total</b> |
| 1                                                                                             | 0                                 | 0                   | 2                                   | 25                                                             | 25                                     | 50           |

|                   |                                                                                                                                                                                                                                           |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose of Course | The purpose of the course is to make students capable of implementing concepts, methods and tools related to machine learning.                                                                                                            |
| Course Objective  | The course aims to develop the ability to design, implement, and evaluate machine learning models for solving real-world problems, with a focus on both theoretical understanding and practical skills using modern tools and techniques. |
| Pre-requisite     | Understanding of Statistics, Mathematics and Algorithms                                                                                                                                                                                   |
| Course Outcome    | After completion of this course, the student will be able to understand and solve real world ML problems, application areas and state of the art ML concepts which are being used in practical implementation.                            |
| Course Content    | After completion of this course, the student will be capable of developing Machine Learning based solutions.                                                                                                                              |
| Practical         | List of practical will be prepared at the beginning of each semester                                                                                                                                                                      |
| Reference Books   | As per paper Major-Machine Learning (Th)                                                                                                                                                                                                  |

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|                                                                                        |                                   |              |                                            |                                                                |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|--------------------------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                                            |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                                    | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                                    | 1                                                              |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From                             | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS12801                         | Course Name  | Minor: Information and Cyber Security - IV |                                                                |                                 |       |
|                                                                                        |                                   |              |                                            |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                                            | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)                              | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 4                                                                                      | 4                                 | 0            | -                                          | 50                                                             | 50                              | 100   |

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| Purpose of Course | Conceptualize the students with the concepts of computer forensics methodology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Course Objective  | Familiarization with different objectives associated with different forensic techniques. Different stages of the forensic investigation process life cycle can focus on a broad idea of the forensic process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Pre-requisite     | Basic knowledge of Cyber security, Information security, computer network, operating systems and hardware mechanism of IT peripherals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Course Outcome    | <ol style="list-style-type: none"> <li>1. Explain the five core functions of NIST CSF 2.0 (Identify, Protect, Detect, Respond, Recover, Govern) and their interdependencies</li> <li>2. Map adversary tactics to the Cyber Kill Chain model (Reconnaissance, Weaponization, Delivery, Exploitation, Installation, Command &amp; Control, Actions on Objectives)</li> <li>3. Distinguish between MITRE ATT&amp;CK Tactics, Techniques, and Sub techniques for threat modeling</li> <li>4. Explain the Shared Responsibility Model and distinguish provider vs. customer duties across AWS, Azure, GCP</li> <li>5. Describe IAM identity types (users, roles, service accounts) and policy enforcement mechanisms</li> <li>6. Compare encryption strategies (at-rest, in-transit, key management) and their trade-offs</li> <li>7. Explain OWASP Top 10 2021 vulnerabilities (Injection, Broken Authentication, Sensitive Data Exposure, XML Injection, Broken Access Control, etc.) with attack scenarios.</li> <li>8. Compare web, mobile (iOS/Android), and API security considerations</li> <li>9. Discuss secure SDLC and DevSecOps integration points</li> <li>10. Define CVE, CVSS, CWE taxonomies and explain scoring</li> </ol> |

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|                | <p>methodology</p> <p>11. Describe vulnerability scanning methodologies and interpret scan results</p> <p>12. Prioritize vulnerabilities using risk-based approach (CVSS + business context)</p> <p>13. Explain NIST Incident Response lifecycle phases (Preparation, Detection, Containment, Eradication, Recovery)</p> <p>14. Analyze phishing emails to identify IoCs; validate authenticity using SPF/DKIM/DMARC</p> <p>15. Design IR playbooks for common incident types</p> <p>16. Explain forensic tool categories (disk, memory, network analysis) and Their use cases</p> <p>17. Describe chain-of-custody requirements and forensic integrity Principles (hashing, write-blockers)</p> <p>18. Explain Windows Registry structure, hives, and key artifacts for forensic investigation</p> <p>19. Interpret Event Logs to identify user activity, privilege escalation, Malware execution</p> <p>20. Describe Windows file system artifacts (NTFS, MFT, USN Journal) useful in forensics.</p>                                                                                                                                                                                            |
| Course Content | <p><b>Unit 1: Cyber Defense Strategy &amp; Frameworks</b></p> <p>1.1 NIST Cybersecurity Framework (CSF)2.0</p> <p>1.1.1 Six core functions (Govern, Identify, Protect, Detect, Respond, Recover)</p> <p>1.1.2 Categories and Sub-categories</p> <p>1.1.3 Implementation Tiers (Partial, Risk-Informed, Repeatable, Adaptive)</p> <p>1.1.4 Profiles (Current vs. Target)</p> <p>1.2 Cyber Kill Chain(Lockheed Martin)</p> <p>1.2.1 7 stages of attack lifecycle</p> <p>1.2.2 Detection opportunities at each stage</p> <p>1.2.3 Defensive implications</p> <p>1.2.4 Case studies (APT28, APT29)</p> <p>1.3 MITRE ATT&amp;CK Framework</p> <p>1.3.1 Tactics vs. Techniques vs. Sub-techniques</p> <p>1.3.2 Threat Groups and Software Mapping</p> <p>1.3.3 Mitigation strategies</p> <p>1.3.4 Navigator tool usage</p> <p>1.4 Defense-in-Depth Principles</p> <p>1.4.1 Layered security model</p> <p>1.4.2 Zero Trust Architecture principles</p> <p>1.4.3 Risk acceptance vs. mitigation</p> <p>1.4.4 Trade-offs between usability and security</p> <p>1.5 Hands-on session based on the above topics</p> <p><b>Unit 2: Cloud Security Fundamentals</b></p> <p>2.1 Shared Responsibility Model</p> |

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|  | <ul style="list-style-type: none"> <li>2.1.1 Provider responsibilities (AWS/Azure/GCP)</li> <li>2.1.2 Customer responsibilities</li> <li>2.1.3 Shared services (IAM, encryption)</li> <li>2.1.4 Common misunderstandings</li> <li>2.2 Cloud IAM (Identity &amp; Access Management) <ul style="list-style-type: none"> <li>2.2.1 Concepts: Authentication, Authorization, Accounting</li> <li>2.2.2 Identity federation and SSO</li> <li>2.2.3 Role-Based Access Control (RBAC)</li> <li>2.2.4 Policy languages (AWS IAM, Azure RBAC)</li> <li>2.2.5 Privilege escalation vectors</li> </ul> </li> <li>2.3 Data Protection: Encryption &amp; Secrets <ul style="list-style-type: none"> <li>2.3.1 Encryption at rest (KMS, key rotation)</li> <li>2.3.2 Encryption in transit (TLS, VPN)</li> <li>2.3.3 Key management best practices</li> <li>2.3.4 Secrets rotation (passwords, API keys)</li> <li>2.3.5 Data classification</li> </ul> </li> <li>2.4 Cloud Network Security <ul style="list-style-type: none"> <li>2.4.1 VPC architecture and subnets</li> <li>2.4.2 Security Groups vs. Network ACLs</li> <li>2.4.3 Public vs. private connectivity</li> <li>2.4.4 DDoS protection</li> <li>2.4.5 WAF principles</li> </ul> </li> <li>2.5 Hands-on session based on the above topics</li> <li><b>Unit 3: Application &amp; Mobile Security</b></li> <li>3.1 OWASP Top 10(Web) <ul style="list-style-type: none"> <li>3.1.1 Injection (SQL, NoSQL, OS command)</li> <li>3.1.2 Broken Authentication &amp; Session Management</li> <li>3.1.3 Sensitive Data Exposure</li> <li>3.1.4 XML External Entities (XXE)</li> <li>3.1.5 Broken Access Control (BOLA)</li> <li>3.1.6 Security Misconfiguration</li> <li>3.1.7 Cross-Site Scripting (XSS: Stored, Reflected, DOM)</li> <li>3.1.8 Insecure Deserialization</li> <li>3.1.9 Using Components with Known Vulnerabilities</li> <li>3.1.10 Insufficient Logging &amp; Monitoring</li> </ul> </li> <li>3.2 OWASP Mobile Top10 <ul style="list-style-type: none"> <li>3.2.1 Improper Platform Usage (iOS/Android APIs)</li> <li>3.2.2 Insecure Data Storage</li> <li>3.2.3 Insecure Communication</li> <li>3.2.4 Insecure Authentication</li> <li>3.2.5 Insufficient Cryptography</li> <li>3.2.6 Reverse Engineering &amp; Tampering</li> <li>3.2.7 Extraneous Functionality</li> <li>3.2.8 Code Quality Issues</li> <li>3.2.9 Memory Management</li> </ul> </li> <li>3.3 API Security</li> </ul> |
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|  | <p>3.3.1 Authorization (BOLA, excessive data exposure)</p> <p>3.3.2 Rate limiting &amp; DDoS protection</p> <p>3.3.3 Input validation</p> <p>3.3.4 Common API vulnerabilities</p> <p>3.4 Secure SDLC /DevSecOps</p> <p>3.4.1 Threat modeling (STRIDE)</p> <p>3.4.2 Secure code review practices</p> <p>3.4.3 SAST vs. DAST tools</p> <p>3.4.4 Dependency scanning</p> <p>3.5 Hands-on session based on the above topics</p> <p><b>Unit 4: Vulnerability Management</b></p> <p>4.1 CVE (Common Vulnerabilities &amp; Exposures)</p> <p>4.1.1 Numbering scheme and structure</p> <p>4.1.2 CVE distribution channels (NVD, vendor advisories)</p> <p>4.1.3 Using CVE databases for threat intelligence</p> <p>4.2 CVSS (Common Vulnerability Scoring System)</p> <p>4.2.1 CVSS v3.1 metrics (Base, Temporal, Environmental)</p> <p>4.2.2 Severity ratings (None, Low, Medium, High, Critical)</p> <p>4.2.3 Scoring calculations and limitations</p> <p>4.2.4 Context-dependent scoring adjustments</p> <p>4.3 CWE (Common Weakness Enumeration)</p> <p>4.3.1 Weakness hierarchy and categories</p> <p>4.3.2 Mapping CWE to OWASP Top 10</p> <p>4.3.3 CWE Top 25 and business impact</p> <p>4.3.4 Using CWE for defense planning</p> <p>4.4 Vulnerability Scanning Tools &amp; Workflows</p> <p>4.4.1 Scanner types: Agent-based, network-based, application-based</p> <p>4.4.2 False positives and false negatives</p> <p>4.4.3 Scan scope definition (IP ranges, ports)</p> <p>4.4.4 Results interpretation and prioritization</p> <p>4.5 Vulnerability Lifecycle Management</p> <p>4.5.1 Detection → Assessment → Prioritization → Remediation → Verification</p> <p>4.5.2 Patch management integration</p> <p>4.5.3 Risk acceptance documentation</p> <p>4.6 Hands-on session based on the above topics</p> <p><b>Unit 5: Social Engineering &amp; Incident Response</b></p> <p>5.1 Phishing Analysis &amp; Detection</p> <p>5.1.1 Email header structure (From, To, Reply-To, Return-Path)</p> <p>5.1.2 Phishing vectors (credential harvesting, malware delivery)</p> <p>5.1.3 Social engineering psychology</p> <p>5.1.4 URL analysis (domain registration, IP geolocation)</p> <p>5.1.5 Email authentication bypasses</p> <p>5.2 Email Authentication(SPF/DKIM/DMARC)</p> <p>5.2.1 SPF record syntax and policy evaluation</p> |
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|  | <p>5.2.2 DKIM signing and verification</p> <p>5.2.3 DMARC alignment and failure handling</p> <p>5.3 NIST IR Lifecycle</p> <p>5.3.1 Phase 1: Preparation (tools, playbooks, training)</p> <p>5.3.2 Phase 2: Detection &amp; Analysis (alert triage, severity assessment)</p> <p>5.3.3 Phase 3: Containment (short-term, long-term)</p> <p>5.3.4 Phase 4: Eradication (root cause removal)</p> <p>5.3.5 Phase 5: Recovery (system restoration, validation)</p> <p>5.3.6 Post-incident review (lessons learned)</p> <p>5.4 Malware &amp; Indicators of Compromise (IoCs)</p> <p>5.4.1 File hashes (MD5, SHA-1, SHA-256)</p> <p>5.4.2 Network IoCs (IPs, domains, URLs)</p> <p>5.4.3 Host IoCs (registry keys, process names)</p> <p>5.4.4 Threat intelligence feeds (VirusTotal)</p> <p>5.4.5 False indicators and context</p> <p>5.5 Hands-on session based on the above topics</p> <p><b>Unit 6: Forensic Investigation Tools</b></p> <p>6.1 Forensic Fundamentals &amp; Tools Categories</p> <p>6.1.1 Disk forensics (file systems, unallocated space)</p> <p>6.1.2 Memory forensics (volatile data)</p> <p>6.1.3 Network forensics (packet capture)</p> <p>6.1.4 Log analysis (SIEM, event logs)</p> <p>6.1.5 Chain of custody and evidence integrity</p> <p>6.2 Splunk Log Analysis</p> <p>6.2.1 Data ingestion methods (forwarders, HTTP Event Collector)</p> <p>6.2.2 Search Processing Language (SPL) fundamentals</p> <p>6.2.3 Queries for threat hunting (authentication, file access)</p> <p>6.2.4 Dashboards and alerting</p> <p>6.2.5 Log retention and compliance</p> <p>6.3 Autopsy Disk Analysis</p> <p>6.3.1 Filesystem analysis (NTFS, FAT, ext4)</p> <p>6.3.2 Timeline generation</p> <p>6.3.3 Artifact extraction (files, registry, media)</p> <p>6.3.4 Deleted item recovery</p> <p>6.3.5 Keyword search and tagging</p> <p>6.4 Network Miner Packet Analysis</p> <p>6.4.1 PCAP file parsing</p> <p>6.4.2 Network reconstruction</p> <p>6.4.3 File extraction from traffic</p> <p>6.4.4 Metadata analysis</p> <p>6.4.5 Anomaly detection</p> <p>6.5 Hands-on session based on the above topics</p> <p><b>Unit 7: Windows Systems Forensics</b></p> <p>7.1 Volatile Data Collection</p> <p>7.1.1 RAM acquisition methods (FDPRO, FTK Imager, DumpIt)</p> <p>7.1.2 Memory forensics tools (Volatility)</p> |
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|                               | <p>7.1.3 Process and network connection extraction<br/> 7.1.4 Rootkit detection in memory<br/> 7.1.5 Live response considerations</p> <p>7.2 Registry Analysis<br/> 7.2.1 Hive structure (HKLM, HKCU, SAM, SECURITY)<br/> 7.2.2 User profiles and SID mapping<br/> 7.2.3 Run keys and persistence mechanisms<br/> 7.2.4 Network shares and mounted devices<br/> 7.2.5 Installed software and drivers</p> <p>7.3 Browser Forensics<br/> 7.3.1 Chrome/Firefox/Edge artifact locations<br/> 7.3.2 History, bookmarks, cache analysis<br/> 7.3.3 Download history and timestamps<br/> 7.3.4 Cookie exfiltration indicators<br/> 7.3.5 Autocomplete data</p> <p>7.4 Event Log Analysis<br/> 7.4.1 Security log events (login, privilege escalation)<br/> 7.4.2 System log events (services, driver loads)<br/> 7.4.3 Application log events (software execution)<br/> 7.4.4 Event IDs relevant to security (4624, 4688, 7045)<br/> 7.4.5 Log forwarding and timestamping issues</p> <p>7.5 Hands-on session based on the above topics</p> <p><b>Unit 8: Cloud forensics</b><br/> 8.1 Introduction to cloud forensic<br/> 8.2 Challenges faced by CSP due to international law enforcement<br/> 8.3 Cloud storage forensic framework<br/> 8.4 Google drive and Drop box analysis<br/> 8.5 Case study</p> |
| Text and Reference Literature | <p>Frameworks &amp; Standards<br/> 1.1 NIST Cybersecurity Framework (CSF) 2.0<br/> 1.2 NIST Incident Response Guide (SP 800-61)<br/> 1.3 MITRE ATT &amp; CK Framework<br/> 1.4 Cyber Kill Chain (Lockheed Martin)<br/> 1.5 OWASP Top 10 (Web &amp; Mobile)<br/> 1.6 ISO 27001/27002 (referenced in institutional context)<br/> 1.7 NIST SP 800-53: Security and Privacy Controls</p> <p>2. Recommended Textbooks<br/> 2.1 Windows Forensic Analysis, by Harlan Carvey<br/> 2.2 Network Forensics: Tracking Hackers Through Cyberspace, by Sherri Davidoff &amp; Jonathan Ham<br/> 2.3 The Incident Response Playbook, by Erica Friedberg<br/> 2.4 Practical Vulnerability Management, by Abhishek Arora<br/> 2.5 Cloud Security: A Comprehensive Beginner's Guide, by Robert Slade</p> <p>3. Free/Open-Source Tools Endorsed<br/> 3.1 Splunk Free Edition</p>                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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|  | <p>3.2 Autopsy (The Sleuth Kit)</p> <p>3.3 Wireshark</p> <p>3.4 Nessus Essentials</p> <p>3.5 OpenVAS</p> <p>3.6 Burp Suite Community</p> <p>3.7 MobSF (Mobile Security Framework)</p> <p>4. External References</p> <p>4.1 SANS Cyber Aces (free labs)</p> <p>4.2 PortSwigger Web Security Academy</p> <p>4.3 HackTheBox (CTF platform)</p> <p>4.4 TryHackMe (interactive labs)</p> <p>4.5 YouTube: NetworkChuck, John Hammond, LiveOverflow</p> <p>5. Computer forensic by John R. Vacca, Firewall media,</p> <p>6. Computer forensic, Nina godbole, sunit belapure, wiley</p> <p>7. Wireless crime and forensic investigation, Gregory kipper, Auerbach publication (Tallor and Francis group)</p> <p>8. Computer forensic and cybercrime 3rd edition, by Marjie Britz, pearson</p> <p>9. Computer forensic investigation network intrusion and cybercrime EC Council, course technology</p> |
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|----------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------|----------------------------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                            |                                                                |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                    | B.Sc. Honours / B.Sc. Honours with Research (Computer Science) |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                    | 1                                                              |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From             | June 2026                                                      |                                 |       |
| Course Code                                                                            | BSCS15802                         | Course Name  | SEC: AI-Driven Development |                                                                |                                 |       |
|                                                                                        |                                   |              |                            |                                                                |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                            | Examination Scheme                                             |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)              | Continuous and Comprehensive Evaluation (CCE)                  | Semester end examinations (SEE) | Total |
| 2                                                                                      | 2                                 | 0            | 0                          | 25                                                             | 25                              | 50    |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| Purpose of Course | The purpose of the course is to introduce advanced ai tools to developers who can automate tasks, generate quality code, customize models, and accelerate software and application development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Course Objective  | <ul style="list-style-type: none"> <li>◆ Understand the application of AI for software development work</li> <li>◆ Use AI pair programming and/or code management and collaboration.</li> <li>◆ Learn to use modern AI automation for handling repetitive writing, project management, and debugging so developers can focus on problem-solving and system architecture.</li> </ul>                                                                                                                                                                                                                                                                                     |
| Pre-requisite     | Programming skills in any language and Familiarity with command-line operations and AI fundamentals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Course Out come   | After completion of this course, the student will be capable of developing and deploying applications with AI assistance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Course Content    | <p><b>Unit 1: Foundations of AI-Driven Development</b></p> <p>1.1 The Core Shift: From Coding to Architecting</p> <p>1.2 Automated Code Generation</p> <p>1.3 Introduction to Vibe Coding</p> <p>1.4 AI Pair Programmer</p> <p>1.5 Inline Autocomplete Plugins, AI-Native IDEs, Coding Agents</p> <p><b>Unit 2: AI Scaffolding and Templates</b></p> <p>2.1 Stack-Aware Generation</p> <p>2.2 Intelligent Templating</p> <p>2.3 Prompt and Agent based project scaffolding</p> <p>2.4 Layered Boundaries and Guardrails</p> <p>2.5 AI code plugins and IDE plugins</p> <p><b>Unit 3: Agentic Development Platform</b></p> <p>3.1 Introduction to Google Antigravity</p> |

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|                               | <p>3.2 Antigravity CLI, Antigravity SDK and IDE</p> <p>3.3 Setup, Installation and Configurations</p> <p>3.4 Projects and Conversations</p> <p>3.5 Project Configurations</p> <p><b>Unit 4: Agent Skills, Rules and Workflows</b></p> <p>4.1 Agent skills</p> <p>4.2 Creating Skills - skills.md file</p> <p>4.3 Script Integrations</p> <p>4.4 Building skill using Antigravity</p> <p>4.5 Rules and Workflows</p> <p>4.6 Plugins</p>                                       |
| Text and Reference Literature | <p>1. AI Engineering: Building Applications with Foundation Models - by Chip Huyen</p> <p>2. The Ultimate Guide to Google Antigravity: From Vibe Coding to Solopreneur: Build &amp; Sell Your First App in 7 Days Without Hiring Devs (Google Antigravity Mastery Series Book 1)</p> <p>3. Google Antigravity Pro: Harness Google AI to accelerate software delivery, improve code quality and scale modern AI-assisted development. (AI Coding) by Codapress Publishing</p> |

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|-----------------------------------------------------------------------------------------------|-----------------------------------|---------------------|-----------------------------------|------------------------------------------------------|----------------------------------------|--------------|
| <b>Name of College:</b> Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |                     |                                   |                                                      |                                        |              |
| <b>Faculty</b>                                                                                | Computer Science and Applications |                     | <b>Program</b>                    | B.Sc. Honours with Research                          |                                        |              |
| <b>Year</b>                                                                                   | 2026-27                           |                     | <b>Version</b>                    | 1                                                    |                                        |              |
| <b>Semester</b>                                                                               | 8                                 |                     | <b>Effective From</b>             | June 2026                                            |                                        |              |
| <b>Course Code</b>                                                                            | BSCS18801                         | <b>Course Name</b>  | <b>Research Project – II (TH)</b> |                                                      |                                        |              |
|                                                                                               |                                   |                     |                                   |                                                      |                                        |              |
| <b>Teaching Scheme</b>                                                                        |                                   |                     |                                   | <b>Examination Scheme</b>                            |                                        |              |
| <b>Credits</b>                                                                                | <b>Lecture (L)</b>                | <b>Tutorial (T)</b> | <b>Practical (P)</b>              | <b>Continuous and Comprehensive Evaluation (CCE)</b> | <b>Semester end examinations (SEE)</b> | <b>Total</b> |
| 2                                                                                             | 2                                 | 0                   | -                                 | 25                                                   | 25                                     | 50           |

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| Purpose of Course | This course aims to provide scholars with a comprehensive understanding of research principles, methodologies, data collection and analysis techniques, literature review, and scientific communication, enabling them to plan, conduct, and present high-quality research.                                                                                                                                                                                                                                                             |
| Course Objective  | <ol style="list-style-type: none"> <li>To introduce the fundamental concepts and principles of research.</li> <li>To develop the ability to design robust research methodologies.</li> <li>To understand various tools and techniques for data collection and analysis.</li> <li>To enable effective communication of research findings through academic writing and presentations.</li> </ol>                                                                                                                                          |
| Pre-requisite     | Basic understanding of the subject domain and fundamental computer skills. No prior research experience is required.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Course Outcome    | Upon successful completion of this course, scholars will be able to: <ul style="list-style-type: none"> <li>Identify and formulate research problems clearly and systematically.</li> <li>Design and implement appropriate research methodologies.</li> <li>Collect, analyse, and interpret research data using appropriate tools and techniques. Critically evaluate, synthesize, and present academic literature to support research.</li> <li>Communicate research findings effectively in both written and oral formats.</li> </ul> |
| Course Content    | <b>Unit 1: Data Collection and Pre-processing</b> <ol style="list-style-type: none"> <li>1.1 Data Sources: Public Datasets, Web Scraping, Sensors, APIs</li> <li>1.2 Data Cleaning, Handling Missing Values, and Outlier Detection</li> <li>1.3 Data Annotation &amp; Labelling Strategies</li> <li>1.4 Ethical Data Handling and Privacy Concerns</li> <li>1.5 Ethical Review Boards and Research Compliance</li> </ol>                                                                                                                |

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**B.Sc. (Honours) (Computer Science) /**  
**B.Sc. (Honours with Research) (Computer Science)**  
**Semester - VII and Semester - VIII**

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <p><b>Unit 2: Algorithmic and Model Development</b></p> <p>2.1 Model Selection Strategies</p> <p>2.2 Comparative Analysis of Models</p> <p>2.2 Parameter, Hyperparameter Tuning and Optimization Techniques</p> <p>2.3 Transfer Learning and Pretrained Models</p> <p>2.4 Interpretable AI and Explainability</p> <p><b>Unit 3: Experimental Design</b></p> <p>3.1 Experimental setup - Hardware specification, Software environment, network configuration, controlled and variable environment</p> <p>3.2 Training, Validation, and Test Splits</p> <p>3.3 Cross-validation and Bootstrapping Methods</p> <p>3.4 Designing Fair and Bias-free Experiments</p> <p>3.5 Performance Evaluation Metrics</p> <p>3.6 Software Tools and Platforms</p> <p>3.6.1 Python Ecosystem for Research (NumPy, Pandas, Scikit-learn, TensorFlow, PyTorch)</p> <p>3.6.2 Big Data Frameworks (Hadoop, Spark) and Cloud Platforms (AWS, Azure, GCP)</p> <p>3.6.3 Research-oriented Tools (Jupyter, Colab, MLflow)</p> <p><b>Unit 4: Presenting Research Findings and Protecting Research Innovations</b></p> <p>4.1 Result Interpretation and Visualization</p> <p>4.1.1 Visualization Tools</p> <p>4.1.2 Statistical Significance in Model Comparisons</p> <p>4.3 Error Analysis and Model Diagnostics</p> <p>4.4 Best Practices for Presenting Research Findings</p> <p>4.5 Patent, Copyright, and Intellectual Property</p> <p>4.6 Open-source Licensing for AI Models</p> <p>4.7 Industry Collaboration and NDA Considerations</p> |
| Text and Reference Literature | <ol style="list-style-type: none"> <li>1. Anshuman Mishra, Research Methodology in Artificial Intelligence, Machine Learning, and Data Science: a comprehensive guide for students and researchers (AI Course)</li> <li>2. Kothari, C. R. Research Methodology: Methods and Techniques. New Age International Publishers.</li> <li>3. Panneerselvam, R. Research Methodology. 2nd Edition. PHI Learning.</li> <li>4. Merriam, S. B., &amp; Tisdell, E. J. Qualitative Research: A Guide to Design and Implementation. 4th Edition. Jossey-Bass.</li> <li>5. Zobel, J. Writing for Computer Science. Springer-Verlag, New York, 1997.</li> <li>6. Parberry, I. A Guide for New Referees in Theoretical Computer Science.</li> <li>7. Parberry, I. How to Present a Paper in Theoretical Computer Science.</li> <li>8. Chapman, D. (Ed.). How to Do Research in the MIT AI Lab.</li> <li>9. Comer, D. How to Write a Thesis in an Experimental Area of Computer Science.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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**Semester - VII and Semester - VIII**

|                                                                                        |                                   |              |                            |                                               |                                 |       |
|----------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------|-----------------------------------------------|---------------------------------|-------|
| Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences |                                   |              |                            |                                               |                                 |       |
| Faculty                                                                                | Computer Science and Applications |              | Program                    | B.Sc. Honours with Research                   |                                 |       |
| Year                                                                                   | 2026-27                           |              | Version                    | 1                                             |                                 |       |
| Semester                                                                               | 8                                 |              | Effective From             | June 2026                                     |                                 |       |
| Course Code                                                                            | BSCS18802                         | Course Name  | Research Project – II (PR) |                                               |                                 |       |
|                                                                                        |                                   |              |                            |                                               |                                 |       |
| Teaching Scheme                                                                        |                                   |              |                            | Examination Scheme                            |                                 |       |
| Credits                                                                                | Lecture (L)                       | Tutorial (T) | Practical (P)              | Continuous and Comprehensive Evaluation (CCE) | Semester end examinations (SEE) | Total |
| 4                                                                                      | 0                                 | 0            | 8                          | 50                                            | 50                              | 100   |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| Purpose of Course | This course aims to provide students with an opportunity to implement and complete the research/project work planned in Research Project-I. It emphasizes implementation of the proposed methodology, experimentation, testing, data analysis, performance evaluation, interpretation of results, and preparation and presentation of the final research/project outcomes.                                                                                                                                                                                                                                                                         |
| Course Objective  | <ol style="list-style-type: none"> <li>7. To enable students to implement the research/project methodology developed in Research Project-I.</li> <li>8. To develop skills in conducting systematic experiments, testing, data collection and computational analysis.</li> <li>9. To enable students to evaluate the developed solution using appropriate performance measures and experimental approaches.</li> <li>10. To develop the ability to analyse, interpret and critically discuss project/research findings.</li> <li>11. To enable students to document the complete research/project work in a structured technical report.</li> </ol> |

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**Semester - VII and Semester - VIII**

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pre-requisite  | Successful completion of Research Project-I (Th)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Outcome | <ul style="list-style-type: none"><li>• Implement an appropriate computational solution based on the research problem and methodology developed in Research Project-I.</li><li>• Conduct systematic experiments, testing and data collection using appropriate tools and techniques.</li><li>• Analyse and interpret project/research data using appropriate computational, statistical and visualization techniques.</li><li>• Evaluate the developed solution using suitable performance measures and compare the results with relevant existing or baseline approaches.</li><li>• Identify limitations, analyse errors and critically discuss the findings in relation to the defined research objectives.</li><li>• Prepare and communicate the complete research/project work through technical documentation, presentation and demonstration.</li></ul> |