ST. FRANCIS DE SALES COLLEGE
A FRANSALIAN INSTITUTE OF HIGHER EDUCATION AUTONOMOUS
NAAC A GRADE • AFFILIATED TO BANGALORE UNIVERSITY • AICTE APPROVED • 2(F) & 12 (B) RECOGNITION OF UGC • ISO 9001:2015 CERTIFIED
Electronics City P.O., Bengaluru - 560 100, Karnataka, INDIA (+91) 8088140679 pro@sfscollege.in www.sfscollege.in

# BCA [3 YEARS] Syllabus

# and

# Scheme From 2024-2025

## BOARD OF STUDIES
## [COMPUTER SCIENCE AND APPLICATIONS]

**St. Francis de Sales College [Autonomous]**
**Electronics City P.O. Bengaluru 560100 Karnataka,**
**INDIA**

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# MEMBERS OF THE BOARD OF STUDIES

| Sl. No. | Name | Designation |
|---|---|---|
| 1. | Dr. S. Sivagami,<br>Program In-charge and Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Chairperson |
| 2. | Dr. Hanumanthappa M<br>Senior Professor & Director, ISC & PM- USHA project,<br>Ex- Registrar,<br>Department of Computer Science,<br>Bangalore University, Bangalore. | University Nominee |
| 3. | Dr. Sabeen Govind P V<br>Assistant Professor, Rajagiri College of Social Sciences | External Expert |
| 4. | Dr. Kousalya Govardhanan<br>Professor & Dean of Research, Dayananda Sagar University, Electronic City (Subject Expert nominated by the Academic Council) | External Expert |
| 5. | Mr. Maria Joseph Frederic<br>Senior Manager, IBM ISL R&D | Industry Expert |
| 6. | Mr. Phani Pramod,<br>Senior Development Manager, Essbase and Database tools, Oracle | Industry Expert |
| 7. | Ms. Umme Hermain Shaikh<br>Associate Consultant, Tarento Technologies, Bengaluru | Alumni |
| 8. | Ms. Sailaja M<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |
| 9. | Ms. S. Annie Christella<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |

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| 12. | Ms. Amruta Gadad<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |
| 13. | Ms. Sathiya Priya<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |
| 14. | Ms. Gowthami Gunasekar<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |
| 15. | Ms. Arundhati Ghosh,<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |
| 16. | Mr. Joseph Rajakumar,<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |
| 17. | Mr. Kirubakaran,<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |
| 18. | Ms. Samadrita Chakraborty,<br>Assistant Professor, St. Francis de Sales College (Autonomous), Electronic City, Bengaluru. | Member |

# PREFACE TO THE BCA 2024-2025 SYLLABUS

ಕರ್ನಾಟಕ ಸರ್ಕಾರದ ನಡಾವಳಿಗಳು

ವಿಷಯ: ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆಯ ವ್ಯಾಪ್ತಿಯಲ್ಲಿನ ವಿಶ್ವವಿದ್ಯಾಲಯಗಳು ಮತ್ತು ಕಾಲೇಜುಗಳಲ್ಲಿ 2024-25ನೇ ಸಾಲಿನಿಂದ ಪದವಿ ಕಾರ್ಯಕ್ರಮಗಳ ಅವಧಿ ಮತ್ತು ಪಠ್ಯಕ್ರಮವನ್ನು ಪರಿಷ್ಕರಿಸುವ ಬಗ್ಗೆ.

ಓದಲಾಗಿದೆ:
1. ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 260 ಯುಎನ್ಇ 2019 (ಭಾಗ-1) ಬೆಂಗಳೂರು, ದಿನಾಂಕ:07.08.2021.
2. ಸರ್ಕಾರಿ ಆದೇಶ ಸಂಖ್ಯೆ:ಇಡಿ 166 ಯುಎನ್ಇ 2023, ಬೆಂಗಳೂರು ದಿನಾಂಕ:11.10.2023
3. ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿ ಆಯೋಗದ ಮಧ್ಯಂತರ ವರದಿ ದಿನಾಂಕ:18.01.2024.
4. ಕರ್ನಾಟಕ ರಾಜ್ಯ ಉನ್ನತ ಶಿಕ್ಷಣ ಪರಿಷತ್ತಿನ ಟಿಪ್ಪಣಿ ದಿನಾಂಕ: 14.02.2024.
5. ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿ ಆಯೋಗದ ವರದಿಗಳ ದಿನಾಂಕ: 19.01.2024 ಮತ್ತು 10.03.2024.
6. ಸರ್ಕಾರದ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿಯವರ ಕಛೇರಿಯ ಅನಧಿಕೃತ ಟಿಪ್ಪಣಿ ಸಂಖ್ಯೆ: CS/05/SCM/2024, dated: 02.04.2024.

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ಮೇಲೆ ಓದಲಾದ ಕ್ರಮ ಸಂಖ್ಯೆ (1) ರ ದಿನಾಂಕ: 07.08.2021ರ ಆದೇಶದಲ್ಲಿ ಭಾರತ ಸರ್ಕಾರವು ಪ್ರಕಟಿಸಿರುವ ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯನ್ನು ರಾಜ್ಯದ ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆಯಡಿ ವಿಶ್ವವಿದ್ಯಾಲಯಗಳು ಮತ್ತು ಸಂಯೋಜಿತ ಕಾಲೇಜುಗಳಲ್ಲಿ 2021-22ನೇ ಶೈಕ್ಷಣಿಕ ವರ್ಷದಿಂದ ಅಗತ್ಯ ಮಾರ್ಗ ಸೂಚಿಗಳನುಸಾರ ಅನುಷ್ಠಾನಗೊಳಿಸಲಾಗಿರುತ್ತದೆ.

ಮೇಲೆ ಓದಲಾದ ಕ್ರಮ ಸಂಖ್ಯೆ (2) ರ ದಿನಾಂಕ: 11.10.2023ರ ಆದೇಶದಲ್ಲಿ ಹೊಸ ಶಿಕ್ಷಣ ನೀತಿಯನ್ನು ರೂಪಿಸುವ ಉದ್ದೇಶದಿಂದ ಕರ್ನಾಟಕ ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿಯ ಕರಡನ್ನು ಸಿದ್ಧಪಡಿಸಲು ಶ್ರೇಷ್ಠ ಶಿಕ್ಷಣ ತಜ್ಞರಾದ Prof. Sukhdev Torat, ಇವರ ಅಧ್ಯಕ್ಷತೆಯಲ್ಲಿ ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿ ಆಯೋಗವನ್ನು ರಚಿಸಲಾಗಿರುತ್ತದೆ.

ಮೇಲೆ ಓದಲಾದ ಕ್ರಮ ಸಂಖ್ಯೆ (3) ರಲ್ಲಿ ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿ ಆಯೋಗವು ದಿನಾಂಕ: 18.01.2024ರಂದು ಸರ್ಕಾರಕ್ಕೆ ಮಧ್ಯಂತರ ವರದಿಯನ್ನು ಸಲ್ಲಿಸಿರುತ್ತದೆ.

ಮೇಲೆ ಓದಲಾದ ಕ್ರಮ ಸಂಖ್ಯೆ (4) ರಲ್ಲಿ ಕರ್ನಾಟಕ ರಾಜ್ಯ ಉನ್ನತ ಶಿಕ್ಷಣ ಪರಿಷತ್ತು ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿ ಆಯೋಗವು ಸರ್ಕಾರಕ್ಕೆ ಸಲ್ಲಿಸಿರುವ ಮಧ್ಯಂತರ ವರದಿಯನ್ನು ಸಂಪೂರ್ಣವಾಗಿ ಒಪ್ಪಲು ಶಿಫಾರಸ್ಸು ಮಾಡಿರುತ್ತದೆ.

ಮೇಲೆ ಓದಲಾದ ಕ್ರಮ ಸಂಖ್ಯೆ (5) ರಲ್ಲಿ ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿ ಆಯೋಗವು ದಿನಾಂಕ: 19.01.2024ರಂದು REPORT PART-1 ಮತ್ತು ದಿನಾಂಕ: 10.03.2024ರಂದು ನ್ನು REPORT PART-1(a) ಮಧ್ಯಂತರ ವರದಿಗಳನ್ನು ಸರ್ಕಾರಕ್ಕೆ ಸಲ್ಲಿಸಿರುತ್ತದೆ.

ಮೇಲೆ ಓದಲಾದ ಕ್ರಮ ಸಂಖ್ಯೆ (6) ರಲ್ಲಿ ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿ ಆಯೋಗವು ಸರ್ಕಾರಕ್ಕೆ ಸಲ್ಲಿಸಿರುವ ಮಧ್ಯಂತರ ವರದಿಯಲ್ಲಿನ ಶಿಫಾರಸ್ಸುಗಳನ್ನು 2024-25 ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಪದವಿ ಕಾರ್ಯಕ್ರಮಗಳಿಗೆ ಅನುಷ್ಠಾನಗೊಳಿಸಲು ದಿನಾಂಕ: 02.04.2024ರಂದು ಮಾನ್ಯವರ್ಯ ಆಯೋಗದ ಅನುಮತಿಯನ್ನು ಪಡೆಯಲಾಗಿರುತ್ತದೆ.

ಮೇಲ್ಕಂಡ ಅಂಶಗಳ ಹಿನ್ನೆಲೆಯಲ್ಲಿ, ರಾಜ್ಯ ಶಿಕ್ಷಣ ನೀತಿ ಆಯೋಗವು ಸರ್ಕಾರಕ್ಕೆ ಸಲ್ಲಿಸಿರುವ ಮಧ್ಯಂತರ ವರದಿಗಳಲ್ಲಿನ ಶಿಫಾರಸ್ಸುಗಳನ್ನು 2024 25 ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಪದವಿ ಕಾರ್ಯಕ್ರಮಗಳಿಗೆ ಅನುಷ್ಠಾನಗೊಳಿಸಲು ಉದ್ದೇಶಿಸಿ, ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 260 ಯುಎನ್ಇ 2019 (ಭಾಗ-1)

ಬೆಂಗಳೂರು, ದಿನಾಂಕ:07.08.2021ರ ಆದೇಶವನ್ನು ಪರಿಷ್ಕರಿಸಲು ಸರ್ಕಾರವು ನಿರ್ಧರಿಸಿ, ಅದರಂತೆ, ಈ ಕೆಳಕಂಡ ಆದೇಶ.

ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 166 ಯುಎನ್‌ಇ 2023, ಬೆಂಗಳೂರು, ದಿನಾಂಕ: 08.05.2024.

ಪ್ರಸ್ತಾವನೆಯಲ್ಲಿ ವಿವರಿಸಿರುವ ಅಂಶಗಳನ್ವಯ ರಾಜ್ಯದಲ್ಲಿ ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆಯಡಿಯ ವಿಶ್ವವಿದ್ಯಾಲಯಗಳು ಮತ್ತು ಸಂಯೋಜಿತ ಕಾಲೇಜುಗಳಲ್ಲಿ ಪದವಿ ಕಾರ್ಯಕ್ರಮಗಳಿಗೆ 2024-25ನೇ ಶೈಕ್ಷಣಿಕ ವರ್ಷದಿಂದ ಅನುಬಂಧ-1 ಮತ್ತು ಅನುಬಂಧ-2 ರ ಮಾರ್ಗಸೂಚಿಗಳಿಗನುಸಾರವಾಗಿ ಪದವಿ ಕಾರ್ಯಕ್ರಮಗಳ ಅವಧಿ ಮತ್ತು ಪಠ್ಯಕ್ರಮವನ್ನು ಪರಿಷ್ಕರಿಸಿ ಅನುಷ್ಠಾನಗೊಳಿಸಿ ಆದೇಶಿಸಲಾಗಿದೆ.

1. ಅನುಷ್ಠಾನದ ಮಾರ್ಗಸೂಚಿಗಳು - ಅನುಬಂಧ-1
2. ಪ್ರೋಗ್ರಾಮ್ ವಿನ್ಯಾಸ (Curriculum Structure) - ಅನುಬಂಧ-2

ಕರ್ನಾಟಕ ರಾಜ್ಯಪಾಲರ ಆಜ್ಞಾನುಸಾರ
ಮತ್ತು ಅವರ ಹೆಸರಿನಲ್ಲಿ,

(ಪ್ರಕಾಶ್ ಬ್ಯಾಡಿ)
ಸರ್ಕಾರದ ಉಪ ಕಾರ್ಯದರ್ಶಿ
ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ (ವಿಶ್ವವಿದ್ಯಾಲಯಗಳು)

ಇವರಿಗೆ,

1. ಸರ್ಕಾರದ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿರವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿ, ಕರ್ನಾಟಕ ಸರ್ಕಾರ.
2. ಕುಲಪತಿಗಳು, ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆಯಡಿಯ ಸಾರ್ವಜನಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯಗಳು, ಕರ್ನಾಟಕ.
3. ಸರ್ಕಾರದ ಅಪರ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿಗಳು, ಮಾನ್ಯ ಮುಖ್ಯ ಮಂತ್ರಿಗಳ ಕಛೇರಿ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
4. ಸರ್ಕಾರದ ಅಪರ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿಗಳು ಮತ್ತು ಆಭಿವೃದ್ಧಿ ಆಯುಕ್ತರು, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
5. ಸರ್ಕಾರದ ಅಪರ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿಗಳು, ಆರ್ಥಿಕ ಇಲಾಖೆ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
6. ಸರ್ಕಾರದ ಅಪರ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿಗಳು, ಸಿಸುಆಇ (ಇ-ಆಡಳಿತ ಇಲಾಖೆ), ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
7. ಸರ್ಕಾರದ ಪ್ರಧಾನ ಕಾರ್ಯದರ್ಶಿ, ಶಾಲಾ ಶಿಕ್ಷಣ ಮತ್ತು ಸಾಕ್ಷರತಾ ಇಲಾಖೆ, ಬಹುಮಹಡಿ ಕಟ್ಟಡ, ಬೆಂಗಳೂರು.
8. ಆಯುಕ್ತರು, ಕಾಲೇಜು ಮತ್ತು ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ ಇಲಾಖೆ, ಶೇಷಾದ್ರಿ ರಸ್ತೆ, ಬೆಂಗಳೂರು-1.
9. ಉಪಾಧ್ಯಕ್ಷರು, ಕರ್ನಾಟಕ ರಾಜ್ಯ ಉನ್ನತ ಶಿಕ್ಷಣ ಪರಿಷತ್, ಬೆಂಗಳೂರು.
10. ಕಾರ್ಯನಿರ್ವಾಹಕ ನಿರ್ದೇಶಕರು, ಕರ್ನಾಟಕ ರಾಜ್ಯ ಉನ್ನತ ಶಿಕ್ಷಣ ಪರಿಷತ್, ಬೆಂಗಳೂರು.
11. ಕುಲಸಚಿವರು (ಆಡಳಿತ) ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆಯಡಿಯಲ್ಲಿನ ಸಾರ್ವಜನಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯಗಳು, ಕರ್ನಾಟಕ
12. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ), ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆಯಡಿಯಲ್ಲಿನ ಸಾರ್ವಜನಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯಗಳು, ಕರ್ನಾಟಕ
13. ಮಾನ್ಯ ಉನ್ನತ ಶಿಕ್ಷಣ ಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿ, ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
14. ಮಾನ್ಯ ಶಾಲಾ ಶಿಕ್ಷಣ ಮತ್ತು ಸಾಕ್ಷರತಾ ಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
15. ಸರ್ಕಾರದ ಅಪರ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿರವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿ, ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
16. ಸರ್ಕಾರದ ಉಪ ಕಾರ್ಯದರ್ಶಿ (ವಿಶ್ವವಿದ್ಯಾಲಯಗಳು), ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ, ಬೆಂಗಳೂರು.
17. ಸರ್ಕಾರದ ಉಪ ಕಾರ್ಯದರ್ಶಿ (ಕಾಲೇಜು ಮತ್ತು ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ), ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ, ಬೆಂಗಳೂರು.

Based on the order received from the parent university (Bangalore University - given above), the Board of Studies (Computer Applications) of St. Francis de Sales College (Autonomous), has decided to adopt the grading scheme of the parent university for its BCA Syllabus from 2024-2025 onwards.

# ST. FRANCIS DE SALES COLLEGE (AUTONOMOUS) ABOUT THE COLLEGE

St. Francis de Sales College (Autonomous), popularly known as SFS College, is one of the leading Institutions of Higher Education in Bengaluru, Karnataka. Founded in 2004 with the vision of Excellence, Efficiency, and Transformation, and the Mission of Love of God and Service to Humanity, the College is run by the Missionaries of St. Francis de Sales (MSFS) of the South West India Province, also known as Fransalians. The College is accredited with "A" grade by NAAC, approved by AICTE, recognized under 2(f) & 12(b) by UGC, and certified under ISO 9001:2015. Permanently affiliated to Bangalore University, the College offers several degree programs at the Bachelors, Masters, and Doctoral levels under various disciplines. In 2024, St. Francis de Sales College received the Autonomous status, and it remains as a center for quality education, equipping the students with the skills, knowledge, and values needed to excel and make a meaningful impact in the world.

## VISION AND MISSION VISION

Excellence, Efficiency and Transformation.

### MISSION

Love of God and Service to Humanity.

## DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS

The Computer Science and Applications Department is dedicated to advancing the understanding of computational systems and technologies through rigorous education, innovative research, and community engagement. The department offers a comprehensive curriculum that blends theoretical foundations with practical skills to prepare students for the rapidly evolving technology landscape. With a focus on problem-solving, software development, and cutting-edge research, the department strives to equip students with the tools and knowledge required to excel in a variety of computing fields.

### VISION AND MISSION VISION

Empowering through technology, innovation and expertise

### MISSION

Leveraging computation knowledge to drive societal progress and student success.

## ELIGIBILITY CRITERIA

Candidates who have completed two years Pre-University course of Karnataka State or its equivalent as notified by the Government from time to time are eligible to seek admission for this programme. The students of other states and foreign countries are eligible in accordance with state and central government guidelines from time to time.

### PROGRAMME STRUCTURE AND DURATION

The programme is for Three (03) years consisting of Six Semesters altogether. A candidate shall complete his/her degree within six (06) academic years from the date of his/her admission to the first semester. A Student who successfully completes Three (03) years of the programme will be awarded Bachelor's Degree in Computer Applications (B.C.A) by Bangalore University.

### PROMOTION

A candidate who has obtained a minimum of 35% marks in End Semester examination and an aggregate of 40% marks in each subject shall be eligible for a pass or exemption in that subject.

# PROGRAM OUTCOME (PO)

| | |
|---|---|
| PO1 | Computational Knowledge: Acquire in-depth computational and mathematical knowledge with an ability to abstract and conceptualize from defined problems and requirements. |
| PO2 | Dynamic Problem- Solving Skill: Identify, formulate, and exhibit strong analytical and dynamic problem-solving skills to address evolving computational challenges. |
| PO3 | Innovative System Analysis and Design/ Development: Design and evaluate solutions for complex problems in Data Science, AI & ML, and Full Stack Development, considering societal, cultural, and environmental factors. |
| PO4 | Investigate complex computing problems: Conduct literature surveys, analyze information, and design experiments using appropriate research methods to derive valid conclusions in relevant domains. |
| PO5 | Use of modern tools/ Adaptive proficiency: Select, adapt, and apply modern IT tools and programming languages effectively in Data Science, AI & ML, and Full Stack Development to solve diverse computing challenges. |
| PO6 | Knowledge Optimization: Modify algorithms or software systems to improve efficiency or resource utilization. |
| PO7 | Life Long Continuous learning and Technology Adaptability: Pursue lifelong learning to stay updated with emerging technologies in Data Science, AI & ML, and Full Stack Development for sustained employability. |
| PO8 | Soft skills and Collaborative Teamwork: Communicate effectively, enhance interpersonal skills, and collaborate in multidisciplinary teams essential for success in professional environments. |
| PO9 | Cyber Security Proficiency: Understand cyber threats, develop secure software, and protect sensitive data in Data Science, AI & ML, and Full Stack Development applications. |
| PO10 | Ethical and Professional Conduct: Adhere to ethical standards and professional practices in Data Science, AI & ML, and Full Stack Development roles and responsibilities. |
| PO11 | Employability: Identify market trends, upgrade skills accordingly, and enhance employability in Data Science, AI & ML, and Full Stack Development careers. |

| | |
|---|---|
| PO12 | Innovation and Entrepreneurship: Identify opportunities, innovate, and create value through Data Science, AI & ML, and Full Stack Development projects for personal growth and societal impact. |

## CONTINUOUS INTERNAL ASSESSMENT

**UNDERGRADUATE PROGRAMS:**

**THEORY:**

1. Continuous Internal Assessment (C1 & C2) – 20 marks
2. End Semester Examination – 80 marks

**PRACTICAL:**

1. Continuous Internal Assessment (C1 & C2) – 10 marks
2. End Semester Practical Examination – 40 marks

| S.NO | ASSESSMENTS | COMPONENTS | MARKS & ATTENDANCE | IA MARKS |
|---|---|---|---|---|
| **THEORY SUBJECTS** | | | | |
| 1 | Unit Test (25% of Syllabus) | C1 | 25 | 2.5 |
| 2 | **Skill-Based Activities:** Case Study / Seminar / Assignment / Quiz | C2 | 10 | 5 |
| 3 | Mid Semester Examination (50% of Syllabus) | C2 | 80 | 5 |
| 4 | **Attendance**<br>● 75.00-79.99% - 1 Mark<br>● 80.00-84.99% - 2 Marks<br>● 85.00-89.99% - 3 Marks<br>● 90.00-94.99% - 4 Marks<br>● 95.00-100.00% -5 Marks | C1 | Minimum of 75% | 5 |
| Total | | | | 20 marks |
| **SEC & PRACTICAL SUBJECTS** | | | | |
| 1 | **Attendance**<br>● 75.00-79.99% - 1 Mark<br>● 80.00-84.99% - 2 Marks<br>● 85.00-89.99% - 3 Marks<br>● 90.00-94.99% - 4 Marks<br>● 95.00-100.00% -5 Marks | C1 | Minimum of 75% | 5 |
| 2 | Mid Semester Examination / Model Practical Examination | C2 | Minimum of 75% | 5 |
| Total | | | | 10 Marks |

# GRADING SYSTEM

Table of Conversion of % Marks to grade point:

| % Marks | Grade Point |
|---|---|
| 96-100 | 10 |
| 91-95 | 9.5 |
| 86-90 | 9.0 |
| 81-85 | 8.5 |
| 76-80 | 8.0 |
| 71-75 | 7.5 |
| 66-70 | 7.0 |
| 61-65 | 6.5 |
| 56-60 | 6.0 |
| 51-55 | 5.5 |
| 46-50 | 5.0 |
| 41-45 | 4.5 |
| 40 | 4 |

## Final Result/Grade Description:

| Semester/ Programme % of Marks | Semester GPA/ Programme/ CGPA | Grade Alpha Sign | Result/Class Description |
|---|---|---|---|
| 90.1-100 | 9.01-10.00 | O | Outstanding |
| 80.1-90.0 | 8.01-9.00 | A+ | First Class Exemplary |
| 70.1-80.0 | 7.01-8.00 | A | First Class Distinction |
| 60.1-70.0 | 6.01-7.00 | B+ | First Class |
| 55.1-60.0 | 5.51-6.00 | B | High Second Class |
| 50.1-55.0 | 5.01-5.50 | C | Second Class |
| 40.0-50.0 | 4.00-5.00 | P | Pass Class |
| Below 40 | Below 4.0 | F | Re-Appear |

## EXTERNAL EVALUATION

### THEORY COURSE

There shall be a written semester examination at the end of each semester for all theory courses of duration of 3 hours with maximum 80 marks. A question paper may contain short answer type and long essay type questions. The question paper pattern is as follows.

| SECTIONS | TYPE OF QUESTIONS | MARKS | NUMBER OF QUESTIONS TO BE ANSWERED |
|---|---|---|---|
| A | CONCEPTUAL | 2 | 5 OUT OF 8 |
| B | ANALYTICAL | 5 | 6 OUT OF 8 |
| C | PROBLEM SOLVING | 8 | 5 OUT OF 6 |
| **TOTAL 80 MARKS** | | | |

**DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS**

COURSE MATRIX AS PER 2025

**SEMESTER I**

| | **Subjects** | **Paper/Subject Code** | **Total Teaching hrs** | **Duration of Exam (hrs.)** | **Marks** | | | **Credits** |
|---|---|---|---|---|---|---|---|---|
| | | | | | **IA** | **Uni. Exam** | **Total** | |
| Part 2 Core Papers | Discrete Structures | 24BCA13 | 45 | 4 | 20 | 80 | 100 | 4 |
| | Problem Solving Technique | 24BCA14 | 45 | 4 | 20 | 80 | 100 | 4 |
| | Computer Architecture | 24BCA15 | 45 | 4 | 20 | 80 | 100 | 4 |
| | Problem Solving Technique Lab | 24BCA16 | 60 | 3 | 10 | 40 | 50 | 2 |
| | Computer Architecture Lab | 24BCA17 | 60 | 3 | 10 | 40 | 50 | 2 |
| | Office Automation Tools | 24BCA18 | 60 | 3 | 10 | 40 | 50 | 2 |
| Part 3 Compulsory | Environmental studies (EVS) | 24EVS1X | 30 | 1.5 | 20 | 30 | 50 | 2 |
| | **Total Credits** | | | | | | **700** | **23** |

SEMESTER II

| | **Subjects** | **Paper/Subject Code** | **Total Teaching hrs** | **Duration of Exam (hrs.)** | **Marks** | | | **Credits** |
|---|---|---|---|---|---|---|---|---|
| | | | | | **IA** | **Uni. Exam** | **Total** | |
| Part 1 Languages | Language - I: Indian & Foreign Languages | | 45 | 3 | 20 | 80 | 100 | 3 |
| | Language II: English | | 45 | 3 | 20 | 80 | 100 | 3 |
| Part 2 Core Papers | Data Structure | 24BCA23 | 45 | 4 | 20 | 80 | 100 | 4 |
| | Object-Oriented Programming Using JAVA | 24BCA24 | 45 | 4 | 20 | 80 | 100 | 4 |
| | Operating Systems | 24BCA25 | 45 | 4 | 20 | 80 | 100 | 4 |
| Part 3 Compulsory | The Constitution of India | 24BCA26 | 30 | 1.5 | 20 | 30 | 50 | 2 |
| | Data Structure Lab | 24BCA27 | 60 | 3 | 10 | 40 | 50 | 2 |
| | Object Oriented Programming Lab | 24BCA28 | 60 | 3 | 10 | 40 | 50 | 2 |
| | LINUX and Shell Programming Lab | 24BCA29 | 60 | 3 | 10 | 40 | 50 | 2 |
| | **Total Credits** | | | | | | **700** | **23** |

**SEMESTER I 24BCA13 : DISCRETE STRUCTURES**

| | | | |
|---|---|---|---|
| **Course Code** | 24BCA13 | **Course Title** | Discrete Structures |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week No of Hours: 60 |
| **Credit** | 4 | **Domain** | Mathematics |

**SYLLABUS**

| | |
|---|---|
| I | **Set Theory** **15 Hours**<br>Fundamentals of Set theory, Set Operations, Laws of Set Theory, Counting and Venn Diagrams, Cartesian Product, Relations, Types of Relations, Functions, Types of Functions, Function Composition, Inverse Functions. Mathematical Induction. |
| II | **Logic and Counting** **15 Hours**<br>Fundamentals of Logic, Propositional Logic, Logical Connectives and Truth Tables, Logic Equivalence, Tautology and Contradiction. Basics of counting, Counting Principles, Pigeonhole Principle, Permutation, Combinations. |
| III | **Matrices** **15 Hours**<br>Basics of Matrix, Types of Matrices, Operations on Matrices, Inverse of a matrix, Solution for system of linear equations, Determinant, Properties of Determinant, Cramer's Rule, Introduction to EigenValues and EigenVectors. |
| IV | **Graph Theory** **15 Hours**<br>Graphs: Introduction, Representing Graphs, Operations on graphs, Directed Graphs Graph Isomorphism, Paths, Cycles, Euler Graph, Hamilton Graph, Planar Graphs.<br>Trees: Introduction, Applications of Trees, Spanning Trees, Minimum Spanning Trees, Prim's and Kruskul's Algorithms. |

**Reference Books**


1 "Discrete Mathematics and Its Applications" by Kenneth H. Rosen (8th Edition, 2019)

2 "Discrete Mathematics with Applications" by Susanna S. Epp (5th Edition, 2020)

3 "Linear Algebra and Its Applications" by David C. Lay, Steven R. Lay, and Judi J. McDonald (6th Edition, 2022)

4 "Schaum's Outline of Discrete Mathematics" by Seymour Lipschutz and Marc Lipson (4th Edition, 2021)

5. "Linear Algebra and Its Applications" by David C. Lay, Steven R. Lay, and Judi J. cDonald (6th Edition, 2022)

| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Apply Set theory, Relations, Functions and Mathematical Induction to solve problems. |
| **CO2** | Getting familiar with counting techniques and Mathematical Logic, and applying the same to address real-life problems. |
| **CO3** | Learn different operations of a Matrix and apply them to solve real-life problems. |
| **CO4** | Analyze the use of EigenValues and EigenVectors in practical applications. |
| **CO5** | Apply graph theory concepts to solve the problems of the real world. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning Formative Assessment: Regular quizzes, problem-solving sessions, and practical tasks on key concepts such as Matrices. This helps in tracking student progress and understanding.

**SKILL DEVELOPMENT**

Venn Diagram Applications Truth
Table Construction Permutations
and Combinations Graph Traversal
Matrix Operations

**24BCA14: PROBLEM SOLVING TECHNIQUE**

| | | | |
|---|---|---|---|
| **Course Code** | 24BCA14 | **Course Title** | Problem Solving Technique |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week No of Hours: 60 |
| **Credit** | 4 | **Domain** | Computer Science |

**SYLLABUS**

| | | |
|---|---|---|
| I | **Introduction** | **15 Hours** |
| | The Role of Algorithms in Computing, Algorithms as a technology, Analyzing algorithms, Designing algorithms. Fundamental Algorithms: Exchanging the values of two variables, Counting, Summation of a set of numbers, Factorial Computation, Generating of the Fibonacci sequence, Reversing the digits of an integer. **Overview of C: History and importance of C, Basic structure of C program, executing a C program. Constants, Variable and Data Types: Introduction, Character Set, C Tokens, Keywords and Identifiers, Constants, Variables, Data Types, Declaration of Variables, Assigning Values to Variables, Defining Symbolic Constants** | |
| II | **C Programming** | **15 Hours** |
| | Getting Started, Arithmetic expressions. Input and Output: Standard input and output, formatted output- printf, variable length argument list, formatted input- scanf. Control Flow: Statements and Blocks, If-else, else-if, switch, loops: while loop, for loop, do while, break and continue, goto and labels. Pointers and Arrays: pointers and address, pointers and function arguments, multidimensional array, initialization of pointer arrays, command line arguments. | |
| III | **Factoring Methods** | **15 Hours** |
| | Finding the square root of a number, the smallest Divisor of an integer, the greatest common divisor of two integers, computing the prime factor of an integer, raising a number to a large power. Array Techniques: Array order reversal, Array counting, Finding the maximum number in a set, removal of duplicates from an ordered array, partitioning an array, finding the $k^{th}$ smallest element, and multiplication of two matrices. | |
| IV | **Sorting** | **15 Hours** |
| | Sorting by selection, sorting by exchange, sorting by insertion, sorting by diminishing increment, sorting by partitioning. Searching: Linear Search, Binary search. **File Management in C:**Introduction, Defining and opening a file, closing a file, Input/output and Error Handling on Files. | |

| | |
|---|---|
| | |

**Reference Books:**


1. **"Introduction to Algorithms"** by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein,4th Edition (2022)
2. **"Programming in ANSI C"** by E. Balagurusamy,8th Edition (2021), McGraw Hill
3. **"Let Us C"** by Yashavant Kanetkar,17th Edition (2020),BPB Publications
4. Greg Perry and Dean Miller, "C programming Absolute Beginner's Guide", 3rd edition, Pearson Education, Inc, 2014.
5. **"Data Structures and Algorithms Made Easy in C"** by Narasimha Karumanchi 2nd Edition (2011),CareerMonk Publications.


| | COURSE OUTCOME | |
|---|---|---|
| | **CO CODE** | **COURSE DESCRIPTION** |
| | **CO1** | To understand algorithmic strategies for enhancing problem solving proficiency |
| | **CO2** | Demonstrate problem solving tools and techniques using C. |
| | **CO3** | To analyze the given problems and use appropriate algorithms. |
| | **CO4** | To implement sorting and searching techniques to develop programs. |
| | **CO5** | Implement file handling operations in C, including opening, closing, reading, writing, and handling errors in file input/output to manage and process data efficiently. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Divide-and-Conquer Approach, Think-Pair-Share, Hands-on Labs, Use of Technology, Scaffolding and Differentiation, Assessment for Learning Formative Assessment: Regular quizzes, problem-solving sessions, and practical tasks on key concepts such as Matrices. This helps in tracking student progress and understanding.

**SKILL DEVELOPMENT**

Code Implementation Practice

Algorithm Complexity Analysis

Debugging Exercises Algorithm

Optimization

**24BCA15: COMPUTER ARCHITECTURE**

| | | | | |
|---|---|---|---|---|
| **Course Code** | 24BCA15 | **Course Title** | Computer Architecture | |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week | No of Hours: 60 |
| **Credit** | 4 | **Domain** | Computer Science | |
| **SYLLABUS** | | | | |
| I | **Number Systems** **15 Hours**<br>Number Systems: Decimal, Binary, Hexadecimal, Octal Number System Conversions, Binary Arithmetic, Complements- r's complement, (r-1)'s complement, Addition and subtraction of BCD, Octal Arithmetic, Hexadecimal Arithmetic, Binary Codes, Decimal Codes, Error detecting and correcting codes, ASCII, EBCDIC, UNICODE, Digital Logic Circuits: Digital Computers, Logic Gates, Universal Gates, Boolean algebra, Map Simplification. | | | |
| II | **Combinational Circuits:** **15 Hours**<br>Half Adder and Full Adder, Flip-Flops- SR Flip- Flop, D Flip-Flop, J-K Flip-Flop, T Flip-Flop, Sequential Circuits- Flip-Flop input equations, State Table, State Diagram and problems. Digital Components: Integrated Circuits, Decoders-3-to-8-line decoder, NAND gate Decoder, Octal to Binary Encoder, Multiplexers- 4-to-1 line Multiplexer, Registers- 4 bit register with parallel load, Shift Registers- Bidirectional shift register with parallel load, Binary Counters-4-bit synchronous binary counter. | | | |
| III | **Basic Computer Organization and Design:** **15 Hours**<br>Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator logic. Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC), CISC Vs RISC. | | | |
| IV | **Introduction to 8085 Assembly language programming:** **15Hours**<br>Architecture of 8085, Pin Configuration, The 8085-programming model, Instruction classification, Instruction, data formats, and storage. overview of 8085 instruction set. Introduction to 8085 Instructions: Instruction classification of 8085 based on word length and functions, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operations, Addressing modes of 8085. Overview of 8086 architecture, Pin diagram, and functional units. | | | |

**Reference Books:**


1. "Digital Logic and Computer Design" by M. Morris Mano (5th Edition, 2021)
2. "Fundamentals of Digital Logic with VHDL Design" by Stephen Brown and Zvonko Vranesic (4th Edition, 2019)
3. Ramesh Gaonkar – "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Penram International Publishing (India) Private Limited, 2013.
4. David A. Patterson, John L. Hennessy – "Computer Organization and Design: The Hardware/Software Interface", 5th Edition, Morgan Kaufmann, 2014.
5. A. Anand Kumar – "Fundamentals of Digital Circuits", 4th Edition, PHI Learning, 2016. Soumitra Kumar Mandal – "Microprocessors and Microcontrollers: 8085, 8086, and 8051", 2nd Edition, Tata McGraw Hill, 2013.


| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Understand various arithmetic and logical operations on different types of numbers to design an arithmetic and logic unit. |
| **CO2** | Demonstrate design and implement sequential logic circuits using ICs. |
| **CO3** | Analyze the basics of computer organization and its design and the basic processing unit. |
| **CO4** | Implement the instruction sets and develop assembly language programming skills. |
| **CO5** | Explore modern CPU architectures and understand the principles of parallel computing to apply in high-performance computing environments. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Active Learning with Peer Instruction, Visual Learning via Interactive Diagrams and Tools, Flipped Classroom Approach, Use of Technology, Scaffolding and Differentiation, Assessment for Learning, Mathematical Modeling and Simulation

**SKILL DEVELOPMENT:**

Analytical and Critical Thinking

Problem-Solving Skills Algorithmic

Thinking

Abstract and Formal Reasoning

Application of Mathematical Tools

Logical Reasoning and Formal Proof Writing

Teamwork and Collaboration

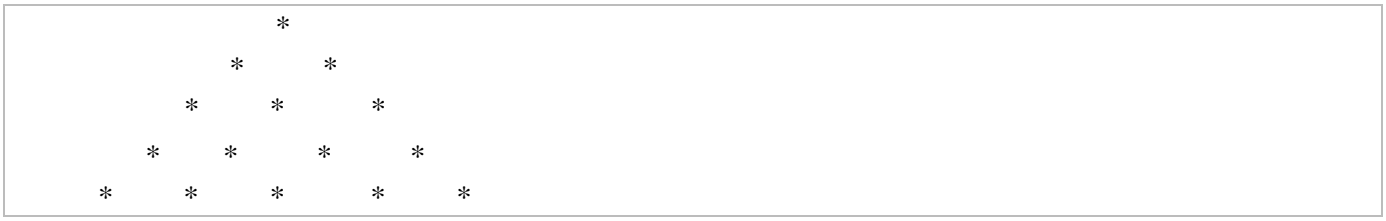
## 24BCA16: PROBLEM-SOLVING TECHNIQUE LAB

| **Course Code** | 24BCA16 | **Course Title** | Problem Solving Technique Lab |
|---|---|---|---|
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week |
| **Credit** | 2 | **Domain** | Computer Science |

**SYLLABUS**

Write, and execute C Program for the following:

1. To exchange the values of two variables using function swap()
2. To read the numbers and find the biggest of three
3. To check whether the number is prime or not.
4. To find the summation of a set of numbers
5. To read a number, find the sum of the digits, reverse the number and check it for palindrome.
6. To convert a lowercase letter into uppercase letter using array concept
7. To read the percentage of marks and to display appropriate messages. If a percentage is 70 and above- Distinction, 60-69 – First Class, 50-59 – Second Class, 40-49 Pass, below 40 – Fail.(Demonstrate of if-else ladder)
8. To simulate a simple calculator with addition, subtraction, multiplication, division and it should display the error message for division of zero using switch case.
9. To read marks scored by n students and find the average of mark (Demonstration of single dimensional array)
10. To find the factorial of a number.
11. To generate Fibonacci series.
12. To find the greatest common divisor
13. To demonstrate string functions. (String Length, String Copy, String Concatenate, String Comparison)
14. To find the length of the string without using built-in functions.
15. To read, display and add two n x m matrices using function.
16. To read a string and to find the number of alphabets, digits, vowels, consonants, space and special characters.
17. To Swap 2 numbers using pointers
18. To demonstrate difference between structure and union
19. To generate array order reversal
20. To design the following pattern using nested loop



| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Demonstrate proficiency in fundamental C programming concepts for mathematical calculations and logical comparisons. |
| **CO2** | Apply array and string manipulation techniques to perform operations like searching, sorting, and modifying data structures efficiently. |
| **CO3** | Utilize advanced programming concepts such as pointers, structures, and unions to manage complex data types and memory manipulation. |
| **CO4** | Implement problem-solving strategies using loops and decision-making constructs in C to design patterns, process student data, and |
| **CO5** | Simulate real-life scenarios like calculators or grade evaluation. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning.

## 24BCA17: COMPUTER ARCHITECTURE LAB

| | | | |
|---|---|---|---|
| **Course Code** | 24BCA17 | **Course Title** | Computer Architecture Lab |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week |
| **Credit** | 2 | **Domain** | Computer Science |

**SYLLABUS**

1. Write an 8085 Program to swap two 8-bit numbers.
2. a. Write a Program to find the largest of two numbers
   b. Write an 8085 Program to find the smallest of two numbers
3. Write an 8085 Program to find whether an 8-bit number is positive, negative or zero. If positive display EE, if negative display FF, if zero display DD.
4. Write an 8085 Program to check whether the 4th bit of a number is zero or one. If $4^{th}$ bit is 1 display FF, if $4^{th}$ bit is 0 display DD.
5. Write an 8085 Program to calculate the sum of the first ten natural numbers.
6. Write an assembly language program in 8085 microprocessors to find the sum of digits of an 8-bit number.
7. Write an 8085 Program to find the reverse of an 8-bit number
8. Write an 8085 Program to check whether 1-byte number is a palindrome or not. If it is a palindrome display FF otherwise display DD.
9. Write an 8085 Program to check whether a number is ODD or EVEN. If Even no. display DD, if odd no. display FF.
10. Write an 8085 program to count a number of ones in the given 8-bit number.
11. Write an 8085 program to find Addition & Subtraction of two 8 –bit HEX numbers.
12. Write an 8085 program to find Subtraction of two 16 –bit numbers.
13. Write an 8085 program to implement 2 out of 5 codes
14. Write an 8085 program to generate Fibonacci series
15. Write an 8085 program to find the first ten terms of odd and even numbers.
16. Write an 8085 program to find 4-Digit BCD addition.
17. Write an 8085 program to find Multiplication of2-digit BCD numbers.

18. Write an 8085 program to find division of two 8-bitnumbers.
19. WRITE AN 8086 PROGRAM TO MULTIPLY TWO NUMBERS
20. WRITE AN 8086 PROGRAM TO REVERSE A STRING

| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Write and debug 8085 assembly programs to perform basic arithmetic operations, including addition, subtraction, and multiplication of 8-bit and 16-bit numbers. |
| **CO2** | Develop 8085 programs to manipulate and analyze 8-bit numbers by implementing functions such as swapping, reversing, and checking for palindromes. |
| **CO3** | Create 8085 programs to handle and display results based on bitwise operations, including checking specific bits and determining the parity of a number. |
| **CO4** | Implement 8085 programs for more advanced number processing tasks, such as generating Fibonacci series, summing digits of numbers, and performing BCD arithmetic. |
| **CO5** | Design and execute 8085 assembly programs to work with codes and data conversions, such as 2 out of 5 codes and finding the sum of first ten natural numbers. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning.

**24BCA18: OFFICE AUTOMATION TOOLS LAB**

| **Course Code** | **24BCA18** | **Course Title** | Office Automation Tools Lab |
|---|---|---|---|
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week |
| **Credit** | 2 | **Domain** | Computer Science |

**SYLLABUS**

1. Document Formatting
2. Resume Preparation
3. Mail Merge
4. Working with Tables
5. Data Entry and Formatting
6. Formula and Functions
7. Sorting, Filtering, and Charts
8. Pivot Table
9. Creating a Basic Presentation
10. Advanced Presentation Features
11. Custom Animation and Timings
12. Creating and Managing a Database
13. Querying the Database
14. Creating Forms and Reports
15. Relational Database Concepts
16. Email and Calendar
17. File and Folder Operations

| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Write and debug 8085 assembly programs to perform basic arithmetic operations, including addition, subtraction, and multiplication of 8-bit and 16- bit numbers. |
| **CO2** | Develop 8085 programs to manipulate and analyze 8-bit numbers by implementing functions such as swapping, reversing, and checking for palindromes. |
| **CO3** | Create 8085 programs to handle and display results based on bitwise operations, including checking specific bits and determining the parity of a number. |
| **CO4** | Implement 8085 programs for more advanced number processing tasks, such as generating Fibonacci series, summing digits of numbers, and performing BCD arithmetic. |
| **CO5** | Design and execute 8085 assembly programs to work with codes and data conversions, such as 2 out of 5 codes and finding the sum of first ten natural numbers. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning.

### CURRICULUM ENHANCEMENT

Certificate Course to be included from Spoken Tutorial IIT Bombay

**SEMESTER II**

**24BCA23: DATA STRUCTURES**

| | | | | |
|---|---|---|---|---|
| **Course Code** | 24BCA23 | **Course Title** | Data Structures | |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week | No of Hours: 60 |
| **Credit** | 4 | **Domain** | Computer Science | |
| **SYLLABUS** | | | | |
| I | **Introduction and Overview** **15 Hours**<br>Definition, Elementary data organization, Data Structures, data Structures operations, Abstract data types, algorithms complexity, time-space trade-off. Preliminaries: Mathematical notations and functions, Algorithmic notations, control structures, Complexity of algorithms, asymptotic notations for complexity of algorithms. Introduction to Strings, Storing String, Character Data Types, String Operations, word processing, Introduction to pattern matching algorithms. | | | |
| II | **Arrays and Linked List** **15 Hours**<br>Definition, Linear arrays, arrays as ADT, Representation of Linear Arrays in Memory, Traversing Linear arrays, Inserting and deleting, multi-dimensional arrays, Matrices and Sparse matrices, searching and sorting techniques using array. Linked list: Definition, Representation of Singly Linked List in memory, Traversing a Singly linked list, Searching in a Singly linked list, Memory allocation, Garbage collection, Insertion into a singly linked list, Deletion from a singly linked list; Doubly linked list, Header linked list, Circular linked list. | | | |
| III | **Stacks and Queues:** **15 Hours**<br>Definition, Array representation of stacks, Linked representation of stacks, Stack as ADT, Arithmetic Expressions: Polish Notation, Conversion of infix expression to postfix expression, Evaluation of Postfix expression, Application of Stacks, Recursion, Towers of Hanoi, Implementation of recursive procedures by stack. Queues: Definition, Array representation of queue, Linked list representation of queues. Types of queue: Simple queue, Circular queue, Double-ended queue, Priority queue, Operations on Queues, Applications of queues. Searching and Sorting: Linear and Binary search, bubble sort, selection sort, insertion sort and heap sort. | | | |
| IV | **Binary Trees:** **15 Hours**<br>Definitions, Tree Search, Traversal of Binary Tree, Tree Sort, Building a Binary Search Tree, Height Balance: AVL Trees, Contiguous Representation of Binary Trees: Heaps, Red Black Tree: Insertion and Deletion, External Searching: B-Trees, Applications of Trees. Graphs: Mathematical Background, Computer Representation, Graph Traversal. | | | |

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| | Hashing: Hash Table ADT, understanding Hashing, Components of Hashing, Hash Table, Hash Function, Hashing Techniques, collisions, collision resolution techniques. |

| COURSE OUTCOME | |
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| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Understand basic concepts of data structures. |
| **CO2** | Analyzing and exploring various ways of storing data using Array and Linked list. |
| **CO3** | Demonstrate stack and queue data structures and their applications |
| **CO4** | Analyze and implement various nonlinear data structures. |
| **CO5** | Design and analyze searching (linear and binary) and sorting techniques |

**Reference Books:**


1. Seymour Lipschutz, "Data Structures with C", Schaum's Outlines, Tata Mc Graw Hill, 2011.
2. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla,"Data Structures and Program Design using C", Pearson Education, 2010
3. Mark Allen Weiss," Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education,2013
4. Forouzan,"A Structured Programming Approach using C",2nd Edition, Cengage LearningIndia,2008.


## TEACHING PEDAGOGY

Active Learning through Game-Based Learning, Practical Application, Simulations, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning. Formative Assessment: Regular quizzes, problem- solving sessions, and practical tasks on key concepts such as Matrices. This helps in tracking student progress and understanding.

**SKILL DEVELOPMENT**

Hands-On

Analysis Group

Activities

Pattern Matching Practice

Error Handling

Recursive Solutions

## 24BCA24: OBJECT ORIENTED PROGRAMMING USING JAVA

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|---|---|---|---|
| **Course Code** | 24BCA24 | **Course Title** | Object Oriented Programming Using Java |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week No of Hours: 60 |
| **Credit** | 4 | **Domain** | Computer Science |
| **SYLLABUS** | | | |
| I | **Introduction** **15 Hours**<br>Basics of object-oriented programming, comparison of procedure-oriented and object- oriented programming paradigms; Difference between C and Java Programming languages; Features of Java; Objects and classes in Java, Structure of a Java program; Data Types, variables and operators in java; Control structures-Branching and looping; Methods & Constructors in java; Java Development Kit (JDK); Built-in classes in Java; Math, Character, String, String Buffer and Scanner; Wrapper classes; The abstract, static and final classes; Casting objects; The instance of operator; Usage of this keyword; Arrays in Java. | | |
| II | **Inheritance:** **15 Hours**<br>Super and subclasses; visibility modifiers; Types of Inheritance- single, multilevel, hierarchical and hybrid inheritance; the interface concept in Java, Polymorphism: Compile time and runtime polymorphism – Method overloading and method overriding. Package: Types of packages; the util, awt and swing packages; Creating and importing user-defined packages. I/O programming: Standard I/O streams in Java; Types of streams – Based on the type of Operations and the type of file. | | |
| III | **Event Handling:** **15 Hours**<br>Major events in Java; Two Event Handling mechanisms- Event classes and Event Listener Interfaces; Mouse and keyboard events; GUI: Panels; Frames; Layout managers – Flow, border and grid layouts; Buttons; Checkboxes; Radio buttons; Labels; Text fields; Text areas; Combo boxes; Scroll bars; Sliders; Menu, Dialog boxes. Applet programming: Comparison of applets and applications; Applet life cycle; Developing and running applets. String handling: String construction, string length, special string operations, character extraction, string comparison, modifying string and string buffers. | | |
| IV | **Exception Handling:** **15 Hours**<br>Types of Java exception – checked and unchecked exceptions; Usage of try- catch-finally blocks. Multithreading: comparison of multithreading and multitasking; Life cycle of a thread; two ways of creating thread – by extending the Thread class | | |

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| | and by implementing the Runnable Interface, Thread synchronization. Advanced concepts: Collections in Java; Introduction to JavaBeans and Java security manager, Importance of generic programming in java with examples. JDBC and ODBC Connections. Simple project in java with JDBC and ODBC. |

**Reference Books**


1. E. Balagurusamy, Programming with JAVA, McGraw Hill, New Delhi, 2007
2. Herbert Schildt, Java A Beginner's Guide – Create, Compile, and Run Java Programs Today, Sixth Edition, Oracle Press, 2014
3. Ken Arnold, James Gosling, "The Java Programming Language, Fourth Edition, Addison Wisely, 2005
4. R Herbert Schildt, 'The Complete Reference Java, 7th Edition, McGraw Hill, 2007


| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Understand object-oriented programming concepts |
| **CO2** | Demonstrate the important feature of Object-oriented programming |
| **CO3** | Examine event handling, String handling, and exception handling concepts |
| **CO4** | Implement concepts to solve real-world problems |
| **CO5** | Design and implement a simple project in Java that integrates JDBC or ODBC to interact with a database |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scenario-Based Learning, Assessment for Learning Formative Assessment: Regular quizzes, problem-solving sessions, and practical tasks on key concepts such as Matrices. This helps in tracking student progress and understanding.

**SKILL DEVELOPMENT**

Identify Object-Oriented

Features Incremental

Programming Exception

Handling Tasks Thread

Visualization

**24BCA25: OPERATING SYSTEMS**

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|---|---|---|---|---|
| **Course Code** | 24BCA25 | **Course Title** | Operating Systems | |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week | No of Hours: 60 |
| **Credit** | 4 | **Domain** | Computer Science | |
| **SYLLABUS** | | | | |
| I | **Introduction:** **15 Hours**<br>Computer System Organization, Architecture, Structure, Operations, Process Management, Memory Management, Storage Management. Operating System Structures: Services, System Calls, Types, Operating System Structure, System Boot. Processes: Process Concept, Scheduling, Operations, Inter-process Communication. Multithreaded Programming: Multithreading Models. | | | |
| II | **Process Synchronization:** **15 Hours**<br>The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples. Process Scheduling: Criteria, Scheduling Algorithms, Multi-Processor Scheduling, Real-time CPU Scheduling. Deadlocks: System model, Characterization, Methods for handling deadlocks,<br>Deadlock Prevention, Avoidance, Detection and Recovery from deadlock. | | | |
| III | **Memory Management Strategies:** **15 Hours**<br>Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. Virtual Memory Management: Demand Paging; Copy-on-Write, Page Replacement; Allocation of Frames, File System: File Concept, Access Methods, Directory and Disk Structure, Protection. File- system Implementation: Structure, File- System and Directory Implementation, Allocation Methods, Free Space Management. Mass-Storage Structure: Overview, Disk Scheduling, Disk Management. System Protection: Goals - Domain - Access matrix. System Security: The Security Problem - Threats – | | | |

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| | Encryption- User Authentication. |
| IV | **Introduction to Linux Programming:** **15 Hours**<br>Linux system Architecture, Linux Command format, Linux Internal and External Commands, Directory Commands, File related commands, Disk related commands, General Utilities. |

**Reference Books**


1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne; “Operating Systems Concepts”, 9th Edition, 2016 India, Wiley.
2. William Stallings, "Operating Systems and Design Principles", Pearson, 5th Edition,2018
3. D M Dhamdhere : Operating Systems - A concept Based Approach, 3rd Edition, Tata McGraw-Hill, 2017.
4. Sumitabha Das: "UNIX Concepts and Applications", 4th Edition, Tata McGraw Hill, 2017.
5. M G Venkateshmurthy, Introduction to UNlX and Shell Programming", Pearson Edition Asia, 2005.


| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | To analyze the memory management and its allocation policies |
| **CO2** | To understand synchronization and deadlock conditions and their possible solutions |
| **CO3** | To discuss the storage management policies with respect to different storage |
| **CO4** | To evaluate the concept of the operating system with respect to Linux architecture and commands |
| **CO5** | To understand and apply system protection mechanisms, including access control using the access matrix model. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning Formative Assessment: Regular quizzes, problem-solving sessions, and practical tasks on key concepts such as Matrices. This helps in tracking student progress and understanding.

**SKILL DEVELOPMENT**

System Design Simulation

Command-Line Exercises

System Utilities

Disk Scheduling Simulation

Paging & Segmentation

**24BCA26: DATA STRUCTURES LAB**

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|---|---|---|---|
| **Course Code** | 24BCA26 | **Course Title** | Data Structures Lab |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week |
| **Credit** | 2 | **Domain** | Computer Science |

**SYLLABUS**

1. Write a program to search for an element in an array using binary and linear search.
2. Write a program to sort a list of n numbers using Bubble Sort algorithms.
3. Perform the Insertion and Selection Sort on the input {75,8,1,16,48,3,7,0} and display the output in descending order.
4. Write a program to insert the elements {61,16,8,27} into a singly linked list and delete 8,61,27 from the list. Display your list after each insertion and deletion.
5. Write a program to insert the elements {45, 34, 10, 63,3} into a linear queue and delete three elements from the list. Display your list after each insertion and deletion.
6. Write a program to simulate the working of a Circular queue using an array.
7. Write a program to insert the elements {61,16,8,27} into an ordered singly linked list and delete 8,61,27 from the list. Display your list after each insertion and deletion.
8. Write a program for the Tower of Hanoi problem using recursion.
9. Write a recursive program to find GCD of 3 numbers.
10. Write a program to demonstrate working of stack using linked list.
11. Write a program to convert an infix expression x^y/(5*z)+2 to its postfix expression
12. Write a program to evaluate a postfix expression 5 3+8 2 - *.
13. Write a program to create a binary tree with the elements {18,15,40,50,30,17,41} after creation insert 45 and 19 into the tree and delete 15,17 and 41 from the tree. Display the tree on each insertion and deletion operation.
14. Write a program to create a binary search tree with the elements {2,5,1,3,9,0,6} and perform inorder, preorder and post order traversal.
15. Write a program to Sort the following elements using heap sort {9.16,32,8,4,1,5,8,0}.
16. Given S1={“Flowers”} ; S2={“are beautiful”} I. Find the length of S1 II. Concatenate S1 and S2 III. Extract the substring “low” from S1 IV. Find “are” in S2 and replace it with “is.
17. Write a program to implement an adjacency matrix of a graph.
18. Write a program to insert/retrieve an entry into hash/ from a hash table with open

addressing using linear probing..

| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Analyze and implement basic searching and sorting algorithms using arrays. |
| **CO2** | Develop and manipulate linear and non-linear data structures like linked lists, stacks, queues, and trees. |
| **CO3** | Solve problems using recursion and understand its application in algorithmic solutions. |
| **CO4** | Apply stack and queue operations in real-world applications like expression conversion and evaluation. |
| **CO5** | Implement and analyze advanced data structures such as heaps, hash tables, and graphs. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning

# 24BCA27: OBJECT-ORIENTED PROGRAMMING LAB

| | | | |
|---|---|---|---|
| **Course Code** | 24BCA27 | **Course Title** | Object-Oriented Programming Lab |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week |
| **Credit** | 2 | **Domain** | Computer Science |

**SYLLABUS**

1. Java program to display “Hello World” and display the size of all the data types.
2. Java program to implement the usage of static, local and global variables.
3. Java program to implement string operations string length, string concatenate, substring
4. Java program to find the maximum of three numbers
5. Java program to check whether the number is odd or even.
6. Java program to implement default and parameterized constructors.
7. Java program to implement an array of objects.
8. Java program to implement Single Inheritance
9. Java program to implement Multiple Inheritance using Interface
10. Java program to implement an applet
11. Java program to demonstrate a division by zero exception
12. Java program to add two integers and two float numbers. When no arguments are supplied, give a default value to calculate the sum. Use method overloading.
13. Java program that demonstrates run-time polymorphism.
14. Java program to catch negative array size Exception. This exception is caused when the array is initialized to negative values.
15. Java program to handle null pointer exception and use the “finally” method to display a message to the user.
16. Java program to import user-defined packages
17. Java program to check whether a number is palindrome or not
18. Java program to find the factorial of a list of numbers reading input as command line argument.
19. Java program to display all prime numbers between two limits.
20. Java program to create a thread using Runnable Interface.

| COURSE OUTCOME | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Understand and apply basic Java syntax, data types, and control structures. |
| **CO2** | Implement object-oriented programming concepts such as inheritance, polymorphism, and encapsulation in Java. |
| **CO3** | Demonstrate exception handling and error management using built-in and custom exceptions. |
| **CO4** | Work with Java string manipulation and methods to perform various string operations. |
| **CO5** | Implement multi-threading and applet-based applications in Java. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning

**24BCA28: LINUX AND SHELL PROGRAMMING LAB**

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|---|---|---|---|
| **Course Code** | 24BCA28 | **Course Title** | Linux and Shell Programming Lab |
| **Course Type** | DSC | **Contact Hours** | 4 Hours per Week |
| **Credit** | 2 | **Domain** | Computer Science |

**SYLLABUS**

1. Write a shell script to print all the prime numbers between M to N (M<N).
2. Write a shell script to reverse a given number and check whether it is a palindrome.
3. Write a shell script to find the sum of digits of a given number using loops and without using loops.
4. Write a shell script to implement 10 Linux commands using case.
5. Write a Shell script that displays a list of all the files in the current directory to which the user
6. has read, write and execute permissions?
7. Write a shell script to copy a file within the current directory
8. Write a shell script to copy file between two directories
9. Write a Shell script to create two data files and compare them to display unique and common entries.
10. Write a shell script to count the number of vowels in a string.
11. Write a shell script to convert uppercase characters to lowercase and vice versa.
12. Write a shell script to accept a word and perform pattern matching in a given file.
13. Write a shell script to find the factorial of a number
14. Write a Menu-driven program to demonstrate the zombie process and orphan process.

| **COURSE OUTCOME** | |
|---|---|
| **CO CODE** | **COURSE DESCRIPTION** |
| **CO1** | Develop shell scripts to perform basic numerical operations and decision-making. |
| **CO2** | Demonstrate file handling and directory management using shell scripting. |
| **CO3** | Implement string manipulation and pattern matching in shell scripts. |
| **CO4** | Apply conditional execution and control structures in scripts to execute system commands. |
| **CO5** | Utilize shell scripting to automate comparisons and manage data files. |

## TEACHING PEDAGOGY

Active Learning through Practical Application, Conceptual Understanding, Problem-Based Learning, Collaborative Learning, Use of Technology, Scaffolding and Differentiation, Assessment for Learning.

CURRICULUM ENHANCEMENT

Internship is to be added.