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

B.Sc./B.A/BBA/BCA/BCom

ENVIRONMENTAL STUDIES
Compulsory Course
Syllabus and Scheme
2024-2025(Onwards)

BOARD OF STUDIES
[PHYSICAL SCIENCES]

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

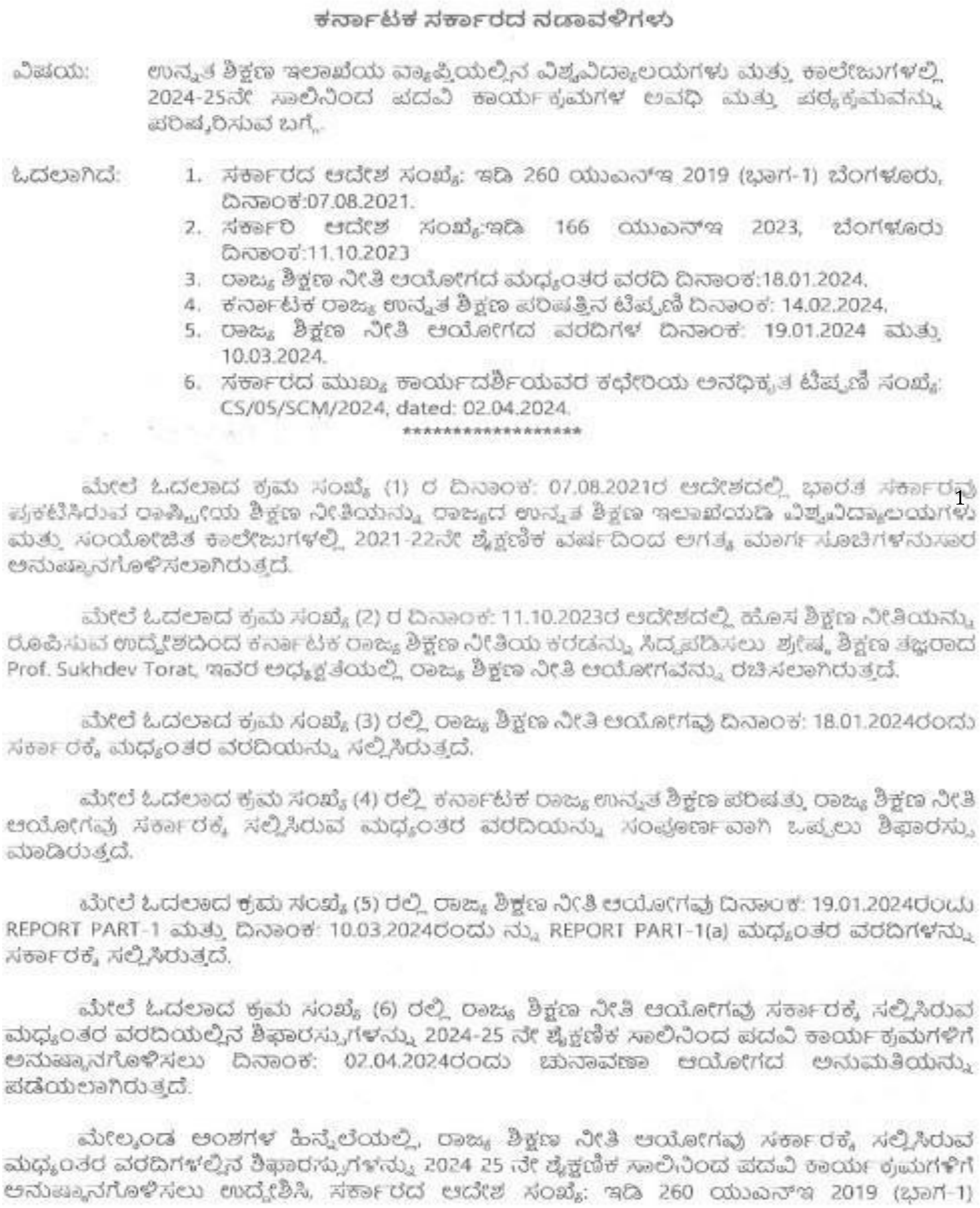
TABLE OF CONTENTS

Members of Board of Studies

Sl. No	Name	Designation
1	Ms Maya Mathew, Asst. Professor of Electronics, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Chairperson
2	Dr. B. Chaluvaraju, Professor , Department of Mathematics, Bangalore University, Bengaluru	University Nominee
3	Dr. Manoj B, Professor& Head, Department of Physics and Electronics, Chirst (Deemed to be University),Bengaluru	External Subject Expert- Physics
4	Dr. B Gunapriya , Associate Professor of Electrical and Electronics, New Horizon College of Engineering, Bengaluru	External Subject Expert-Electronics
5	Dr. Athimoolam Arunachalampillai, Associate Director, Amgen Inc.Bengaluru	Subject Expert in Chemistry& Industry Expert
6	Mr. Chella Pandian Pitchai, Global Head, DEI, Biocon Biologics, Bengaluru	Industry Expert
7	Mr. Sanju Joseph, Project Manager, WIPRO Technologies, UK	Alumni Representative
8	Ms.Sonima Mohan, Asst. Professor of Physics, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member
9	Ms Umamaheswari U, Asst. Professor of Physics, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member
10	Dr. GisaGrace Ninan, Asst. Professor of Physics, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member
11	Dr.Savithri H. Ezhikode, Asst. Professor of Physics, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member
12	Ms. Jenifer Sujitha, Asst. Professor of Electronics, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member
13	Dr. Regimol George,Asst.Professor of Chemistry, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member
14	Dr. Julia Sebastian, Asst.Professor of Chemistry, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member
15	Dr. S H Yasmin, Asst.Professor of Chemistry, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member

16	Sr.Rofin Mangali, Asst.Professor of Chemistry, Department of Physical Sciences &Mathematics St. Francis de Sales College (Autonomous), Bengaluru	Member

PREFACE TO THE BSc 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.

****

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 ಮಾರ್ಗಸೂಚಿಗಳನುಸಾರ 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 ಚುನಾವಣಾ ಆಯೋಗದ ಅನುಮತಿಯನ್ನು ಪಡೆಯಲಾಗಿರುತ್ತದೆ.

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

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

<u>ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 166 ಯುಎನ್‌ಇ 2023, ಬೆಂಗಳೂರು, ದಿನಾಂಕ: 08.05.2024.</u>

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,
8/5
(ಶ್ರೀ. ಮುಕೇಶ್ ಬಾಬು)
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 ಅಭಿವೃದ್ಧಿ 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. ಕಾರ್ಯ ನಿರ್ವಾಹಕ 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.

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 CHEMISTRY

The study of Chemistry is a scientific discipline that involves the study of matter, its compositions, properties and reactivity with other elements. The basic concepts laid down in Chemistry is the foundation of matter ranging from atoms, molecules, compounds and the measuring units of matter. It provides a foundation for understanding both the basis and applied scientific disciplines at a fundamental level. There are six semesters with various teaching methodologies including seminars, assignments, practicals, assessments and internships.

VISSION

Create, Nurture Scientific Knowledge& Research Aptitude

MISSION

Science in Service to Humanity

ELIGIBILITY CRITERIA

Students who have passed PUC/ 10+2 or equivalent in Science stream with Chemistry and Mathematics subjects are eligible for opting Chemistry in the UG program.

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 Science with Chemistry as one of the major subjects by Bangalore University.

PROMOTION

A candidate who has obtained a minimum of 40% 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	**Disciplinary Knowledge:** Acquire and apply the subject knowledge of Chemistry in solving day to day and their complex real-world problems.
PO2	**Critical Thinking and Analytical Reasoning:** To acquire the ability of critical thinking and logical reasoning and capability of recognizing and distinguishing the various aspects of real-life problems.
PO3	**Problem Solving Techniques:** Apply the key concepts and standard methodologies to solve problems and to develop an ability to analyse the problems, identify and define standard methodology for its solutions by utilising the knowledge gained.
PO4	**Research Related Skills:** Comprehend the fundamental aspects of research, use research-based knowledge and appropriate research methods to provide valid and precise results.
PO5	**Scientific Skills:** Ability to apply quantitative reasoning skills to answer scientific questions, use quantitative reasoning and data to address societal issues. Understand the impact of environmental conditions and demonstrate the knowledge and need of the sustainable development
PO6	**Higher Studies:** Possess the level of proficiency in subjects required for post-graduation as well as for pursuing research in Chemistry, and related interdisciplinary subjects.
PO7	**Intra personal skills:** Integrate intra personal skills to enhance the professional effectiveness, personal development, and ability to navigate complexities in academic and real-world context.
PO8	**Employability skills:** Students will develop the skills required for employment and demonstrate the ability to solve problems, make decisions, plan, innovate, organize information, and network with professionals in the industry. Provides opportunity to the students for getting job in industries besides academic and administrative works.
PO9	**Communication Skills:** Communicates effectively on physical activities with scientific community and with the society at large scale, and write effective reports on science events and design documentation, makes effective communication skills.
PO10	**Information/Digital Literacy:** Utilise the techniques and modern tools for solving complex problems with an understanding of limitations.
PO11	**Lifelong Learning/Self-directed learning:** Develop the ability of working independently and makein depth study of domain specific subjects. Helps learners to think independently and develop computational skills for solving real world problems.
PO12	**Moral and Ethical Awareness:** To develop an ability to identify unethical behaviour such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and their specialised subjects in particular. Develop soft skills in practising professional ethics.

COURSE MATRIX AND PATTERN SEP 2024

Title of the paper	Teaching hours	Contact hours/Week	Exam. hours	IA	Marks	Total Marks	Credits
First Semester							
24BSC15B: Chemistry I	**60**	**4**	**3**	**20**	**80**	**100**	**4**
24BSC18BP: Inorganic Chemistry	**60**	**4**	**3**	**10**	**40**	**50**	**2**
24EVS1X Environmental Studies	**45**	**3**	**1.5**	**10**	**40**	**50**	**2**
Second Semester							
24BSC25B: Chemistry II	**60**	**4**	**3**	**20**	**80**	**100**	**4**
24BSC28BP: Physical Chemistry	**60**	**4**	**3**	**10**	**40**	**50**	**2**

CONTINUOUS INTERNAL ASSESSMENT

THEORY

S.No	ASSESSMENT	MARKS
1	Continuous Internal Assessment (C1 & C2)	20 marks
2	End Semester Examination	80 marks

SEC & PRACTICAL

S.No	ASSESSMENT	MARKS
1	Continuous Internal Assessment (C1 & C2)	10 marks
2	End Semester Examination	40 marks

THEORY

S.NO	ASSESSMENTS	COMPONENTS	MARKS & ATTENDANCE	IA MARKS
1	Unit Test 1(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	Unit Test 2(25% of Syllabus covered after MSE)	C1	25	2.5
5	Attendance 75.00-% - 79.99% -1 Mark 80.00-% - 84.99% -2 Mark 85.00-% - 89.99% -3 Mark 90.00-% - 94.99% -4 Mark 95.00-% - 100.00% -5 Mark	C1	Minimum of 75%	5
			Total	20

SEC & PRACTICAL SUBJECTS

S.NO	ASSESSMENTS	COMPONENTS	MARKS & ATTENDANCE	IA MARKS
1	Attendance 75.00-% - 79.99% -1 Mark 80.00-% - 84.99% -2 Mark 85.00-% - 89.99% -3 Mark 90.00-% - 94.99% -4 Mark 95.00-% - 100.00% -5 Mark	C1	Minimum of 75%	5
2	id Semester Examination / Model Practical Examination	C2	40	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

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. The question paper pattern is as follows.

PART	TYPE OF QUESTIONS	MARKS	NUMBER OF QUESTIONS TO BE ANSWERED
A	Conceptual Question	2	10 OUT OF 12
B	Problem Analysis& Descriptive Question Pattern for part B ● 4+3+3 = 10 Marks ● 5+5 = 10 Marks	10	6 OUT OF 8
TOTAL 80 MARKS			

PRACTICAL

There shall be a written semester examination at the end of each semester for all Practical courses of duration of 3 hours with maximum 40 marks. The question paper pattern is as follows.

SL No	Particulars	Marks
1	Experimental performance	25
2	Procedure Writing	5
3	Record assessment	5
4	Oral performance (Viva-voce)	5
TOTAL 40 MARKS		

Environmental Studies

There shall be a written semester examination at the end of the semester for a duration of 1.5 hours with maximum 40 marks. The question paper pattern is as follows.

PART	TYPE OF QUESTIONS	MARKS	NUMBER OF QUESTIONS TO BE ANSWERED
A	Short Answer Questions 5 x 2 = 10 Marks	2	5 OUT OF 5
B	Medium Answer Questions 4 x 5 = 20 Marks	5	4 OUT OF 6
C	Long Answer Questions 1 x 10 = 10 Marks	10	1 OUT OF 2
TOTAL 40 MARKS			

SEMESTER I

24BSC15B: Chemistry I

Course Code	24BSC15B	**Course Title**	Chemistry I (Theory)
Course Type	Core	**Contact Hours**	4 Hours per Week
Credit	4	**Total Hrs**	60hrs

COURSE OBJECTIVE

The objective of this course is to make the students aware about the SI Units, various analytical methods, types of errors in chemical analysis. It discusses the Periodicity in properties with reference to the *s* and *p* block, which is necessary in understanding their group chemistry, noble gases. The course is also infused with fundamentals of organic chemistry. To establish the applications on the concepts like alkanes, alkenes, alkynes and aromatic hydrocarbons are introduced. It is emphasizing on the concept of gases, liquids and solutions

COURSE OUTCOME

COs	
CO1	Understand the concepts of chemical analysis, accuracy, precision, and statistical data treatment. Prepare solutions after calculating the required quantity of chemicals, in preparing the reagent/solutions and dilution of stock solution
CO2	Understand the basic information about the periodic table and periodic properties and the properties with reference to the s and p block elements.
CO3	Understand the concepts of noble gases and their compounds in detail and the elementary ideas about lanthanides and actinides
CO4	To recognize the importance of nomenclature and preparations of alkanes and alkynes
CO5	Derive the critical constants Tc, Pc, and Vc and their experimental determination.

Syllabus

UNIT I	**15 HOURS** **Analytical Chemistry** Definitions of the Basic Units: Mass, Length, Time, Temperature, Amount of substance, Derived units, conversion between units. Chemical concentrations: Molar concentration, Analytical molarity, Equilibrium molarity of a particular species, Percent concentration, Parts per million/billion (ppm/ppb), Volume ratios for dilution procedures. Preparation of solutions: standard solutions, primary standards, secondary standards. Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy,

precision, sensitivity, selectivity and method validation.

Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. Standard calibration curve - correlation coefficient (R^2). Numerical problems.

UNIT II

15Hours

Periodic table and Periodic properties **3 hours**

Review of the modern periodic table and Periodic Properties

Comparative study of elements of alkali and alkaline earth metals, chalcogens and halogens with respect to electronic configuration, atomic and ionic radii, ionisation energy and electronegativity.

p-Block Elements **5 hours**

Group–13: Structure of diborane and higher Boranes (B4H10 and B5H9), Boron nitrogen compounds (B3N3H6 and BN), Lewis acid nature of BX3.

Group – 14: Carbides; Classification as ionic, covalent, interstitial. Structures and reactivity. Industrial applications. Silicones; Classification –straight chain, cyclic and cross-linked. Group –15: Nitrides – Classification – ionic, covalent and interstitial. Reactivity – hydrolysis. Reactions of hydrazine, hydroxyl amine, phosphazenes.

SUGGESTED ADDITION :Electron affinity

General study of d and f block elements. **4 hours**

Transition elements: electronic configuration, atomic and ionic radii, ionization energy, oxidation states, redox potentials, spectral and magnetic properties, catalytic activity, interstitial compound formation.

Lanthanides and Actinides: Electronic configuration, atomic and ionic sizes, lanthanide contraction and its consequences. Oxidation states, spectral and magnetic properties, comparison of oxidation states, complex formation and magnetic properties of d and f block elements. Ion exchange method for separation of Lanthanides. comparison of oxidation states, complex formation and magnetic properties of d and f block elements.

Noble gases **3 hours**

Introduction, isolation of Helium from Natural gas, applications of Noble gases. Preparation properties and structures of fluorides and oxides of Xenon (XeF2, XeF4, XeF6, XeO3, XeO4).

UNIT III

15 HOURS

Basic concepts in organic chemistry: **3hours**

Bond cleavage – homolytic and heterolytic. Types of reagents – electrophilic and nucleophilic reagents. Reactive intermediates - generation and relative stabilities of carbocation, carbanion, carbon free radicals and carbenes explanation for stability and reactivity based on inductive, resonance and hyper conjugation effects. Types of reactions - addition, substitution and elimination. Concept of isomerism - structural isomerism, stereo isomerism - geometrical andoptical isomerism, chiral centre – definition and examples.

Aliphatic Hydrocarbons **12 hours**

Alkanes: Sources, nomenclature of branched chain alkanes, preparation of symmetrical and unsymmetrical alkanes, Corey-House synthesis, Wurtz reaction and Wurtz-Fittig reaction-their merits and demerits.

Difference between conformation and configuration. Conformations of ethane, propane and butane, explanation of stability based on energy profile diagrams. Conformation and stability of 1,2- dichloroethane, ethylene glycol and acetaldehyde. **Cycloalkanes:** Nomenclature. Method of formation, explanation for stability based on heat of hydrogenation data, Baeyer's strain theory and its limitation, Sachse - Mohr theory of strain-less rings; cyclopropane ring - banana bonds.

Conformations of cyclohexane (chair, twist boat, boat,half-chair and envelop forms and their stability). Geometrical isomerism with examples, *cis* and *trans* isomerism in 1,2-dimethylcyclopropane and 1,2-dimethylcyclohexane.

Alkenes: Preparation of alkenes by Wittig reaction-stereoselectivity. Addition of HX to unsymmetrical alkene - Markownikov's rule and Antimarkownikov's rule with mechanism. Reactions: Hydroboration- oxidation, reduction, oxymercuration- demercuration, epoxidation. Mechanism of oxidation with $KMnO4$ and $OsO4$. Ozonolysis- mechanism and importance.

Dienes: Classification- isolated, conjugated, cumulated. Structure of allene and butadiene.1,2 addition and 1,4 addition reactions. Diels Alder reaction-1,3-butadiene with maleic anhydride.

Alkynes: Preparation- Acetylene from $CaC2$ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: alkylation of terminal alkynes and conversion to higher alkynes, ozonolysis and oxidation with hotalk. $KMnO4$.

UNIT IV

15 HOURS

Gaseous state **9 hours**

Introduction: Maxwell-Boltzmann distribution law, mathematical expression for both mole and molecule (explanation of the terms only). Explanation of velocity distribution curves based on this law (no derivation). Mean free path, collision frequency and collision number. Definition and expressions using SI units (no derivations). Derivation of expression for most probable speed from Maxwell- Boltzmann equation. Definitions and expressions for RMS velocity, average velocity and relationships between them. Numerical problems.

Andrew’s isotherm on carbon dioxide and explanation of the curves (no experimental details).

Derivation of critical constants Tc, Pc and Vc from van der Waal’s equation and their experimental determination by Cagniard de La Tour method for Tc and Pc. Amagat’s mean density method for Vc. Problems on the calculation of Tc, Pc and Vc, *a* and *b*.

Law of corresponding states-statements, reduced equation of state and explanation, Joule-Thomson effect-explanation. Joule-Thomson co-efficient, inversion temperature-definition (no derivation). The application of Joule-Thomson effect to the liquefaction of air and hydrogen by Linde’s process.

Liquids and Solutions **6 hours**

Viscosity-

Definition, mathematical expression, coefficient of viscosity, effect of temperature, size,weight, shape of molecules and intermolecular forces on it.

Surface tension-Definition, mathematical expression, effect of temperature and solute on it.

Completely miscible liquids: Fractional distillation, Tc curves for all the three types, azeotropic mixtures with examples. Critical solution temperature (three types), examples. Effect of additionof salt on CST of phenol-water system.

Immiscible liquids: Steam distillation and its applications.

Distribution law: Statement, partition coefficient and condition for validity of distribution law.Application-solvent extraction.

REFERENCE BOOKS:

1. Analytical Chemistry: Basic Concepts, Priti Malhotra, Ane Books Pvt Ltd, 2021.
2. Advanced Inorganic Chemistry, 6th Edition, F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann-John Wiley & Sons, 1999.
3. Inorganic Chemistry, ELBS 2nd Edition, D. F. Shriver, P. W. Atkins and C. H.
4. Langford, Oxford Univ. Press 2002.
5. Organic Chemistry, Morrison, R.T. & Boyd, R.N. Pearson, 2010.
6. Physical Chemistry, Castellan, G.W. 4th Ed. Narosa, 2004.
7. Advanced Organic Chemistry, Bahl, A. & Bahl, B.S, S. Chand, 2010

Additional References:

8. Organic Chemistry, Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. John Wiley & Sons, 2014.
9. Inorganic Chemistry, 4th Edition, J. E. Huhee, E. A. Keiter and R. I. Keiter, PearsonEducation Asia, 2000
10. Analytical Chemistry, Gary D. Christian, 6th Edition, Wiley, 2007
11. Physical Chemistry, Barrow, G.M. Tata McGraw-Hill, 2007
12. Physical Chemistry, Puri, Sharma, Pathania, 48th Edition, Vishal Publishing Company 2021.

.

13. Modern Organic Chemistry, Jain M.K, Sharma S.C, Vishal Publishing Company

TEACHING PEDOGOGY

The curriculum will be delivered through various methods including chalk and talk, power point presentations, audio, video tools, E-learning/E-content, virtual labs, simulations, field trips/Industry visits, seminars (talks by experts), workshops, projects, models and class discussions.

SEMESTER I

Course Code	24BSC18BP	**Course Title**	**Inorganic Chemistry** (Practical)
Course Type	Core	**Contact Hours**	4 Hours per Week
Credit	2	**Total Hrs**	60 hrs

COURSE OBJECTIVES:.

- 1 Understand the calibration and handling of the glass wares
- Learn to carryout titrations
- Preparation of a solution of the desired concentration and the desired volume along with calculations to be taught
- Determination of the percentage of the given analyte
- Estimation of binary mixture.

COURSE OUTCOME	
CO CODE	**COURSE DESCRIPTION**
CO1	Understand the safety practices in the Chemistry Laboratory and develop awareness regarding toxicity of chemicals
CO2	Prepare standard/working solutions, standard solutions
CO3	Determination of the respective analyte and Determination of the percentage of the chemicals in a given solution
CO4	Estimation of an analyte in the standard solutions and Estimation of binary mixtures
CO5	Derivation of critical constants Tc, Pc andVc and their experimental determination

Syllabus	**56hrs**
Content	List of Experiments to be conducted 1. Calibration of glass wares; pipette, burette and volumetric flask. 2. Estimation of ferrous ammonium sulphate using standard potassium Dichromate solution using internal indicator. 3. Estimation of ferrous ammonium sulphate using standard potassium Dichromate solution using external indicator. 4. Estimation of sodium thiosulphate using standard potassium dichromate solution. 5. Determination of the percentage of available chlorine in the given sample of commercial bleaching powder. 6. Determination of percentage of manganese dioxide from pyrolusite ore. 7. Estimation of the amount of alkali present in soaps/detergents. 8. Estimation of potassium permanganate using standard sodium oxalate solution. 9. Estimation of nitrogen in an ammonium salt using sodium hydroxide solution and standard oxalic acid. 10. Estimation of the amount of carbonate and bicarbonate in the given mixture.

Course Code	24EVS1X	**Course Title**	Environmental Studies
Course Type	Compulsory Course	**Contact Hours**	3 Hours per Week
Credit	2	**Total Hrs**	45 hrs

COURSE OBJECTIVE

The objective of this course is to create awareness, enhance knowledge, develop skills and Environmental attitudes and ethics necessary to understand the Environment in its totality and enables students to participate proactively for the cause of the environment.

COURSE OUTCOME

COs	
CO1	Define the multidisciplinary approach and nature that is for productivity of different ecosystems and ecological dynamics., sustaining of natural resources.
CO2	Explain the current status of natural resources, habitats and biodiversity.
CO3	Describe the types of environmental pollution and control measures. Environmental policies and practices.
CO4	Interpret the human development and environmental threats.
CO5	Summarize the environmental ethics, values and environmental movements in environmental conservation.

Syllabus

UNIT I	**09 HOURS** **Introduction to Environmental Studies**: Multidisciplinary nature of environmental studies, Scope and importance; Concept of sustainability and sustainable development, SDG Goals. **Ecosystem**: Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. **Terrestrial Ecosystems**: Forest ecosystem, Grassland ecosystem, Desert ecosystem, **Aquatic ecosystems**: ponds, streams, lakes, rivers, oceans, estuaries

UNIT II	**13 HOURS** **Natural Resources**: Renewable and Non-Renewable Resources: Land resources: Land-use and land cover change; Land degradation, Soil erosion, and desertification. **Forest Resources**: Types and scope; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity, and tribal populations. **Water Recourses**: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). **Energy resources**: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies. **Biodiversity and Conservation**: Levels of biological diversity: Genetic, species and ecosystem diversity; Biogeographic zones of India Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India. **Threats to biodiversity**: Habitat loss, poaching of wildlife, man-wildlife conflicts with case studies, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
UNIT III	**13 HOURS** **Environmental pollution:** Types, causes, effects and controls; Air, water, soil and noise pollution, nuclear hazards and human health risks, Solid waste; management and control measures of urban and industrial waste with case studies. **Environmental Policies and Practices:** Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. **Environment Laws:** Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.
UNIT IV	**10 HOURS** **Human Communities and the Environment:** Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies. **Disaster management:** floods, earthquake, cyclones and landslides with case studies. **Environmental movements:** Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Ecological, economic, social, ethical, aesthetic and Informational value. Role of Indian and other religions And cultures in environmental conservation. Environmental communication and public awareness, case studies - CNG vehicles in Delhi. **Field work –** Field report to be submitted

REFERENCE BOOKS:

1. Bharucha, E. (2015). Textbook of Environmental Studies.
2. Carson, R. (2002). Silent Spring. Houghton Mifflin Harcourt.
3. Climate Change: Science and Politics. (2021). A Centre for Science and Environment (CSE), Publication, New Delhi.
4. Gadgil, M., and Guha, R. (1993). This Fissured Land: An Ecological History of India. Univ. of California Press.
5. Gleeson, B. and Low, N. (eds.) (1999). Global Ethics and Environment, London, Routledge.
6. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. (2006). Principles of Conservation Biology. Sunderland: Sinauer Associates.
7. McCully, P. (1996). Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
8. McNeill, John R. (2000). Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Nandini, N., Sunitha N., and Sucharita Tandon. (2019). A text book on Environmental Studies (AECC). Sapna Book House, Bengaluru.
10. Odum, E.P., Odum, H.T. and Andrews, J. (1971). Fundamentals of Ecology. Philadelphia: Saunders.
11. Pepper, I.L, Gerba, C.P. and Brusseau, M.L. (2011). Environmental and Pollution Science. Academic Press.
12. Rajit Sengupta and Kiran Pandey. (2021). State of India's Environment 2021: In Figures. Centre Science and Environment.
13. Raven, P.H., Hassenzahl, D.M. and Berg, L.R. (2012). Environment. 8th Edition. John Wiley & Sons.
14. Rosencranz, A., Divan, S., and Noble, M. L. (2001). Environmental law and policy in India.
15. Sengupta, R. (2003). Ecology and economics: An approach to sustainable development. OUP.
16. Singh, J.S., Singh, S.P. and Gupta, S.R. (2014). Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
17. Sodhi, N.S., Gibson, L. and Raven, P.H. (Eds). (2013). Conservation Biology: Voices from the Tropics. John Wiley and Sons.
18. Wilson, E. O. (2006). The Creation: An appeal to save life on Earth. New York: Norton.
19. World Commission on Environment and Development. (1987). Our Common Future. Oxford University Press.

TEACHING PEDOGOGY

Teaching Strategies: Use of Digital tools and platforms for teaching, learning and field/dissertation analysis. Inquiry-based learning, group discussions, Interactive Lectures, quiz, group work, Field–oriented studies, and case studies.

SEMESTER II

24BSC25B: Chemistry II

Course Code	24BSC25B	**Course Title**	Chemistry II (Theory)
Course Type	Core	**Contact Hours**	4 Hours per Week
Credit	4	**Total Hrs**	60 hrs

COURSE OBJECTIVE: The course reviews the structure of the atom, which is a necessary pre-requisite in understanding the nature of chemical bonding in compounds. It provides basic knowledge about ionic, covalent and metallic bonding. Structure, properties and applications of silicates. To establish applications of aromatic hydrocarbons, alkyl and aryl halides. Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, radial and angular distribution curves, shapes of s, p, and d orbitals. The constitution of the course strongly focuses on the Colligative properties of the solutions. It helps in understanding the photophysical and photochemical processes. The course explains the properties of Colloids and relates with the Surface chemistry and catalysed surface reactions. This course helps the students to relate the structure of an organic compound to its physical and chemical properties.

CO CODE	COURSE DESCRIPTION
	COURSE OUTCOME
CO1	Analyze approaches related to the valence bond theory and hybridization, and understand the mechanism of nucleophilic and electrophilic reactions
CO2	To discuss on the postulates of quantum mechanics and understand the importance of orbital shapes.
CO3	Analyze the structure and applications of zeolites and silicates
CO4	Understand the laws of photochemistry and photochemical processes and evaluate the Kinetic, Optical and Electrical stability of colloids.
CO5	Gain an understanding of the mechanism behind the reaction and the significance of catalysts.

Syllabus	
UNIT I	**15Hours** **Chemical Bonding** **13 hours** Ionic bond: Lattice energy, Born-Haber cycle, Born-Lande equation (No derivation), problems on it. Calculation of lattice energies of NaCl and MgO, effect of lattice energy on solubility of ionic compounds. Polarization concept, Fajan’s rule, polarity and polarizability of ions. Covalent bond: Valence bond approach; hybridization and directional characteristics of sp, sp^2, sp^3, sp^2d, sp^3d^2. Shapes of BeCl2, BF3, SiCl4, PCl5 and SF6. VSEPR theory: shapes of CH4, NH3, NH^+, H2O, BrF3 and ICl2. Molecular orbital theory: H2, He^+, Be2, N2, O2, O^{2-}, O^{2+}, CO and NO (bond order, stability and magnetic properties to be discussed). $_2$ $_2$ $_2$ Bond length, bond angle and bond energy. Polar and non-polar molecules, dipole moment. Weak interactions: i). Hydrogen bonding: Intra molecular and Intermolecular types, anomalous properties of HF, H2O, NH3, alcohols, carboxylic acids, nitro phenols and bio molecules. ii) van der Waals forces: Noble gases and molecular crystals (dry ice, Iodine and solid SO2) Metallic bond: Band theory, electrical properties of metals, semiconductors and insulators. **Silicates** **2 hours** Structure of SiO_4 $^{4-}_{4}$, classification of silicates based on the structure. Zeolites: structure and applications.
UNIT II	**15Hours** **Aromatic hydrocarbons** **10 hours** Nomenclature. Structure of benzene using molecular orbital theory. Criteria for aromaticity Huckel’s rule (Examples: cyclopentadienyl anion, cycloheptatrieneyl cation, benzene, naphthalene, anthracene and phenanthrene). Antiaromaticity. General mechanism of aromatic electrophilic substitution. Mechanism of nitration of benzene including evidence for the formation of nitronium ion, energy profile diagram and isotopic effect. Orienting influence of substituents in toluene, chlorobenzene, nitrobenzene and phenol. Aromatic nucleophilic substitution via benzyne intermediate, mechanism with evidences for the formation of benzyne by trapping with anthracene, Birch reduction. Side chain oxidation of toluene to benzaldehyde and benzoic acid. Oxidation of naphthalene, anthracene and phenanthrene. Diels Alder reaction of anthracene with 1,2-dichloroethene. Alkenyl benzenes: Styrene, cis- and trans-stilbenes and their preparations. Biphenyl: Preparation-Ullmann reaction. **SUGGESTED ADDITION: Frost Circle Diagram** **Organic halogen compounds** **5 hours** Alkyl halides: Nomenclature. Nucleophilic substitution reactions - SN^1 and SN^2 mechanisms with energy profile diagrams. Effect of (i) nature of alkyl groups (ii) nature of leaving groups, (iii) nucleophiles and (iv) solvents on SN^1 and SN^2 mechanisms. Elimination reactions - E1 and E2 mechanisms; Hofmann and Saytzeff eliminations with mechanism.

	Aryl halides: Preparation by halogenation. Relative reactivity of alkyl, allyl, vinyl, aryl and aralkyl halides towards nucleophilic substitution.
UNIT III	**15 HOURS** **Quantum Mechanics and Atomic Structure** **12 hours** *Review of Bohr's atomic model*: Derivation of expressions for radius, energy and ionization energies of hydrogen like atoms. Numerical Problems. Limitations of classical mechanics. Wave particle duality, Uncertainty principle. New quantum mechanics-sinusoidal wave (Explanation). Schrodinger wave equation - derivation. Postulates of quantum mechanics. Significance of the terms; Hamiltonian operator, Eigen function; Ψ (significance of ψ and ψ^2) and Eigen values. Application of Schrodinger equation to particle in one dimensional box (derivation required), and to the hydrogen atom (detailed solution not required). Expressing the solution as a product of $\psi n,l,m$ (r, θ, φ) = $\psi n, l.$ (r)ψ $l.$ m (θ, φ). Explanation on quantum numbers (only qualitative). Radial and angular probability distribution. Orbitals: shapes of s, p, d and orbitals. Contour, probability and boundary surface diagrams of orbital representation. **Colligative properties** **3 hours** Liquid Mixture: Review of Raoult's law, ideal and non-ideal solutions. Dilute solutions- Review of colligative properties and concentration terms. Determination of molecular mass of a solute by: (i) Berkeley-Hartley's method (π); (ii)Beckmann's method (ΔTf) and (iii) Landsberger's method. Numericalproblems. (ii)Beckmann's method (ΔTf) and (iii) Landsberger's method. Numerical problems

UNIT IV	**15Hours** **Photochemistry** **5Hours** Introduction to photochemical reactions, Laws of photochemistry-Grotthus-Draper law, Stark-Einstein law. Differences between photophysical and photochemical processes with examples. Comparison of photochemical and thermal reactions. Quantum yield of photochemical combination of (i) H_2 and Cl_2 (ii) H_2 and Br_2 (iii) dissociation of HI (iv) dimerisation of anthracene. Reasons for the high and low quantum yield. Problems based on quantum efficiency. Photosensitization and photostationary equilibrium. Singlet and triplet states. Fluorescence, phosphorescence, luminescence, bioluminescence and chemical sensors. Jablonski diagram. Explanation of internal conversion, inter- system crossing Beer-Lambert's law and its applications. Numerical problems on absorption coefficient and molar extinction coefficient. **Colloids** **5Hours**

Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties – Kinetic, Optical and Electrical stability of colloids. Protective action. Hardy–Schultz law and Gold number. Liquids in liquids (emulsions): Types of emulsions, preparation and emulsifier. Liquids in solids (gels): Classification, preparations and properties. General applications of colloids.

Adsorption and catalysis **5Hours**

Introduction. Types of adsorptions. Factors influencing adsorption. Freundlich adsorption isotherm. Langmuir theory of unilayer adsorption isotherm. Applications.
Catalysis –Types and theories (intermediate compound theory and adsorption

REFERENCE BOOKS

1. Heterogeneous catalysis: surface reactions, unimolecular and bi-molecular
2. Basic Inorganic Chemistry, 3rd Edition, F. A. Cotton, G. Wilkinson, P. L. Gaus-John Wiley & Sons, 1995
3. Principles of Inorganic Chemistry, B. R. Puri and L. R. Sharma, Jauhar S. P-S. N. Chand & Co., 1998..
4. Fundamentals of Organic Chemistry, McMurry, J.E., 7th Edition, Cengage Learning India Edition, 2013.
5. Text Book of Physical Chemistry, K. L. Kapoor, McGraw Hill Education Private Limited, 2022.
6. Introduction to Quantum Theory and Atomic Structure, P.A. Cox, Oxford Chemistry Primers, 1996

Additional References:

1. Text Book of Physical Chemistry, Soni P.L., Dharmarha OP, Dash UN, Sultan Chand & Sons, 2023.
2. Organic Chemistry, Finar, I.L. Vol. 1, 6th Edition, Pearson, 2002.
3. Physical Chemistry, Puri, Sharma, Pathania, 48th Edition, Vishal Publishing Company 2021.
4. Fundamentals of Photochemistry, K K Rohatgi, K K Mukherjee, New Age International, 2021.

TEACHING PEDOGOGY

The curriculum will be delivered through various methods including chalk and talk, power point presentations, audio, video tools, E-learning/E-content, virtual labs, simulations, field trips/Industry visits, seminars (talks by experts), workshops, projects, models and class discussions.

SEMESTER II

24BSC28BP: **Physical Chemistry (Practicals)**

Course Code	24BSC28BP	**Course Title**	**Physical Chemistry (Practicals)**
Course Type	Core	**Contact Hours**	4hrs
Credit	2	**Total Hrs**	60hrs

COURSE OBJECTIVES:
● Perform colorometric titrations Know the principle and handling of pH meter, colorimeter, viscometer ● Determination of the density and surface tension ● Study of the variation of viscosity of a solute ● Study of critical solution temperature

COURSE OUTCOME	
CO CODE	**COURSE DESCRIPTION**
CO1	Know the importance of surface tension and understanding of the concepts of viscosity
CO2	Gain understanding on the distribution coefficient, when solute undergo association or dissociation.
CO3	Evaluate the applicability of transition temperature
CO4	Skills in maintaining laboratory equipments
CO5	Understand the basic principles of colorimeter ..

Syllabus	**56hrs**
Content	**List of Experiments to be conducted** 1. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald’s viscometer. 2. Determination of the density using specific gravity bottle and surface tension of a liquid using Stalagmometer. 3. Determination of molar mass of a non-electrolyte by Walker-Lumsden method. 4. Study of the variation of viscosity of sucrose solution with the concentration of a solute. 5. Determination of molar mass of polymer by viscosity method. 6. Determination of transition temperature of a salt hydrate by thermometric method. 7. Determination of degree of dissociation of KCl by Walker-Lumsden method. 8. Determination of critical solution temperature of phenol water system. 9. Determination of distribution coefficient of benzoic acid between water and toluene. 10. Study of kinetics of the reaction between KI and K2S2O8 by colorimetric method.

QUESTION PAPER PATTERN
CHEMISTRY

Time: 3 Hours Max. Marks: 80

Instructions: Answer Q. no. 1 and any 6 of the following

1. Answer any TEN of the following 10X2 = 20 Marks
    - a)
    - b)
    - c)
    - d)
    - e)
    - f)
    - g)
    - h)
    - i)
    - j)
    - k)
    - l)
2. Q. no. 2 from Unit-I 10 Marks
    - a)
    - b)
    - c)
3. Q. no. 3 from Unit-II 10 Marks
    - a)
    - b)
    - c)
4. Q. no. 4 from Unit-III 10 Marks
    - a)
    - b)
    - c)
5. Q. no. 5 from Unit-IV 10 Marks
    - a)
    - b)
    - c)
6. Q. no. 6 from Unit-I and II 10 Marks
    - a)
    - b)
    - c)
7. Q. no. 7 from Unit-II and III 10 Marks
    - a)
    - b)
    - c)
8. Q. no. 8 from Unit-III and IV 10 Marks
    - a)
    - b)
    - c)
9. Q. no. 9 from Unit-I and IV 10 Marks
    - a)
    - b)
    - c)

1. Pattern for Question Nos. 2 to 9

- 4+3+3 = 10 Marks OR 5+5 = 10 Marks

QUESTION PAPER PATTERN
ENVIRONMENTAL STUDIES

Time: 1.5 Hours **Max. Marks: 40**

Instruction: Answer All Sections

Section - A: Short Answer Questions **(5 x 2 = 10)**

All questions are compulsory

1. (a). Question from Unit 1
   (b). Question from Unit 2
   (c). Question from Unit 3
   (d). Question from Unit 4
   (e). Question from Unit 4

Section - B: Medium Answer Questions **(4 x 5 = 20)**

Answer any **FOUR** questions

2. Question from Unit 1
3. Question from Unit 2
4. Question from Unit 2
5. Question from Unit 3
6. Question from Unit 4
7. Question from Unit 4

Section - C: Long Answer Questions **(1 x 10 = 10)**

Answer any **ONE** question

8. Question from Unit 1
9. Question from Unit 3