# FACULTY OF LANGUAGES

SYLLABUS FOR THE

## SUBJECT: ENGLISH LANGUAGE SKILLS (Ability Enhancement Course) APPRECIATING ENGLISH LITERATURE (Multidisciplinary Course)

for the award of the Degree in

**BACHELOR OF ARTS/ BACHELOR OF SCIENCE**

(Offered under 3-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

**Batch: 2024–27**

## GURU NANAK DEV UNIVERSITY AMRITSAR

Bachelor of Arts/Bachelor of Science
(English Language Skills & Appreciating English Literature)
(CBGS) (under NEP 2020) (Batch 2024-27) (Semester I-VI)
(Faculty of Languages)

**SCHEME**

| Sr. No. | Course Code | Course Title | Semester | Credits L-T-P |
|---|---|---|---|---|
| 1. | ENAEC101 | ENGLISH LANGUAGE SKILLS-1 **(Ability Enhancement Course)** | SEM - I | 4-0-0 |
| 2. | ENMDC 151 | APPRECIATING ENGLISH LITERATURE-1 **(Multidisciplinary Course)** | SEM -II | 4-0-0 |
| 3. | ENAEC201 | ENGLISH LANGUAGE SKILLS-2 **(Ability Enhancement Course)** | SEM -III | 4-0-0 |
| 4. | ENMDC 251 | APPRECIATING ENGLISH LITERATURE-2 **(Multidisciplinary Course)** | SEM -IV | 4-0-0 |
| 5. | ENAEC301 | ENGLISH LANGUAGE SKILLS-3 **(Ability Enhancement Course)** | SEM -V | 4-0-0 |
| 6. | ENMDC 351 | APPRECIATING ENGLISH LITERATURE-3 **(Multidisciplinary Course)** | SEM -VI | 4-0-0 |

Bachelor of Arts/Bachelor of Science
(English Language Skills & Appreciating English Literature)
(CBGS) (under NEP 2020) (Batch 2024-27) (Semester I-VI)
(Faculty of Languages)

**SEMESTER–I**
**ENAEC101 : ENGLISH LANGUAGE SKILLS-1**
**(Ability Enhancement Course)**

**Time: 3 Hours**

**Credits: 4-0-0**
**(6 periods per week)**
**Total Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Texts Prescribed:-**
- *Prose for Young Learners* (Guru Nanak Dev University, Amritsar)
- *English Grammar in Use* (Fifth Edition) by Raymond Murphy, CUP

**The syllabus is divided in four sections as mentioned below.**

**SECTION–A**

*English Grammar in Use*, 5th Edition by Raymond Murphy, CUP (Units: 1-37)

**SECTION–B**

Paragraph Writing and *English Grammar in Use* (Units: 38-48)

**SECTION–C**

*Prose for Young Learners*: Essays at Sr. No. 1, 2, 3, 5 and 6

**SECTION–D**

*Prose for Young Learners*: Essays at Sr. No. 7, 8, 9, 10 and 11

Bachelor of Arts/Bachelor of Science
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(Faculty of Languages)

**SEMESTER–II**
**ENMDC 151: APPRECIATING ENGLISH LITERATURE-1**
**(Multidisciplinary Course)**

**Time: 3 Hours**

**Credits: 4-0-0**
**(6 periods per week)**
**Total Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Texts Prescribed:**
1. *Tales of Life* (Guru Nanak Dev University, Amritsar)
2. *English Grammar in Use* (Fifth Edition) by Raymond Murphy, CUP (Units: 49-97)

**The syllabus is divided in four sections as mentioned below.**

**SECTION–A**

*English Grammar in Use*, 5th Edition by Raymond Murphy, CUP (Units: 49-81)

**SECTION–B**

Personal letter Writing and *English Grammar in Use* (Units: 82-97)

**SECTION–C**

*Tales of Life* (Guru Nanak Dev University, Amritsar): Stories at Sr. No. 1, 2, 3, 5 and 6

**SECTION–D**

*Tales of Life* (Guru Nanak Dev University, Amritsar): Stories ar Sr. No. 7, 9, 10, 11, 12

Bachelor of Arts/Bachelor of Science
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**SEMESTER–III**
**ENAEC201 : ENGLISH LANGUAGE SKILLS-2**
**(Ability Enhancement Course)**

**Time: 3 Hours**

**Credits: 4-0-0**
**(6 periods per week)**
**Total Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Important Note:** The textbook *Making Connections* (3rd edition) is significantly different from its 2nd edition. The third edition (by Kenneth J Pakenham, Jo EcEntire, Jessica Williams) is to be followed for this course.

**Texts Prescribed:**
1. *Making Connections* by Kenneth J. Pakenham, Jo McEntire, Jessica Williams, 3rdEdition. CUP.
2. *English Grammar in Use* (Fifth Edition) by Raymond Murphy, CUP

**Texts Suggested:**
*Oxford Guide to Effective Writing and Speaking* by John Seely
*A Course in Grammar and Compostion* by Geetha Nagaraj, Foundation Books, 2006

**Syllabus is divided into four sections as mentioned below:**

**SECTION–A**
*English Grammar in Use* (Fifth Edition) by Raymond Murphy, CUP: Units 98-130

**SECTION–B**
Essay writing and *English Grammar in Use*: Units 131-145

**SECTION–C**
*Making Connections* by Kenneth J. Pakenham, 3rd Edn. CUP: Unit-I (Global Health) and Unit-II (Multicultural Societies)

**SECTION–D**
*Making Connections* by Kenneth J. Pakenham, 3rd Edn. CUP: SECTION–III (Aspects of Language) and SECTION–IV (Sustaining Planet Earth)

Bachelor of Arts/Bachelor of Science
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(CBGS) (under NEP 2020) (Batch 2024-27) (Semester I-VI)
(Faculty of Languages)

**SEMESTER–IV**
**ENMDC 251: APPRECIATING ENGLISH LITERATURE-2**
**(Multidisciplinary Course)**

**Time: 3 Hours**

**Credits: 4-0-0**
**(6 periods per week)**
**Total Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Texts Prescribed:-**

1. *Moments in Time: An Anthology of Poems*, GNDU, Amritsar.
2. *English Grammar in Use* (Fifth Edition) by Raymond Murphy, CUP.

**Syllabus is divided into four sections as mentioned below:**

**SECTION–A**

*English Grammar in Use* (Fifth Edition) by Raymond Murphy, CUP: Revision of Units 26-37, 42-48, 92- 97, 113-120.

**SECTION–B**

*Moments in Time*: Poems at Sr. No. 1-6

**SECTION–C**

*Moments in Time*: Poems at Sr. No. 7-12

**SECTION–D**

Paragraph Writing, Business Letters, Writing emails.

Bachelor of Arts/Bachelor of Science
(English Language Skills & Appreciating English Literature)
(CBGS) (under NEP 2020) (Batch 2024-27) (Semester I-VI)
(Faculty of Languages)

**SEMESTER–V**
**ENAEC301 : ENGLISH LANGUAGE SKILLS-3**
**(Ability Enhancement Course)**

**Time: 3 Hours**

**Credits: 4-0-0**
**(6 periods per week)**
**Total Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Texts Prescribed:**
1. *All My Sons* by Arthur Miller
2. *Poems of Nature and Culture*, Guru Nanak Dev University, Amritsar

**Texts Suggested (for Section D):**
*Oxford Guide to Effective Writing and Speaking* by John Seely
*A Course in Grammar and Composition* by Geetha Nagaraj, Foundation Books, 2006

**The syllabus is divided into four sections as mentioned below:**

**SECTION - A**

*All My Sons* by Arthur Miller: the whole text.

**SECTION - B**

The following poems from *Poems of Nature and Culture*:
William Wordsworth: "The World is Too Much with Us"
Gordon Lord Byron: "She Walks in Beauty"
P.B. Shelly: "Ozymandias"
Alfred Lord Tennyson: "In Memoriam"
Robert Browning: "Meeting at Night"
Mathew Arnold: "Dover Beach"
W.B. Yeats: "Words"
Wilfred Owen: "Strange Meeting"

**SECTION - C**

The following poems from *Poems of Nature and Culture*:
Robert Graves: "The Portrait"
W.H. Auden: "The Unknown Citizen"
Dylan Thomas: "Do not Go Gentle into That Good Night"
Ted Hughes: "The Thought-Fox"
Sylvia Plath: "Mirror"
Seamus Heaney: "Honeymoon Flight"
Rabindranath Tagore: "False Religion"
Nissim Ezekiel: "Night of Scorpion"

**SECTION - D**

Formal Letter and Application Writing, Resume Writing, and Precis Writing

Bachelor of Arts/Bachelor of Science
(English Language Skills & Appreciating English Literature)
(CBGS) (under NEP 2020) (Batch 2024-27) (Semester I-VI)
(Faculty of Languages)

**SEMESTER–VI**

**ENMDC 351 : APPRECIATING ENGLISH LITERATURE-3**
**(Multidisciplinary Course)**

**Time: 3 Hours**

**Credits: 4-0-0**
**(6 periods per week)**
**Total Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Texts Prescribed:**

1. *The Guide* by R.K. Narayan
2. *Glimpses of Theatre*, Guru Nanak Dev University Amritsar.
   i) "The Will"
   ii) "Villa for Sale"
   iii) "Progress"
   iv) "The Monkey's Paw"
   iv) "Sorry Wrong Number"
   v) "No eggs!No eggs!"

**Texts Suggested (for Section D):**
*Oxford Guide to Effective Writing and Speaking* by John Seely
*A Course in Grammar and Composition* by Geetha Nagaraj, Foundation Books, 2006
*Writing Essays and Reports: A Student's Guide* by Stephen McLaren (Viva Books)

**SECTION–A**

Study of the novel, *The Guide* by R.K. Narayan

**SECTION–B**

One-Act plays **"The Will," "Villa for Sale"**and **"Progress"** from *Glimpses of Theatre***,** Guru Nanak Dev University Amritsar

**SECTION–C**

One-Act plays **"The Monkey's Paw," "Sorry Wrong Number"** and **"No eggs! No eggs!"**from *Glimpses of Theatre*, Guru Nanak Dev University Amritsar

**SECTION–D**

Essay Writing, Business Writing, and Report Writing

# FACULTY OF ARTS & SOCIAL SCIENCES

SYLLABUS FOR THE

# SUBJECT: PUNJAB HISTORY & CULTURE

**(SPECIAL PAPER IN LIEU OF PUNJABI COMPULSORY)**
**(FOR THOSE STUDENTS WHO ARE NOT DOMICILE OF PUNJAB)**

for the award of the Degree in

**BACHELOR OF ARTS/ BACHELOR OF SCIENCE**

(Offered under 3-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

**Batch: 2024–27**

## GURU NANAK DEV UNIVERSITY AMRITSAR

Bachelor of Arts /Bachelor of Science Punjab History & Culture
(CBGS) (under NEP 2020) *(Batch 2024-27) (Semester I-VI)*
*(Faculty of Arts & Social Sciences)*

## SCHEME

## PUNJAB HISTORY & CULTURE
**(Special Paper in lieu of Punjabi compulsory)**
**(For those students who are not domicile of Punjab)**

### SEMESTER - I

| Sr. No. | Course Code | Course Title | L | T | P | Total Credits | Marks |
|---|---|---|---|---|---|---|---|
| 1. | PHC 110 | PUNJAB HISTORY & CULTURE (FROM EARLIEST TIMES TO C 320) | 4 | 0 | 0 | 4 | 100 |

### SEMESTER - II

| Sr. No. | Course Code | Course Title | L | T | P | Total Credits | Marks |
|---|---|---|---|---|---|---|---|
| 1. | PHC 111 | PUNJAB HISTORY & CULTURE (C.320 TO 1000 A.D.) | 4 | 0 | 0 | 4 | 100 |

### SEMESTER - III

| Sr. No. | Course Code | Course Title | L | T | P | Total Credits | Marks |
|---|---|---|---|---|---|---|---|
| 1. | PHC 112 | PUNJAB HISTORY & CULTURE (FROM 1000 T0 1605 A.D) | 4 | 0 | 0 | 4 | 100 |

### SEMESTER - IV

| Sr. No. | Course Code | Course Title | L | T | P | Total Credits | Marks |
|---|---|---|---|---|---|---|---|
| 1. | PHC 113 | PUNJAB HISTORY & CULTURE (FROM 1605 TO 1849 A.D) | 4 | 0 | 0 | 4 | 100 |

### SEMESTER - V

| Sr. No. | Course Code | Course Title | L | T | P | Total Credits | Marks |
|---|---|---|---|---|---|---|---|
| 1. | PHC 114 | PUNJAB HISTORY & CULTURE (FROM 1849-1947 A.D) | 4 | 0 | 0 | 4 | 100 |

### SEMESTER - VI

| Sr. No. | Course Code | Course Title | L | T | P | Total Credits | Marks |
|---|---|---|---|---|---|---|---|
| 1. | PHC 115 | PUNJAB HISTORY & CULTURE (1947-2000 A.D.) | 4 | 0 | 0 | 4 | 100 |

Bachelor of Arts /Bachelor of Science Punjab History & Culture
(CBGS) (under NEP 2020) *(Batch 2024-27) (Semester I-VI)*
*(Faculty of Arts & Social Sciences)*

**SEMESTER–I**

**PHC 110 : Punjab History & Culture (From Earliest Times to C 320)**

**(Special Paper in lieu of Punjabi compulsory)**

**(For those students who are not domicile of Punjab)**

**Time: 3 Hours** **Credits : 4-0-0**
**Max. Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

1. Physical features of the Punjab and its impact on history.
2. Sources of the ancient history of Punjab

**SECTION-B**

3. Harappan Civilization: Origin and extent Town planning; social, economic and religious life of the Indus Valley People.
4. The Indo-Aryans: Original home and settlements in Punjab.

**SECTION-C**

5. Social, Religious and Economic life during *Rig* Vedic Age.
6. Social, Religious and Economic life during Later Vedic Age.

**SECTION-D**

7. Teachings and impact of Buddhism
8. Jainism in the Punjab

**Suggested Readings:**


1. L. M Joshi (ed.), *History and Culture of the Punjab*, Art-I, Patiala, 1989 (3rd edition)
2. L.M. Joshi and Fauja Singh (ed.), *History of Punjab*, Vol.I, Patiala 1977.
3. BudhaParkash, *Glimpses of Ancient Punjab*, Patiala, 1983.
4. B.N. Sharma, *Life in Northern India*, Delhi. 1966.
5. Chopra, P.N., Puri, B.N., & Das, M.N.(1974). *A Social, Cultural & Economic History of India,* Vol. I, New Delhi: Macmillan India.

Bachelor of Arts /Bachelor of Science Punjab History & Culture
(CBGS) (under NEP 2020) *(Batch 2024-27) (Semester I-VI)*
*(Faculty of Arts & Social Sciences)*

**SEMESTER–II**

**PHC 111 : Punjab History & Culture (C. 320 to 1000 A.D.)**

**(Special Paper in lieu of Punjabi compulsory)**

**(For those students who are not domicile of Punjab)**

**Time: 3 Hours** **Credits : 4-0-0**
**Max. Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION–A**

1. Alexander's Invasion and its Impact
2. Punjab under Chandragupta Maurya and Ashoka.

**SECTION–B**

3. The Kushans and their Contribution to the Punjab.
4. The Panjab under the Gupta Empire.

**SECTION–C**

5. The Punjab under the Vardhana Emperors
6. Socio-cultural History of Punjab from 7$^{th}$ to 1000 A.D.

**SECTION–D**

7. Development of languages and Education with Special reference to Taxila
8. Development of Art & Architecture

**Suggested Readings**

1. L. M Joshi (ed), *History and Culture of the Punjab*, Art-I, Punjabi University, Patiala, 1989 (3$^{rd}$ edition)
2. L.M. Joshi and Fauja Singh (ed.), *History of Punjab* , Vol.I, Punjabi University, Patiala, 1977.
3. Budha Parkash, *Glimpses of Ancient Punjab*, Patiala, 1983.
4. B.N. Sharma : *Life in Northern India*, Delhi. 1966.

Bachelor of Arts /Bachelor of Science Punjab History & Culture
(CBGS) (under NEP 2020) *(Batch 2024-27) (Semester I-VI)*
*(Faculty of Arts & Social Sciences)*

**SEMESTER–III**

**PHC 112 : Punjab History & Culture (From 1000 to 1605 A. D)**

**(Special Paper in lieu of Punjabi compulsory)**

**(For those students who are not domicile of Punjab)**

**Time: 3 Hours** **Credits : 4-0-0**
**Max. Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION- A**

1. Society and Culture of Punjab during the Turko-Afghan rule.
2. The Punjab under the Mughals

**SECTION- B**

3. Bhakti movement and its impact on Society of Punjab
4. Sufism in Punjab with special reference to Baba Farid.

**SECTION--C**

5. Guru Nanak-Early Life and travels
6. Teachings of Guru Nanak, Concept of Sangat, Pangat and dharmsal.

**SECTION--D**

7. Contribution of Guru Angad Dev, Guru Amar Das and Guru Ram Das.
8. Compilation of Adi Granth and martyadom of Guru Arjun Dev

**Suggested Readings**


1. Chopra, P.N., Puri, B.N., & Das, M.N.(1974). *A Social, Cultural & Economic History of India,* Vol. II. New Delhi : Macmillan India.
2. Grewal, J.S. (1994). *The Sikhs of the Punjab*, Cambridge University Press, New Delhi.
3. Singh, Fauja (1972). *A History of the Sikhs*, Vol. II, I. Patiala: Punjabi University.
4. Singh, Kushwant (2011). *A History of the Sikhs*- Vol. I (1469-1839). New Delhi : Oxford University Press.
5. Singh,Kirpal (1990). *History and Culture of the Punjab*-Part II (Medieval Period). Patiala : Publication Bureau, Punjabi University.

**SEMESTER–IV**

**PHC 113 : Punjab History & Culture (From 1605 to 1849 A.D)**

**(Special Paper in lieu of Punjabi compulsory)**

**(For those students who are not domicile of Punjab)**

**Time: 3 Hours** **Credits : 4-0-0**
**Max. Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION- A**

1. Politicization of Sikhism under Guru Hargobind.
2. Martydom of Guru Teg Bahadur

**SECTION--B**

3. Creation of Khalsa
4. Khalsa and its impact on the Punjab

**SECTION--C**

5. Rise of Banda Bahadur and his achievements.
6. Rise of Misls.

**SECTION--D**

7. Ranjit Singh's rise to power; Civil, Military and Land Revenue Administration.
8. Art and Architecture, Fair, Festivals and Folk Music in the Punjab during the medieval period.

**Suggested Readings**

1. Chopra P.N., Puri, B.N., & Das, M.N.( 1974), *A Social, Cultural & Economic History of India.* Vol.II, Macmillan India Limited, New Delhi.
2. Grewal, J.S. (1994). *The Sikhs of the Punjab*, Cambridge University Press, New Delhi.
3. Singh, Fauja (1972). *A History of the Sikhs*, Vol. III, Patiala: Punjabi University.
4. Singh, Kushwant (2011). *A History of the Sikhs*- Vol. I (1469-1839). New Delhi : Oxford University Press.
5. Singh,Kirpal (1990). *History and Culture of the Punjab*-Part II (Medieval Period). Patiala: Publication Bureau, Punjabi University.

**SEMESTER–V**

**PHC 114 : Punjab History & Culture (From 1849-1947 A.D)**

**(Special Paper in lieu of Punjabi compulsory)**

**(For those students who are not domicile of Punjab)**

**Time: 3 Hours** **Credits : 4-0-0**

**Max. Marks: 100**

**Instructions for the Paper Setters:-**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

1. First Anglo-Sikh War.
2. Annexation of Punjab by the British and Board of Administration

**SECTION-B**

3. British Policy towards agriculture, industry, trade and commerce.
4. Spread of modern education

**SECTION-C**

5. Social religious reform movements: Namdhari, Singh Sabha and Arya Samaj
6. Gadhar Movement and Jallianwala Bagh Massacre & its aftermath

**SECTION-D**

7. Gurdwara Reform Movement
8. Contribution to freedom struggle: Non-cooperation; HSRA and Quit India Movement.

## Suggested Readings

1. Singh, Fauja, *History and Culture of the Punjab*, Part II, Publication Bureau, Punjabi University, Patiala, 1987.
2. Singh, Fauja , *Freedom Struggle in the Punjab*, Publication Bureau, Punjabi University, Patiala, 1974.
3. Grewal, J.S., *The Sikhs of the Punjab*, New Cambridge House, New Delhi, 2005.
4. Singh, Kushwant , *A History of the Sikhs*. Vol. II (1839-1998), Oxford University Press, Delhi, 1991.
5. Rai, Satya. M (1978), *Heroic Tradition in the Punjab (1900-1947*). Punjabi University, Patiala, 1978.
6. Chopra, P.N. & Das, M.N. (1974), *A Social, Cultural & Economic History of India.* Vol.III, Macmillan India, 1974.
7. Yadav, K.C., *Haryana Aitihasik Simhavalokan* (Hindi). Haryana Sahitya Akademy, Chandigarh, 1991.
8. Saini B. S, *The Social & Economic History of the Punjab 1901-1939,* Ess Ess Publications, Delhi, 1975.
9. Mittal, S.C, *Freedom Movement in the Punjab (1905-29)*, Concept Publishing Company Delhi, 1977.

**SEMESTER–VI**

**PHC 115 : Punjab History & Culture ( 1947-2000 A.D.)**

**(Special Paper in lieu of Punjabi compulsory)**

**(For those students who are not domicile of Punjab)**

**Time: 3 Hours** **Credits : 4-0-0**
**Max. Marks: 100**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

1. Partition and its Impact on Punjab
2. Rehabilitation.

**SECTION--B**

3. Punjabi Suba Movement and Reorganization Act of 1966.
4. Green Revolution.

**SECTION--C**

5. Punjabi Diaspora
6. Development of education in Punjab after Independence

**SECTION--D**

7. Development of Punjabi Literature and Drama.
8. Emerging Concerns: Drug Addiction and Female Foeticide.

**Suggested Readings**

1. Chopra, P.N. & Das, M.N. (1974), *A Social, Cultural & Economic History of India.* Vol.III, Macmillan India, New Delhi, 1974.
2. Grewal, J.S., *Social and Cultural History of Punjab: Prehistoric, Ancient and Early Medieval*. Foundation Books Pvt Ltd Cambridge House, New Delhi, 2004.
3. Grewal, J.S., *The Sikhs of Punjab*. New Cambridge House, New Delhi, 2005
4. Rai Satya M., *Heroic Tradition in Punjab(1900-1947)*. Publication Bureau, Punjabi University, Patiala, 1978.
5. Singh, Fauja., *Freedom Struggle in Punjab*. Publication Bureau, Punjabi University, Patiala, 1974.
6. Singh, Fauja, *History and Culture of the Punjab*. Part II, Publication Bureau, Punjabi University, Patiala, 1987.
7. Singh, Kushwant, *A History of the Sikhs*. Vol. II (1839-1998), Oxford University Press, Delhi, 1991.
8. Yadav, K.C., *Haryana Aitihasik Simhavalokan* (Hindi). Haryana Sahitya Akademy, Chandigarh, 1991.

# FACULTY OF SCIENCES

SYLLABUS FOR THE

# SUBJECT: CHEMISTRY

for the award of the Degree in

**BACHELOR OF ARTS/ BACHELOR OF SCIENCE/ HONOURS**

(Offered under 4-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

**Batch: 2024–28**

## GURU NANAK DEV UNIVERSITY AMRITSAR



**(ii)** Syllabi are subject to change at the discretion of the authority.
Please visit the University website from time to time.

Bachelor of Arts /Bachelor of Science/Honours Chemistry (CBGS)
(under NEP 2020) *(Batch 2024-28) (Semester I-VIII)*
*(Faculty of Sciences)*

**SCHEME**

**CHEMISTRY**

**FIRST SEMESTER**

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | **Major Core Course** | |
| 1. | | Inorganic Chemistry-I: Atomic structure and periodic table | 4-0-0 |
| 2. | | Inorganic Chemistry-I: Lab qualitative analysis | 0-0-1 |

**SECOND SEMESTER**

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | **Major Core Course** | |
| 1. | | Organic Chemistry-I: Hydrocarbons and alkyl halides | 4-0-0 |
| 2. | | Organic Chemistry-I: Lab Functional group analysis | 0-0-1 |

**THIRD SEMESTER**

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | **Major Core Course** | |
| 1. | | Physical Chemistry-I: States of matter and electrochemistry | 4-0-0 |
| 2. | | Physical Chemistry-I: Lab | 0-0-1 |

**FOURTH SEMESTER**

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | **Major Core Course** | |
| 1. | | Inorganic Chemistry-II: Periodic table and coordination chemistry | 4-0-0 |
| 2. | | Inorganic Chemistry-II: Lab Volumetric/Gravimetric analysis and preparations | 0-0-1 |

Bachelor of Arts /Bachelor of Science/Honours Chemistry (CBGS)
(under NEP 2020) *(Batch 2024-28) (Semester I-VIII)*
*(Faculty of Sciences)*

**FIFTH SEMESTER**

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | **Major Core Course** | |
| 1. | | Organic Chemistry-II: Chemistry of O/N containing compounds | 4-0-0 |
| 2. | | Organic Chemistry-II: Lab Preparations-I | 0-0-1 |
| | | **Summer Internship** | |
| 3. | | Summer Internship (02 Weeks) | 0-0-2 |

**SIXTH SEMESTER**

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | **Major Core Course** | |
| 1. | | Physical Chemistry-II: Thermodynamics and equilibrium | 4-0-0 |
| 2. | | Physical Chemistry-II: Lab | 0-0-1 |

**SEVENTH SEMESTER**

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | **Major Core Course** | |
| 1. | | Physical Chemistry-III: Chemical kinetics | 3-0-0 |
| 2. | | Organic Chemistry-IV: Structure-reactivity relationship | 3-0-0 |
| 3. | | Inorganic Chemistry-III: Organometallics | 3-0-0 |
| 4. | | Physical Chemistry-IV: Thermodynamics of biopolymer solution | 3-0-0 |
| 5. | | Organic Chemistry-IV: Lab Preparations-II | 0-0-2 |
| 6. | | Physical Chemistry-III: Lab | 0-0-2 |
| | | **Minor Stream Courses** | |
| 7. | | Synthesis and characterization of materials | 4-0-0 |
| | | **Summer Internship** | |
| 8. | | Summer Internship (02 Weeks) | 0-0-2 |

Bachelor of Arts /Bachelor of Science/Honours Chemistry (CBGS)
(under NEP 2020) *(Batch 2024-28) (Semester I-VIII)*
*(Faculty of Sciences)*

**EIGHTH SEMESTER**

| **Sr. No.** | **Course Code** | **Course Title** | **Credits** |
|---|---|---|---|
| | | **Major Core Course** | |
| 1. | | Inorganic Chemistry-IV: Cluster and cage compounds | 4-0-0 |
| 2. | | Organic Chemistry-V: Organic synthesis-I | 4-0-0 |
| 3. | | Inorganic Chemistry-V: Nuclear chemistry | 3-0-0 |
| 4. | | Physical Chemistry-V: Electroanalytical techniques | 3-0-0 |
| 5. | | Inorganic Chemistry-III: Lab | 0-0-2 |
| | | **Minor Stream Courses** | |
| 6. | | Atomic and molecular spectroscopy | 4-0-0 |

**SEMESTER–I**

**CHEMISTRY**

**INORGANIC CHEMISTRY – I: Atomic structure and Periodic table**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **60 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section

**SECTION-A** **(15 Hrs.)**

**Atomic Structure-** Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, Quantum numbers, Shapes of s, p, d and f orbitals. Aufbau's and Pauli's Exclusion principle, Hund's multiplicity rule. Electronic configurations of the elements and ions.

**Periodic Properties**- Position of elements in the periodic table; effective nuclear charge and its calculations. Details of atomic and ionic radii, ionization energy, electron affinity and electronegativity.

**SECTION-B** **(15 Hrs.)**

**Ionic Solids:** Concept of close packing, Ionic structures, radius ratio rule and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born–Haber cycle. Fajan's rule, Weak Interactions –Hydrogen bonding, van der Waals forces.

**Chemical Bonding-I:** Covalent Bond–Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, Valence shell electron pair repulsion (VSEPR) theory, homonuclear and heteronuclear diatomic molecules. Multicentre bonding in boranes, Percentage ionic character from dipole moment and electronegativity difference.

**SECTION-C** **(15 Hrs.)**

**s- and p-block elements and their comparative study**: General remarks about each group (I-VIII), trends in electronic configuration, atomic and ionic radii, ionization potential, electron affinity, electronegativity, oxidation states, Melting and boiling point, density, electropositive or metallic character, flame colouration. Lattice energies. Photoelectric effect, inert pair effect, catenation and hetero catenation. Anomalies in first and second row elements. Chemical properties in details.

**Acids and Bases:** Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

**SECTION-D** **(15 Hrs.)**

**p-Block Elements: Group 13:** General characteristics, Atomic and ionic radii, melting and boiling point, Ionisation energies, Oxidation states, Electropositive character, Tendency to form covalent compounds. **Compounds of group 13**: Hydrides, Oxides and hydroxides, Oxoacid; Structure and Properties of Boric acid, Preparation, properties and structure of Diborane, Borazine, Boron halides: Boron hydrides ($LiBH_4$, $NaBH_4$), Anomalous behaviour of Boron and its diagonal relationship with Silicon.

**Group 14:** General characteristics; Atomic radii, Ionisation energies, Melting and boiling point, oxidation state, metallic character, catenation, Allotropy, Tendency to form multiple bonding. **Compounds of group 14**: Hydrides of silicon: preparation and properties, toxic nature of CO, Dioxide of carbon and silicon. Comparison of carbon tetrachloride and silicon tetrachloride. Chemistry of Fullerenes.

Course Outcome:

- Develop understanding for the concepts of structure and bonding
- Enrich the knowledge of chemistry related to ionic and covalent compounds

**Books Suggested**

1. Cotton, F.A., Wilkinson, G., Gaus, P.L., Basic Inorganic Chemistry; 3rd edition, Pubs: John Wiley Sons. 1995.
2. Lee, J.D., Concise Inorganic Chemistry; 4th edition, Pubs: Chapman Hall Ltd., 1991.
3. Shriver, D.E., Alkins, P.W., Langford, C.H., Inorganic Chemistry; 4th edition, Oxford Publisher: Oxford University Press, 2006.
4. Douglas, B. McDamiel, D., Alexander, J., Concepts and Models of Inorganic Chemistry; 3rd edition, Pubs: John Wiley and Sons Inc., 1994.
5. Miessler, G.L., Larr, D.A., Inorganic Chemistry; 3rd edition, Pubs: Pearson Education Inc., 2004.
6. Jolly, W.L., Modern Inorganic Chemistry; 2nd edition, Pubs: McGraw-Hill Publishing Company Limited, 1991.
7. Purcell, K.F., Kotz, J.C., Inorganic Chemistry; Pubs: W.B. Saunders Company, 1977.
8. Puri, B.R., Sharma, L.R., Kalia, K.C., Principles of Inorganic Chemistry; 30th edition, Pubs: Milestones Publisher, 2006-07.

**SEMESTER -I**

**INORGANIC CHEMISTRY-I: Lab Qualitative Analysis**

**(PRACTICAL)**

**Time: 2 Hrs** **Marks: 25**

**Credits: 0-0-1** **15 Hrs.**

Semi Micro analysis. Cation analysis, Separation and identification of ions from groups I, II, III, IV, V, and VI. Anionic analysis. Four ions with no interference.

**Volumetric titrations**

1. Determination of strength of $Na_2CO_3$ solution by titrating it against a standard solution of HCl.
2. Determination of molarity of $KMnO_4$ solution by titrating it against a standard solution of Oxalic acid.
3. Standardise the given $K_2Cr_2O_7$ solution by titrating it against a standard solution of Mohr's Salt.
4. Estimation of free alkali present in different soaps/detergents
5. Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).
6. Estimation of available chlorine in bleaching powder iodometrically

Course Outcome

To develop technical skills relevant to quantitative analysis.

**Practical Examination**

| | |
|---|---|
| 1) Detection of Salt | 12 |
| 2) Volumetric titration | 05 |
| 3) Viva-Voce | 06 |
| 4) Note Book | 2 |

**Books Suggested**

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

**SEMESTER–II**

**CHEMISTRY**

**ORGANIC CHEMISTRY – I: Hydrocarbons and Alkyl Halides**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **60 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(15 Hrs.)**

Hybridization, localized and delocalized chemical bond, Electron displacement, Use of arrows, Types of reagents, Reactive Intermediates: Carbocations, Carbanions, Free radicals Carbenes, arenes and Nitrenes. Stereochemistry: Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions, Geometrical isomerism, E/Z notations with C.I.P rules, Optical Activity, enantiomeric and diastereomeric excess, Chirality/Asymmetry, Enantiomers, Diastereoisomers, Racemic mixture and resolution, optical activity in absence of chiral carbon, Relative and absolute configuration: D/L and R/S designations,

**SECTION-B** **(15 Hrs.)**

**Chemistry of alkanes**: methods of formation of alkanes, Free radical substitutions: Halogenation -relative reactivity and selectivity. Cycloalkanes and Conformational Analysis: Baeyer strain theory, Conformation analysis, relative stability and energy diagrams of ethane, propane, butane, cyclohexane and Chair, Boat and Twist boat forms of cyclohexane.

**Chemistry of alkenes/alkynes**: Nomenclature and Formation of alkenes and alkynes, Mechanism of E1 and E2 reactions, Saytzeff and Hofmann eliminations. Mechanisms and Reactions of alkenes, reduction, syn and anti-hydroxylation (oxidation), 1,2- and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction, mechanism of allylic and benzylic bromination. Reactions of alkynes.

**SECTION-C** **(15 Hrs.)**

Aromaticity: Huckel's rule, aromatic ions. Nomenclature of benzene derivatives. The aryl group, Aromatic nucleus and side chain. Structure of benzene: Molecular formula and Kekule structure. Stability and C-C bond lengths of benzene, resonance structure.

Aromatic electrophilic substitution–general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, reactivity and orientation of disubstitution. Side chain reactions of benzene derivatives. Methods of formation and chemical reactions of alkylbenzenes.

**SECTION-D** **(15 Hrs.)**

Alkyl halides: Methods of preparation, details of nucleophilic substitution reactions – SN1, $SN_2$ and SNi mechanisms with stereochemical aspects and effect of solvent, nucleophilic substitution vs. elimination. Aryl halides: Preparation, including preparation from diazonium salts, nucleophilic aromatic substitution in details; SNAr, Benzyne mechanism. Relative reactivity and mechanism of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions in details.

Course Outcome:

The students will learn about the basic chemistry of organic compounds along with methods of formation and reactions of alkanes, cycloalkanes, alkenes, alkynes, aromatic compounds, alkyl halides and their derivatives.

**Books suggested**

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Solomons, T. W., Fryhle, C.B., Organic Chemistry; 9th edition, Pubs: Wiley India, 2007.
4. Wade Jr., L.G., Singh, M.S., Organic Chemistry; 6th edition, Pubs: Pearson Education, 2008.
5. Fundamentals of Organic Chemistry, Solomons, John Wiley.
6. Introduction to Organic Chemistry, Sireitwieser, Heathcock and Kosover, Macmilan.

7. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
8. McMurry, J. E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
9. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.

**SEMESTER -II**

**ORGANIC CHEMISTRY-I: Lab Functional Group Analysis**

**(PRACTICAL)**

**Time: 2 Hrs** **Marks: 25**

**Credits: 0-0-1** **15 Hrs.**

Basic techniques on purification of organic compounds. Determination of melting point and boiling point of organic compounds. Detection of nitrogen, halogens and sulphur in organic compounds. Qualitative analysis of unknown organic compounds containing simple functional groups.

Course Outcome

The objective of this course is to familiarize the students with the basic techniques and to learn methods for qualitative analysis of functional groups present in the organic compounds.

**Practical Examination**

| | |
|---|---|
| 1) Detection of Elements | 5 |
| 2) Detection of functional group, melting point & derivative preparation | 12 |
| 3) Viva-Voce | 6 |
| 4) Note Book | 2 |

**Books suggested**

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5 th Ed. Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

**SEMESTER–III**

**CHEMISTRY**

**PHYSICAL CHEMISTRY – I: States of matter and electrochemistry**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **60 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(15 Hrs.)**

**Gaseous States**: Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waals equation of State. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waal's equation, relationship between critical constants and van der Waals constants, the law of Corresponding states, reduced equation of state. Molecular Velocities: Root mean square, average and most probable velocities. Qualitative Discussion of the Maxwell's distribution of molecular velocities. Collision number, mean free path and collision diameter. Liquefaction of gases.

**Liquid State**: Intermolecular forces, surface tension and viscosity of liquids and its determination. Structure of liquids (a qualitative description). Structural differences between solids, liquids and gases.

**SECTION-B** **(15 Hrs.)**

**Colloidal State:** Definition of colloids, classification of colloids. Solids in liquids (Sol): kinetic, optical and electrical properties, stability of colloids, protective action, Hardy Schulze law, gold number. Liquids in liquids (emulsions): Types of emulsions, preparation. Emulsifiers. General applications of colloids.

**Solid State:** Definition of space lattice and unit cell, Law of crystallography- (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices, (iii) Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's Law in Reciprocal space. Determination of crystal structure of NaCl, KCl by use of Powder method; Laue's method. Liquid crystals, Classification, structure of nematic and cholestric phases.

**SECTION-C** **(15 Hrs.)**

**Solutions, Dilute Solutions and Colligative Properties:** Ideal and non–ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, non-ideal system, azeotropes-HCl-$H_2O$ and ethanol-water system. Relative lowering of vapour pressure, molecular weight determination. Osmosis, Law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

**Electrochemistry–I:** Specific conductance and equivalent conductance, measurement of equivalent conductance, Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations.

**SECTION-D** **(15 Hrs.)**

**Electrochemistry–I:** Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Migration of ions, Transport number, Applications of conductivity measurements, Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Standard electrode potential, standard hydrogen electrode, reference electrodes, sign conventions, electrochemical series and its significance. Nernst equation, derivation of cell E.M.F. and single electrode potential. EMF of a cell and its measurements. Calculation of thermodynamic quantities of cell reactions ($\Delta G$, $\Delta H$ and K). Types of reversible electrodes: gas- metal ion, metal ion, metal insoluble salt-anion and redox electrodes. Electrode reactions. EMF of reversible electrodes.

**Electrochemistry–II:** Polarization, over potential, hydrogen overvoltage and its application. Concept of activities and activity coefficient. Concentration cells with and without transference, liquid junction potential, application of concentration cells, valency of ions, solubility product and pH determination, potentiometric titrations.

Course Outcome:

To teach the applications of basic concepts related to three states of matter. The contents of the paper cover the areas of physical chemistry such as electrochemistry which will provide the basic knowledge and theoretical foundation about these topics.

**Books Suggested**

1. Atkins, P., Paula, J.de, Atkins Physical Chemistry; 8th edition, Pubs: Oxford University Press, 2008.
2. Puri, B.R., Sharma, L.R., Pathania, M.S., Principles of Physical Chemistry; 43rd edition, Pubs: Vishal Publishing Co., 2008.
3. Barrow, G.M., Physical Chemistry; 6th edition, Pubs: McGraw Hill Inc, 1996.
4. Rao, C.N.R., University General Chemistry; Pubs: Macmillan India, 1985.
5. Berry, R.S., Rice, S.A., Ross, J., Physical Chemistry; 2nd edition, Pubs: Oxford University Press, 2000.
6. Albert, R.A., Silbey, R.J., Physical Chemistry; 1st edition, Pubs: John Wiley & Sons Inc., 1992.
7. Dogra, S.K., Dogra, S., Physical Chemistry Through Problems; Pubs: Wiley Eastern Limited, 1991.
8. Levine, I.N., Physical Chemistry; 5th edition, Pubs: Tata McGraw Hill Publishing Co. Ltd., 2002.
9. Moore, W. J., Basic Physical Chemistry; Pubs: Prentice Hall of India Pvt. Ltd, 1983.
10. University General Chemistry, C.N.R. Rao, Macmillan.
11. Metz, C.R., Theory and problems of Physical Chemistry; Schaum's outline series, 2nd edition, Pubs: McGraw-Hall Book Company, 1989.

**SEMESTER–III**

**CHEMISTRY**

**PHYSICAL CHEMISTRY – I: Lab**

**(PRACTICAL)**

**Time: 2 Hrs** **Marks: 25**

**Credits: 0-0-1** **15 Hrs.**

1. To determine the specific reaction rate of hydrolysis of ethyl acetate catalysed by acid at room temperature.
2. To study the effect of acid strength on hydrolysis of an ester.
3. To find the relative and absolute viscosity of given liquid at room temperature. (n-butyl alcohol, sucrose, and glycerine solution in water)
4. To study the surface tension of liquids by drop number and drop weight methods.
5. To determine the Refractive indices of given liquids (water, acetone, methanol, ethyl acetate, cyclohexane) by Abbe's refractometer & calculate their molecular refractivity.
6. To determine the composition of unknown mixture of two liquids by refractive index measurements.
7. Indexing of a given powder diffraction pattern of a cubic crystalline system.
8. Preparation of buffer solutions of different pH (a) Sodium acetate-acetic acid (b) Ammonium chloride-ammonium hydroxide
9. pH metric titration of (a) strong acid vs. strong base, (b) weak acid vs. strong base.
10. Determination of dissociation constant of a weak acid.

Course Outcome

The students will get hand on experience of the properties of matter and correlate with the theory learnt.

**Practical Examination**

| | |
|---|---|
| 1) Titration 1 | 08 |
| 2) Titration 2 | 08 |
| 3) Viva-Voce | 07 |
| 4) Note Book | 02 |

**Books Suggested**

1. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
2. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
3. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
4. Experiments in General Chemistry, C.N.R. Rao and U.C. Aggarwal, East-West Press.
5. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill.
6. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
7. Advanced Experimental Chemistry, Vol. I, Physical, J.N. Guru and R. Kapoor, S. Chand & Co.
8. Selected Experiments in Physical Chemistry, N.G. Mukherjee, J.N. Ghosh & Sons.
9. Experiments Physical Chemistry, J.C. Ghosh, Bharati Bhavan.
10. Findlay's Practical Physical Chemistry, Author: Alexander Findlay, Publisher: Wiley, 1972, ISBN-10:0470258853.
11. Advanced Practical Physical Chemistry, Author: J. B. Yadav, Publisher: Krishna Prakashan Media (P) Ltd (2015), ISBN-10:8182835925.

**SEMESTER–IV**

**CHEMISTRY**

**INORGANIC CHEMISTRY–II: Periodic table and coordination chemistry**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **60 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(15 Hrs.)**

**p–Block Elements: Group 16:** General characteristics: atomic radii, Ionisation energies, Melting and boiling point, Electron affinity, Oxidation state, Catenation, Elemental state, Allotropy, Hydrides of group 16, Chemical properties of $SO_2$, structure of $SO_2$ & $SO_3$, Oxoacid of sulphur: structure and basicity. Preparation of sulphuric acid by contacts process and its chemical properties

**Group 17:** General characteristics: atomic radii, Ionisation energies, melting and boiling point, Electron affinity, Electronegativity, Non-metallic character, colour, Oxidation state and reactivity**,** Hydrides of group 17, Relative acidic strength of hydro acids and Oxoacids of group 17, structure of interhalogen compounds and polyhalides.

**Important compounds of p-block:** Carbides, fluorocarbons, Silicones and phosphazenes, triphosphazenes.

**SECTION-B** **(15 Hrs.)**

**Chemistry of Transition Elements:** General characteristics of Transition Elements. Properties of the elements of the first transition series, Relative stability of their oxidation state. Coordination number and geometry. General characteristics of elements of Second and Third Transition Series. Difference in the properties of first transition elements with second and third transition series elements in respect of ionic radii, oxidation states, magnetic behaviour.

***f*-block elements**: Lanthanoids: Electronic configurations, oxidation states, ionic radii, lanthanide contraction, colour, spectral and magnetic properties, lanthanum compounds. Actinoids: electronic configurations, oxidation states, ionic radii, actinide contraction, colour,

spectral and magnetic properties. Comparison of lanthanoids and actinoids and their analytical applications.

**SECTION-C** **(15 Hrs.)**

**Coordination Compounds:** Nomenclature of coordination compounds, Werner's coordination theory, effective atomic number, polydentate, chelating ligands and chelation, factors affecting stability of chelates, structural and stereoisomerism in coordination compounds with co-ordination number 4 and 6, resolution of racemic mixture, Valence bond theory of transition metal complexes, hybridization and geometry of complexes of Cr, Fe, Co, Cu and its ions, Magnetic properties and colour of coordination compounds.

Transition Metal complexes: an elementary idea of crystal field theory, Jahn-Teller effects. methods of determining magnetic susceptibility by Gouy's and Faraday method. L-S coupling, correlation of $\mu_s$ and $\mu_{eff}$ values, Nucleophilic Substitution reactions in square planar complexes

**SECTION-D** **(15 Hrs.)**

**Electronic Spectra of Transition Metal Complexes:** Types of electronic transitions, selection rules and relaxations, splitting of Russel-Saunder states in octahedral and tetrahedral, spectrochemical series, Orgel diagram of one electron-one hole system and two electron-two hole system in octahedral and tetrahedral complexes. Limitation of Orgel diagram.

**Organometallic Compounds:** Definition, nomenclature and classification of organometallic compounds. σ and π complexes, types of organoligands, EAN rule, bonding in organometals, Preparation, properties, bonding and applications of alkyl lithium and organoaluminium compounds ($AlR_3$). Metal olefin complexes, bonding in metal-ethylenic complexes, Mechanism of homogeneous hydrogenation reactions of alkene. Metal carbonyls: examples and bonding.

Course Outcome

This course will provide the knowledge of the p, d, f block elements and will also cover basics of coordination and organometallic chemistry.

**Books Suggested**

1. Cotton, F.A., Wilkinson, G., Gaus, P.L., Basic Inorganic Chemistry; 3rd edition, Pubs: John Wiley Sons. 1995.
2. Lee, J.D., Concise Inorganic Chemistry; 4th edition, Pubs: Chapman Hall Ltd., 1991.
3. Shriver, D.E., Alkins, P.W., Langford, C.H., Inorganic Chemistry; 4th edition, Oxford Publisher: Oxford University Press, 2006.
4. Douglas, B. McDamiel, D., Alexander, J., Concepts and Models of Inorganic Chemistry; 3rd edition, Pubs: John Wiley and Sons Inc., 1994.
5. Porterfield, W.W., Wesley, A., Inorganic Chemistry; Pubs: Addison-Wesley Publishing Company, 1984.
6. Miessler, G.L., Larr, D.A., Inorganic Chemistry; 3rd edition, Pubs: Pearson Education Inc., 2004.
7. Jolly, W.L., Modern Inorganic Chemistry; 2nd edition, Pubs: McGraw-Hill Publishing Company Limited, 1991.
8. Purcell, K.F., Kotz, J.C., Inorganic Chemistry; Pubs: W.B. Saunders Company, 1977.
9. Puri, B.R., Sharma, L.R., Kalia, K.C., Principles of Inorganic Chemistry; 30th edition, Pubs: Milestones Publisher, 2006-07.
10. Inorganic Chemistry, W.W. Porterfield Addison-Wesley.
11. Inorganic Chemistry, A.G. Sharpe, ELBS.

**SEMESTER–IV**

**CHEMISTRY**

**INORGANIC CHEMISTRY – II: Lab Volumetric, gravimetric analysis and preparations**

**(PRACTICAL)**

**Time: 2 Hrs** **Marks: 25**

**Credits: 0-0-1** **15 Hrs.**

**Quantitative Analysis**

**Volumetric Analysis**

1. Determination of acetic acid in commercial vinegar using NaOH.
2. Determination of alkali content-antacid tablet using HCI.
3. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
4. Standardisation of EDTA with $Pb(NO_3)_2$ / $ZnSO_4$. $7H_2O$ and Estimation of hardness of water by EDTA.
5. Estimation of ferrous and ferric by dichromate method.
6. Estimation of copper using sodium thiosulphate.

**Gravimetric Analysis**

Analysis of Cu as CuSCN; Ni as Ni (dimethylgloxime) and Determination of silver(I) as its chloride

**Inorganic Preparations**:

Synthesis of Iron(III) Hexacyanoferrate(II) $Fe_4[Fe(CN)_6]_3$ (Prussian Blue).

Preparation of Potassium Aluminum Sulfate $KAl(SO_4)\cdot 12\,H_2O$ (Potash Alum)

Preparation of bis Acetylacetonate Copper(II) $Cu(O_2C_5H_7)_2$ .

Course Outcome:

To develop good laboratory technical skills relevant to quantitative analysis and synthesis of inorganic compounds.

**Practical Examination**

| | |
|---|---|
| 1) Volumetry/Gravimetry | 08 |
| 2) Inorganic Preparations | 07 |
| 3) Viva-Voce | 07 |
| 4) Note Book | 03 |

**Books Suggested**

1. Vogel's Textbook of Quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney, G.H. Jeffery and J. Mandham, ELBS.
2. Standard Methods of Chemical. Analysis, W.W. Scott: The Technical Press.
3. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.
4. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
5. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
6. Experiments in General Chemistry, C.N.R. Rao and U.C. Aggarwal, East-West Press.
7. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
8. Marr, G. and Rockett, B.W. Practical Inorganic Chemistry, 1972

**SEMESTER–V**

**CHEMISTRY**

**ORGANIC CHEMISTRY–II: Chemistry of O/N containing compounds**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **60 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(15 Hrs.)**

**Alcohols**: Classification and nomenclature. Monohydric and Dihydric alcohols alcohols—nomenclature. Acidic nature, methods of formation, chemical reactions, oxidative cleavage [$Pb(OAC)_4$] and [$HIO_4$] and pinacol-pinacolone rearrangement.

**Phenols**: Nomenclature, structure and bonding, Preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols—electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Reimer Tiemann reaction.

**Ethers and epoxides**: Preparation and chemical reactions ethers and epoxides.

**Sulphur containing compounds**: Preparation and reactions of thiols, thioethers and sulphonic acids.

**SECTION-B** **(15 Hrs.)**

**Aldehydes and Ketones:** Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones, Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Witting reaction. Mannich reaction. Use of acetals as protecting group. Cannizzaro reaction. Halogenation of enolizable ketones. Addition reactions of unsaturated carbonyl compounds, Active methylene compounds.

**Carboxylic Acids:** Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Synthesis of acid chlorides, esters and amides.

**SECTION-C** **(15 Hrs.)**

Reactions of carboxylic acids, Hell Volhard-Zelinsky reaction, Reduction of carboxylic acids, Mechanism of decarboxylation.

**Carboxylic Acids Derivatives:** Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides, Relative stability & reactivity of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions.

**Organic Compounds of Nitrogen:** Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes, Mechanisms of nucleophilc substitution in nitroarenes and their reduction in acidic, neutral and alkaline media. Reactivity, Structure and nomenclature of amines,

**SECTION-D** **(15 Hrs.)**

**Organic Compounds of Nitrogen**: Methods of preparation of amines by Reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction and Hofmann bromamide reaction. Physical properties. Stereochemistry of amines. separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts.

**Heterocyclic Compounds:** Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Course Outcome:

The objective of this course is to teach the chemistry of organic functional groups to the students.

**Book Suggested**

1. Morrison, R.T., Boyd, R.N., Organic Chemistry; 6th edition, Pubs: Prentice-Hall, 1992.
2. Wade Jr., L.G., Singh, M.S., Organic Chemistry; 6th edition, Pubs: Pearson Education, 2008.

3. Mukherji, S.M., Singh, S.P., Kapoor, R.P., Organic Chemistry; Pubs: Wiley Eastern Limited, 1985, Vol. I, II, III.
4. Solomons, T.W., Fryhle, C.B., Organic Chemistry; 9th edition, Pubs: Wiley India, 2007.
5. Carey, F.A., Organic Chemistry; 4th edition, Pubs: McGraw-Hill, 2000.
6. Streitwieser, A., Clayton, Jr., Heathcock, H., Introduction to Organic Chemistry; 3rd edition, Pubs: Macmillan Publishing Company, 1989.
7. Introduction to Organic Chemistry, Sireitwieser, Heathcock and Kosover, Macmilan.

**SEMESTER–V**

**CHEMISTRY**

**ORGANIC CHEMISTRY – II: Lab Preparations**

**(PRACTICAL)**

**Time: 2 Hrs** **Marks: 25**

**Credits: 0-0-1** **15 Hrs.**

**Thin Layer Chromatography:** Determination of Rf values and identification of organic compounds.
**Column Chromatography**: Separation of o & p nitrophenol

**Synthesis of Organic Compounds**

1. Preparation of p-nitroacetanilide
2. Preparation of Methyl Orange
3. Preparation of quinoline (Skraup Synthesis)
4. Preparation of 1,2-dihydro-1,5-dimethyl-2-phenyl-3H-pyrazole-3-one) (antipyrine)
5. Synthesis of flavone (2-Phenyl-4H-1-benzopyran-4-one, 2-Phenylchromone)
6. Acetylation of amines and phenols
7. Bromination of Acetanilide.
8. Reduction of meta dinitrobenzene and p-nitrobenzaldehyde.
9. Semicarbazone of ethyl methyl ketone and benzaldehyde

Course Outcome

To provide the synthetic skills to the students and to make them aware of various techniques involved in synthesis.

**Suggested Books**

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Vogel's text book of practical organic chemistry, 5th Ed., Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
5. Experimental organic chemistry by Laurence M. Harwood, C. J. Moody, Black well Scientific Publications, Oxford, 1989.
6. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
7. Arthur, I. V. Quantitative Organic Analysis, Pearson.

**SEMESTER–V**

**SUMMER INTERNSHIP**

**(02 WEEKS)**

**Time: 3 Hrs** **Marks: 50**

**Credits: 0-0-2** **02 Weeks**

Students will be required to undertake Community Engagement and service/ Field based learning/ Minor Projects and will have to submit a Report along with original certificate at the completion of the Internship. Every student will be required to submit an internship report in typed standard prescribed format containing a copy of original certificate. The objective of the Summer Internship is to test the ability of the student to grasp the practical knowledge. Every student will make PowerPoint presentation of internship and will be orally examined in the context of the training report. The Summer Internship Report shall be evaluated by a committee constituted by the college Principal. i) Head of the department ii) one senior faculty member from the department

Course Outcomes: Students should work in the industry/laboratories as trainees so that they can acquire knowledge about the different processes.

**SEMESTER–VI**

**CHEMISTRY**

**PHYSICAL CHEMISTRY–II: Thermodynamics and equilibrium**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **60 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(15 Hrs.)**

**Thermodynamics-I:** Definition of thermodynamic terms, Types of systems, intensive and extensive properties. State and path functions. Thermodynamic process. Concept of heat and work.

***First Law of Thermodynamics:*** Statement and definitions, Heat capacity at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, Calculation of w, q, $\Delta U$ & $\Delta H$ for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

**Thermochemistry:** Standard state, types of enthalpies of reactions, Hess's Law of heat summation. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

**SECTION-B** **(15 Hrs.)**

**Thermodynamics-II:** *Second Law of Thermodynamics:* Statements, Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature, Entropy as a state function, entropy as a function of V & T; P & T, entropy change in physical change, Clausius inequality, entropy as a criterion of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases.

**Thermodynamics-III:** *Third Law of Thermodynamics:* Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic

quantities, A & G as a criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.

**SECTION-C (15 Hrs.)**

**Chemical Equilibrium:** Determination of Kp, Kc, Ka and their relationship, Clausius-Clapeyron equation

**Introduction to Phase Equilibrium:** Phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system, two component systems-solid-liquid equilibria, Solid solutions-compound formation with congruent and incongruent melting point, Lower and upper consulate temperature, Nernst distribution law.

**Introduction to Ionic equilibria**: Strong, moderate and weak electrolytes, degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids, calculation of hydrolysis constant, derivation of Henderson equation, applications of buffers in analytical chemistry, applications of solubility product principle Qualitative treatment of acid – base titration curves, Theory of acid–base indicators

**SECTION-D (15 Hrs.)**

**Quantum Mechanics:** Black-body radiation, Planck's radiation law, Photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. Sinusoidal wave equation, Hamiltonian operator, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one-dimensional box, quantization of energy levels, extension to two and three-dimensional boxes, degeneracy. Simple harmonic oscillator model of vibrational motion, setting up Schrodinger equation and discussion of solution and wave functions. Rigid rotator model of rotation of diatomic molecules transformation to spherical polar coordinates spherical harmonics and their discussion. Qualitative investigation H-atom, setting up Schrodinger equation, radial and angular part, radial distribution functions of 1s, 2s, 2p, 3s, 3p and 3d.

Course Outcome

The student will get the information about basic phenomenon/concepts related to the thermodynamics and how the knowledge of these thermodynamic parameters will be useful for various applications.

**Books Suggested**

1. Atkins, P., Paula, J.de, Atkins, Physical Chemistry; 8th edition, Pubs: Oxford University Press, 2008.
2. Puri, B.R., Sharma, L.R., Pathania, M.S., Principles of Physical Chemistry; 43rd edition, Pubs: Vishal Publishing Co., 2008.
3. Barrow, G.M., Physical Chemistry; 6th edition, Pubs: McGraw Hill Company Inc., 1996.
4. Berry, R.S., Rice, S.A., Ross, J., Physical Chemistry; 2nd edition, Pubs: Oxford University Press, 2000.
5. Albert, R.A., Silbey, R.J., Physical Chemistry; I edition, Pubs: John Wiley & Sons Inc., 1992.
6. Dogra, S.K., Dogra, S., Physical Chemistry Through Problems, Pubs: Wiley Eastern Ltd., 1991.
7. Moore, W.J., Basic Physical Chemistry; Pubs: Prentice Hall of India Pvt. Ltd., 1983.
8. Metz, C.R., Theory and Problems of Physical Chemistry; Schaum's outline series, 2nd edition, Pubs: McGraw-Hall Book Company, 1989.
9. Banwell, C.N., McCash, E.M., Fundamentals of Molecular Spectroscopy; 4th edition, Pubs: Tata McGraw Hill Publishing Co. Ltd., 1999.
10. Atkins, P. Friedman, R., Molecular Quantum Mechanics; 4th edition Pubs: Oxford University Press, 2007.
11. Levine, I.N., Quantum Chemistry; 5th edition, Pubs: Prentice Hall International Inc., 2000.
12. Glasstone, B. (2003) Thermodynamics for Chemists, East West Press, New Delhi. ISBN-10: 8176710148.
13. Rock, P.A. (1983) Chemical Thermodynamics, University Science Books, Sausalito, CA. ISBN 10: 1891389327
14. Maron S.H., Prutton C.F. (1965) Principles of Physical Chemistry, 4th Edition, Mac Millan Publishing Company, New York.
15. Kapoor, K.L (2006) A Text Book of Physical Chemistry, 6th Volume, Macmillan Publishers India Ltd., New Delhi. ISBN10: 0230332765
16. Laidler, K.J. (1995) The world of Physical Chemistry, 3rd Volume, Oxford University Press, London. ISBN-10: 0198559194

17. Jou D., Llebot J.E. (1990) Introduction to the Thermodynamics of Biological Processes, Prentice Hall. ISBN: 9780135028810
18. Rajaram J., Kuriacose J. C. (1986) Thermodynamics for Students of Chemistry, Shoban Lal Nagin Chand & Co. Delhi ISBN-13: 1234567145987.

**SEMESTER–VI**

**CHEMISTRY**

**PHYSICAL CHEMISTRY–II: Lab**

**(PRACTICAL)**

**Time: 2 Hrs** **Marks: 25**

**Credits: 0-0-1** **15 Hrs.**

1. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2. Determination of heat of solution of $Na_2SO_4$.
3. Determination of Lattice energy of NaCl (using Born-Haber cycle).
4. Study of the solubility of benzoic acid in water and determination of ΔH.
5. To determine the dissociation constant of picric acid by studying its distribution between benzene and water.
6. To determine the molecular weight of naphthalene by Rast method.
7. To prepare and draw phase diagram of microemulsions comprising sodium dodecyl sulfate, water and hexanol.
8. Potentiometry: (a) Titration of HCl solution with NaOH solution using quinhydrone solution; (b) Titration of $CH_3COOH$ solution with NaOH; (c) Titration of oxalic acid solution with NaOH.
9. Conductometry: (a) To find strength of given strong acid; (b) To find dissociation constant of weak electrolyte.
10. Colorimetry: To verify the Lambert – Beer's Law.

Course Outcome

The practical's mentioned in the syllabus will reinforce the theoretical concepts of the students taught in the class rooms.

**Practical Examination**

| | |
|---|---|
| 1) Titration 1 | 08 |
| 2) Titration 2 | 08 |
| 3) Viva-Voce | 07 |
| 4) Note Book | 02 |

**Suggested Books**

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry, New Age International: New Delhi (2001).
3. Findlay's Practical Physical Chemistry, Author: Alexander Findlay Publisher: Wiley, 1972, ISBN-10:0470258853.
4. Advanced Practical Physical Chemistry, Author: J. B. Yadav, Publisher: Krishna Prakashan Media (Pvt) Ltd (2015), ISBN-10: 8182835925.
5. Quantitative Organic Analysis by Vogel, Author: A. I. Vogel, Publisher: Wiley, John & Sons, Incorporated, ISBN-13: 780582442504

**SEMESTER–VII**

**CHEMISTRY**

**PHYSICAL CHEMISTRY–III: CHEMICAL KINETICS**

**(THEORY)**

**Time: 3 Hrs** **Marks: 75**

**Credits: 3-0-0** **45 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(12 Hrs.)**

Recapitulation of Basic Concepts of Kinetics: Scope of chemical kinetics. Rate laws. Molecularity and order of a reaction. Activation energy. Experimental Methods of Chemical Kinetics: Potentiometric, conductometric, optical methods; polarimetry, and spectrophotometry. Kinetics of Reactions: Reversible or/ opposing reactions. Consecutive or/ series reactions. Parallel reactions. Theories of Reaction Rates: The Collision theory of bimolecular reactions based on hard sphere model. Steric factor. Lindemann's mechanism. The transition state theory. Thermodynamic treatment and statistical mechanical approach. Eyring treatment. Transmission coefficient. Tunneling effect. Kinetic theory of termolecular reactions. Elementary Gas-phase Reactions: Lindemann-Christiansen hypothesis. Hinshelwood's treatment. Rice-Ramsperger-Kassel (RRK) treatment. Slater's treatment. Rice-Ramsperger-Kassel Marcus (RRKM) treatments of unimolecular gas phase reactions.

**SECTION-B** **(11 Hrs.)**

Reactions in Solutions: Factors affecting reactions in solutions. Ionic reactions in solutions. Effect of solvent. Effect of ionic strength. Primary and Secondary salt effects. Composite/Complex Reactions: Types of composite mechanisms. Rate equations for composite mechanisms. Simultaneous and Consecutive reactions. Steady-state treatment. Rate-determining (Rate- controlling) steps. Microscopic reversibility and detailed balance.

**SECTION-C** **(11 Hrs.)**

Homogeneous Catalysis: Catalysis. Character of catalyst. Simple Catalysed reactions. Kinetics of acid-base catalysis; General acid base catalysis. Mechanisms of acid-base catalysis. Catalysis by enzymes; Influence of substrate concentration, Influence of pH,

Influence of temperature. Transient - phase kinetics. Reaction in Flow Systems: Techniques for very fast reactions. General features of fast reactions. Stopped-flow method. Relaxation method. Shock tube method. Pulse radiolysis. Flash photolysis. Nuclear- magnetic resonance and electron spin resonance methods.

**SECTION-D (11 Hrs.)**

Kinetics of Dynamic Chain Reactions: Hydrogen-bromine reaction. Hydrogen-chlorine reaction. Pyrolysis of acetaldehyde. Organic decomposition. Decompositon of ethane. Photochemical Reactions: Hydrogen-bromine reaction. Hydrogen-chlorine reaction. Oscillatory Chemical Reactions: Belousov-Zhabotinsky reactions. Classification of Oscillatory Reactions, Lotka-Voltera model.

Course Outcome:

The study will get the information about how rate of reaction provides important kinetic data in establishing the mechanism by which the reaction takes place.

**Books Suggested**

1. Chemical Kinetics, 3rd edn, Author: Laidler, K. J., Publisher: Pearson Education India (2003), ISBN-10: 8131709728.
2. Kinetics and Mechanism, 2ndedn, Author: Frost, A. A. & Pearson, R. G., Publisher: John Wiley & Sons. Inc. New York (1961), ISBN-10: B0037F1GMQ.
3. Comprehensive Chemical Kinetics, Author: Bam Ford, C. H. & Tipper, C. F. H., Publisher: Elsevier Science Ltd (1978), ISBN-10: 044441651X.
4. Principles of Physical Chemistry, Author: Maron, S. H. & Prutton, C.F. Publisher: Collier Macmillan Ltd; 4th Revised edn (1965) ISBN-10: 0023762306
5. Kinetics and Mechanism of Chemical Transformations, Author: Rajaraman, J. & Kuriacose, J. Publisher: Macmillan/Laxmi Publications (P) Ltd., New Delhi (2000) ISBN-10: 0333926587.

**SEMESTER–VII**

**CHEMISTRY**

**ORGANIC CHEMISTRY–IV: Structure-reactivity relationship**

**(THEORY)**

**Time: 3 Hrs** **Marks: 75**

**Credits: 3-0-0** **45 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(11 Hrs.)**

Mechanistic significance of entropy, enthalpy and Gibb's free energy. Arrhenius equation. Transition state theory. Hammond's postulate. Potential energy surface model. Marcus theory of electron transfer. Reactivity and selectivity principles. Kinetic isotope effects: Theory of isotope effects. Primary and secondary kinetic isotope effects. Heavy atom isotope effects. Tunneling effect. Solvent effects.

**SECTION-B** **(12 Hrs.)**

Linear free energy relationships (LFER). The Hammett equation, substituent constants, theories of substituent effects. Reaction constant ρ. Deviations from Hammett equation. Dual-parameter correlations, inductive substituent constant. The Taft model, Qualitative understanding of solvent-solute effects on reactivity, Effects of solvation on reaction rates and equilibria. Use of solvation scales in mechanistic studies. Solvent effects from the curve-crossing model. Acids, Bases, Electrophiles, Nucleophiles and Cataylsis: Acid-base dissociation. Electronic and structural effects, acidity and basicity. Acidity function and their applications. Hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The α - effect. Ambivalent nucleophiles. Acid- base catalysis, specific and general catalysis. Bronsted catalysis. Nucleophilic and electrophilic catalysis. Catalysis by non-covalent binding-micellar catalysis, phase transfer catalysis.

**SECTION-C** **(11 Hrs.)**

Various type of steric strain and their influence on reactivity. Steric LFER. Conformational barrier to bond rotation-spectroscopic detection of individual conformers. Acyclic and monocyclic systems. Rotation around partial double bonds. Winstein-Holness and Curtin-

Hammett principle. Aliphatic Nucleophilic Substitution: The mixed $SN_1$ and $SN_2$ and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations.

**SECTION-D (11 Hrs.)**

Aliphatic Electrophilic Substitution: Bimolecular mechanisms- $SE_2$ and SEi. The $SE_1$ mechanism, electrophilic substitution accompanied by double bond shifts. Free Radical Reactions: Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactvity in the attacking radicals. The effect of solvents on reactivity, Allylic halogenation (NBS), Free radical rearrangement. Hunsdiecker reaction.

Course Outcome

The course content will provide knowledge of nucleophilic, electrophilic and free radical substitution and addition reactions and their reactivity.

**Books Suggested**

1. Mechanism and Theory in Organic Chemistry, T.H. Lowry and K.C. Richardson, Harper and Row.
2. Introduction to Theoretical Organic Chemistry and Molecular Modeling, W.B. Smith, VCH, Weinheim.
3. Physical Organic Chemistry, N.S. Issacs, ELBS/Longman
4. The Physical Basis of Organic Chemistry, H. Maskill, Oxford University Press.
5. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
6. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
7. Modern Physical organic Chemistry, Eric V. Anslyn and Deniis A. Doughutes. P 637-655 (2004) University, Science Books.
8. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
9. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
10. Modern Organic Reactions, H.O. House, Benjamin.
11. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
12. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.

**SEMESTER–VII**

**CHEMISTRY**

**INORGANIC CHEMISTRY–III: ORGANOMETALLICS**

**(THEORY)**

**Time: 3 Hrs** **Marks: 75**

**Credits: 3-0-0** **45 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(10 Hrs.)**

Introduction: Brief history of organometallic chemistry, Importance of organometallic compounds as reagents, additives and catalysts. The 18 Valence Electron Rule: counting of electrons and finding metal-metal bonds and related problems. Alkyl and Aryl Ligands: Sigma bonded alkyl groups as ligands: Synthesis of metal-alkyl compounds, β-hydride elimination, σ-bonded η1 -aryl ligands.

**SECTION-B** **(12 Hrs.)**

Ligands with Higher Hapticity: Cyclic and acyclic polyenyl π-bonded ligands: Cyclopentdienyl (Cp-), Synthesis of Cp based sandwich compounds, Structure and properties of MCp2 complexes, The first metal-sandwich compound Ferrocene, Reactions of metal-sandwich compounds, Bent sandwich compounds, Schwartz reagent and hydrozirconation, Chemistry of $Cp^*$, Chemistry of arene sandwich compounds, Allyl groups as ligands, 1,3-Butadiene complexes, Cyclobutadiene complexes, Cycloheptatriene and Cyclooctatetraene as ligands. Davies-Green-Mingos (DGM) rules.

**SECTION-C** **(10 Hrs.)**

Ferrocene: Structure and bonding of ferrocenes, Basic chemical reactions of Ferrocene, Reactions of Acetyl Ferrocene and formyl Ferrocene, lithiated ferrocenes and their reactions, (Dimethylaminomethyl)Ferrocene and its methiodide salt, Ferrocene boronic acid and haloferrocenes, Chirality in Ferrocene derivatives, Synthesis of chiral Ferrocene based compounds, Ferrocene based condensation polymers.

**SECTION-D** **(13 Hrs.)**

Applications of Organometallic Complexes to Catalysis: Catalysis, Terminology in catalysis, sequences involved in a catalysed reaction, asymmetric synthesis using a catalyst. Hydrogenation catalysts: classification of hydrogenation catalysts, catalytic cycle of Wilkinson's catalyst, catalytic cycles of iridium and ruthenium-based catalysts, hydrogenation by lanthanide organometallic compounds, catalytic asymmetric synthesis. Hydroformylation: Cobalt catalysts and phosphine modified cobalt catalysts, Rhodium-phosphine catalysts, factors affecting the n/iso ratio of hydroformylation products. Methanol Carbonylation and Olefin Oxidation: Monsanto, Cativa and Wacker Processes. Polymerisation and oligomerisation of olefins and dienes. Synthetic gas. Bioorganometallic Chemistry: Role of organometallics in heavy metal poisoning: Mercury and Arsenic poisoning. Organometallic compounds as drugs: ruthenium and ferrocene-based drugs. Organometallics as radiopharmaceutical, tracers, ionophores and sensors.

Course Outcome

This course will provide a systematic examination of the formation, structure and reactivity of transition metal-carbon (M-C) bonds and their utility in catalysis.

**Books suggested**

1. B. D. Gupta and A.J. Elias, Basic organomettallic chemistry-concepts, synthesis and applications, 2nd edition, Universities Press (2013).
2. C. E. Elschenbroich and A. Salzer and Organometallics- A Concise Introduction, 2nd edition, VCH publisher (1992).
3. Robert H. Crabtree, The organometallic chemistry of the transition metals, 4th edition, John Wiley & Sons, Inc., Publication (2005)
4. J. E. Huheey, E. A. Keiter and R.L. Keiter, Inorganic Chemistry- Principles of Structure and Reactivity, 4th edition, Harper Collins publisher (1993).
5. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 3rd edition, Wiley Inter-Science

**SEMESTER–VII**

**CHEMISTRY**

**PHYSICAL CHEMISTRY–IV: Thermodynamics of biopolymer solutions**

**(THEORY)**

**Time: 3 Hrs** **Marks: 75**

**Credits: 3-0-0** **45 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(11 Hrs.)**

Thermodynamics of Biopolymer Solutions: Introduction, Dissolution of Low Molecular Weight Solutes and Macromolecules: Effect of Molecular Weight and Thermodynamics, Thermodynamics of Dissolution of Crystalline and Amorphous Polymers: Heat of Dissolution, Solubility parameters, The Flory-Huggins Theory of Polymer Solutions.

**SECTION-B** **(12 Hrs.)**

Thermodynamics in Biological Systems: Laws of Thermodynamics and Biological Systems, Standard free energy change in biochemical reactions, effect of pH and concentration, Additivity Rule of Standard Free Energy Change (Exergonic, Endergonic and Coupled reaction); Free Energy-Hydrolysis of ATP-Complex Equilibria (dependence of pH, metal ions and Concentration), Group Transfer Potential, Energetics of Hydrolysis of Phospho-Creatine, Acetyl Phosphate and 1,3-bisphosphoglycerate.

**SECTION-C** **(11 Hrs.)**

Characterization of Biological Systems: Isothermal Titration calorimetry, Differential Scanning Calorimetry, Circular Dichroism (Theoretical background, Instrumentation, Application to Study Protein-Protein, Protein-Ligand, Protein-Drug and Protein Surfactant Interactions, and Stability of Biomolecules).

**SECTION-D** **(11 Hrs.)**

Optical Properties of Biomacromolecules: Light Scattering, fundamental concepts, Rayleigh Scattering, Scattering by Larger particles, Information about size and molecular weight. Ultracentrifugation: Svedberg equation, sedimentation equilibrium, density gradient sedimentation. Electrophoresis: General principles, Double layer techniques, moving

boundary electrophoresis, zonal electrophoresis, isoelectric focusing. Osmotic Pressure: Second virial coefficient, Donnan effect, molecular mass and geometry from osmotic pressure measurements.

Course Outcome

This course will provide information about the applications of physical chemistry in fundamental biological processes.

**Books Suggested**

1. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W. H. Freeman.
3. Biochemistry, Voet and Voet, John Wiley.
4. Biophysical Chemistry, J. P. Allen, John Wiley.
5. Macromolecules: Structure and Function, F. Wold., Prentice Hall.
6. Text Book of Polymer Science, F. W. Billmeyer.
7. Physical Chemistry of Polymers, A. Tager.

**SEMESTER–VII**

**CHEMISTRY**

**ORGANIC CHEMISTRY-IV: Lab Preparations-II**

**(PRACTICAL)**

**Time: 3 Hrs** **Marks: 50**

**Credits: 0-0-2** **30 Hrs.**

1. An NMR study of Keto-Enol Tautomerism in β-dicarbonyl compounds (J. Chem Edu., 1976, 53, p392).
2. Preparation of bromohydrin of methyl oleate (Eur. J. Lipid Sci. Technol. 2004, 106, p27)
3. Epoxidation of methyl oleate (JACS, 1944, 66, p1925; J. Agric Food Chem, 2010, 58, p6234)
4. Solvent free Cannizaro reaction using 2-chlorobenzaldehyde (J. Chem Edu., 2009, 86, p85)
5. Reduction of 3- nitroacetophenone using i) NaBH4 ii) using Sn and HCl. Identification of the products with NMR, UV, IR spectra (Modern projects and experiments in organic chemistry, p193)
6. Synthesis of N,N-diethyl-m-toluamide (mosquito repellent) from m-toluic acid (Modern projects and experiments in organic chemistry, p227)
7. Dihydroxylation of cyclohexene with: (a) $KMnO_4$ (J. Chem. Edu. 2008, 85, p959) and (ii) p-toluene sulphonic acid/$H_2O_2$ (J. Chem. Edu. 2011,88, 1002-1003) and $HCO_2H/H_2O_2$ (Book 1, p 549) Compare product distribution by TLC.
8. Preparation of fluorescein from resorcinol and phthalic anhydride (Book 1, p935).
9. Synthesis of benzpinacol and its pinacol rearrangement.
10. Synthesis of 2,4-dinitrophenyl hydrazine from chlorobenzene.

Course Outcome

The use of multi-step approach in organic synthesis and applications of spectroscopic techniques to determine the structures of the compounds prepared.

**Books Suggested**

1. Vogel's text book of practical organic chemistry, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, 5th Ed., 1989, Longman Group.
2. Introduction to Organic Laboratory Techniques – A Contemporary Approach. D. L. Pavia, G. M. Lampmana and G. S. Kriz, W. B. Saunders Company, 1976.

**SEMESTER–VII**

**CHEMISTRY**

**PHYSICAL CHEMISTRY–III: Lab**

**(PRACTICAL)**

**Time: 3 Hrs** **Marks: 50**

**Credits: 0-0-2** **30 Hrs.**

**(I) Adsorption**:

1. To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal and examine the validity of Freundlich and Langmuir's adsorption isotherms.

2. To determine the adsorption isotherms of $CH_3COOH$ from aqueous solutions by charcoal.

**(II) Colloidal State**:

3. To prepare colloidal solutions of arsenius sulphide, cadmium sulphide and ferric hydroxide. 4. To determine the precipitating values of KCl, $K_2SO_4$ and $K_3Fe(CN)_6$ for ferric hydroxide solution.

5. To study the protective action of hydrophilic colloid on the precipitation of a hydrophobic colloid.

6. To prepare and characterize (melting and gelling temperature by ball bearing method) the hydrogel of agarose.

7. To investigate the effect of concentration of agarose on melting and gelling temperature of hydrogel.

8. To prepare and draw phase diagram of microemulsions comprising sodium dodecyl sulfate, water and hexanol (or propanol) (III) Molecular weight determination:

9. Determination of molecular weight of a volatile substance by Victor Mayer's method.

10. Determination of molecular weight of a liquid by steam distillation.

11. Determination of molecular weight of high polymer (polystyrene) by viscosity measurements.

12. To determine the critical micelle concentration of a soap (potassium laurate) by surface tension measurements.

13. To extract oil from given seeds with the help of soxhlet apparatus.

Course Outcome

The practical's mentioned in the syllabus will reinforce the theoretical concepts taught in the class rooms.

**Books Suggested**

1. Findlay's Practical Physical Chemistry, Author: Alexander Findlay Publisher: Wiley, 1972, ISBN-10:0470258853.

2. Advanced Practical Physical Chemistry, Author: J. B. Yadav, Publisher: Krishna Prakashan Media (Pvt) Ltd (2015), ISBN-10: 8182835925.

3. Quantitative Organic Analysis by Vogel, Author: A. I. Vogel, Publisher: Wiley, John & Sons, Incorporated, ISBN-13: 780582442504

**SEMESTER–VII**

**Minor Stream Course**

**SYNTHESIS AND CHARACTERIZATION OF MATERIALS**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **60 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(15 Hrs.)**

Single crystal growth: Czochlralski, Bridgmann and float zone methods, Preparation of bulk polycrystalline materials by solid state reaction, sintering, calcination and annealing. Glass synthesis by melt-quenching, Preparation of nanomaterials by Inert gas condensation, Ball Milling, Thin film deposition by evaporation, sputtering, Molecular beam epitaxy, Chemical vapour deposition method, Electrodeposition.

**SECTION-B** **(15 Hrs.)**

Metal nanocrystals by reduction, Solvothermal synthesis, Nanocrystals of semiconductors and other materials by arrested precipitation, Thermolysis routes, Sonochemical routes, Liquid-liquid interface, Hybrid methods, Solvated metal atom dispersion, post-synthetic size-selective processing. Sol- gel, Micelles and microemulsions, Cluster compounds.

**SECTION-C** **(15 Hrs.)**

X-ray and neutron diffraction, Atomic Force Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunnelling Microscope, Optical transmission and metallurgical microscope; their description, operational principle and application for analysis of materials, UV-VIS-IR Spectrophotometers, Principle of operation and application for band gap measurements, Raman spectroscopy, Magnetic measurements, electrical conductivity measurement by two probe, four probe and Van-der-Pauw methods

**SECTION-D** **(15 Hrs.)**

AFM based nanolithography and nanomanipulation, electron beam lithography and SEM based nanolithography and nanomanipulation, Ion beam lithography, oxidation and metallization. Mask and its application. Deep UV lithography, X-ray based lithography.

Course Outcome

The students will get the knowledge about the synthesis of nanomaterials and their characterization using state of the art techniques.

**Books Suggested**

1. Nanostructures and Nanomaterials G. Cao World Scientific Principles of Nanotechnology G. Ali. Mansoori World Scientific
2. Structure and properties of Atomic Nanoclusters J. A. Alonso World Scientific Nanoscience Dupas Claire Springer, June, 2006

**SEMESTER–VII**

**SUMMER INTERNSHIP**

**(02 WEEKS)**

**Time: 3 Hrs** **Marks: 50**

**Credits: 0-0-2** **02 Weeks**

Students will be required to undertake Community Engagement and service/ Field based learning/ Minor Projects and will have to submit a Report along with original certificate at the completion of the Internship. Every student will be required to submit an internship report in typed standard prescribed format containing a copy of original certificate. The objective of the Summer Internship is to test the ability of the student to grasp the practical knowledge. Every student will make PowerPoint presentation of internship and will be orally examined in the context of the training report. The Summer Internship Report shall be evaluated by a committee constituted by the College principal

Course Outcomes: Students should work in the industry/laboratories as trainees so that they can acquire knowledge about the different processes.

**SEMESTER–VIII**

**CHEMISTRY**

**INORGANIC CHEMISTRY–IV: Cluster and cage compounds**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **45 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(10 Hrs.)**

Chains: Catenation, heterocatenation, zeolites, intercalation chemistry, one-dimensional conductors; Rings: Borazines, Phosphazenes (synthesis, bonding & reactions), Phosphazene polymers, other heterocyclic inorganic systems, homocyclic inorganic systems.

**SECTION-B** **(12 Hrs.)**

Cages: Introduction, boranes, styxnumbers, bonding problems in Boranes, Chemistry of boranes- reaction with Lewis bases, Borane cages, $[B_{12}H_{12}]^{2-}$ and other boranes derived from $[B_{12}H_{12}]^{2-}$, structure relationship of closo, nido, archano and hypo boranes, heteroboranes, carboranes, metallocarboranes, structure prediction of heterocarboranes. Cage compounds having phosphorus and oxygen, Cage compounds of phosphorus and sulphur.

**SECTION-C** **(13 Hrs.)**

Cluster Compounds: Cluster compounds, molecular structures of clusters, metal carbonyl clusters, Low nuclearity carbonyl clusters (LNCCs), high nuclearity carbonyl clusters (HNCCs) (Structure patterns, synthesis methods), Electronic structures of clusters with π-acid ligands, Polyhedral skeletal electron pair theory (PSEPT), electron counting schemes for HNCCs, the capping rule, structures not rationalized by PSEPT model, isoelectronic and isolobal relationships, stereochemical nonrigidity in metal clusters, heteroatoms in metal clusters: carbide and nitride containing clusters, HNCCs of Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt.

**SECTION-D** **(10 Hrs.)**

Lower Halide and Chalcogenide Clusters: Octahedral metal halide and chalcogenide clusters ($M_6X_8$ and $M_6X_{12}$ types), Chevrel phases, triangular clusters and solid-state extended arrays.

Compounds with M-M multiple bonds: Major structural types, quadrupole bonds, other bond orders in tetragonal context, relation of clusters to multiple bonds.

Course Outcome

This course will enrich the knowledge of students about the concepts of inorganic chains, rings and cages.

**Books suggested**

1. B. E. Douglas, D. H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, John Wiley & Sons, Inc., New York., 1994.

2. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry, 4th Edn., Pearson Education, Singapore, 1999.

3. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th or 6th Edition Interscience Publishers.

**SEMESTER–VIII**

**CHEMISTRY**

**ORGANIC CHEMISTRY-V: Organic Synthesis-I**

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **45 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(11 Hrs.)**

Addition to Carbon-Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydroboration, Sharpless asymmetric epoxidation. Elimination Reactions: The E2, E1 and E1cB mechanisms and their spectrum. Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

**SECTION-B** **(12 Hrs.)**

Reagents for protection and deprotection of hydroxyl, amino, carbonyl and carboxylic acid in organic synthesis, preparation and reactions of Sulfonium and Sulfoxonium ylides, Umpolung reactions (Sulphur compounds, nitro compounds, lithiated ethers and related compounds). Chemistry of organometallic Reagents: Synthesis and chemical reactions based on organomagnesium, organozinc, organolithium, organocopper, organoboron, organosilicon and organotin.

**SECTION-C** **(11 Hrs.)**

Selected named reactions and rearrangements: Baker-Venkataraman, Barbier, Baylis-Hillman, Corey-Bakshi-Shibata, Corey-Seebach, Darzen, Dakin, Fischer, Friedlander, Fukuyama, Mukaiyama, Pictet-Spengler, Prins, Stork, Strecker, Vilsmeier. Mitsonobu reaction. 1,3-dipolar cycloaddition in the construction of rings. Prevost and Woodward procedures, Benzidine, Cope, Fries, Lossen, Wolf and Demjanov, Von-richter, Discussion on Steven’s reaction, Sommelet rearrangement and related reactions and Smiles Rearrangement.

**SECTION-D** **(11 Hrs.)**

Palladium in Organic Synthesis: Palladium-catalyzed cross-coupling and related reactions of Unactivated/activated alkyl electrophiles with organometallic compounds: Wacker reaction, Heck reaction, Suzuki, Negishi, Stille, Sonogashira, Hiyama, Kumada-Murahashi, Buchwald-Hartwig coupling, and Tsuji-Trost reaction, Palladium-catalyzed Annulation of alkynes, Palladium catalyzed cycloaddition reaction of Arynes.

Course Outcome

The objective of this course is to provide information about the organic reactions involving C-C bond formation using different reagents.

**Books Suggested**

1. Advanced Organic Chemistry, 5th Edition, Part B: Reactions and Synthesis by Francis A. Carey and Richard J. Sundberg, Plenum Press, N. York, 2007.
2. Palladium in Organic Synthesis (Editor: Jiro Tsuji) Volume 14, 2005, Springer.
3. Advanced Organic Chemistry: Reaction mechanism by Reinhard Bruckner (2001) “Reactionof Ylides with Saturated or α,β -Unsaturated Carbonyl Compounds”, Chapter 9, pp 347-372.
4. Organic Reaction Mechanism by Jerry March, John Wiley Ed. 5, 2002; 5. Advanced Organic Chemistry by Francis Carey, Vol. A and Vol. B
5. T. W. Greens, P. G. M. Wuts. Protective groups in Organic synthesis, 3rd / 4th Ed. John Wiley &Sons, INC.
6. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.

**SEMESTER–VIII**

**CHEMISTRY**

**INORGANIC CHEMISTRY-V: Nuclear chemistry**

**(THEORY)**

**Time: 3 Hrs** **Marks: 75**

**Credits: 3-0-0** **45 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(11 Hrs.)**

Nuclear chemistry: Introduction, nuclear and chemical reactions. Nuclear particles: properties of alpha, beta, gamma, positrons, mesons, hyperons, neutrino and antineutrino, antiprotons, antineutrons and quarks. Nuclear structure, forces and stability: Nucleus shape, isotopes, isobars, isotones, isomers and nuclear forces, nuclear mass & binding Energy, packing Fraction, Mass defect, binding energies and stability.

**SECTION-B** **(12 Hrs.)**

Radioactivity: Rate of radioactive disintegration and units of radioactivity. Artificial radioactivity: artificial transmutation of elements and induced radioactivity. Cyclotron. Preparations of tranuranic elements. Q-values of nuclear reactions: endoergic and exoergic. Nuclear coulombic barrier. Group displacement law - statement and explanation - with examples; radioactive series - U, Th, Ac and Np series (mention of the first and last stable elements, number of α- and β- particles. Type of series: viz., 4n, (4n+1), (4n+2) and (4n+3).

**SECTION-C** **(11 Hrs.)**

Nuclear Models: Detail information about the nuclear shell and nuclear liquid drop model. Nuclear reactions: Nuclear reactions induced by charged particles: Protons, deuterons, neutrons and alpha particles.Nuclear fission - explanation with an example, chain reaction, principle of atomic bomb, calculation of energy liberated, fissionable isotopes. Nuclear fusion - explanation with an example, thermonuclear reaction, advantages and disadvantages of fusion over fission, the principle of a hydrogen bomb.

**SECTION-D** **(11 Hrs.)**

Nuclear reactor and detectors: Nuclear reactors: principle, working of a thermal reactor, diagram, and explanation of the terms like nuclear fuel, control rods, moderators and coolant. Breeder reactors- a brief explanation of their functioning. Nuclear detection of radioactivity: The Geiger-Muller Counter and Wilson cloud chamber. Nuclear hazards, waste disposal and applications nuclear isotopes: Hazards of nuclear materials. Disposal methods of nuclear waste. Applications of radioisotopes in tracer technique - agriculture (phosphorous in agriculture research), medicine (phosphorous to check crack in bones, sodium/iodine to detect clots in blood vessels), food preservation. Carbon dating - formation of radioactive carbon in the atmosphere. Explanation of the determination of age of wood/peat or fossil. Numerical problems on carbon dating.

Course Outcome

The students will get the knowledge about Radiation and Nuclear chemistry along with knowledge of types of radioactive decay, natural decay series, nuclear models, nuclear properties,

**Books suggested**

1. B.C. Harvey, Introduction to Nuclear Chemistry, Prentice-Hall (1969)
2. G. Friedlander, J.W. Kennedy, E.S. Marcus & J.M. Miller Nuclear & Radiochemistry. John- Wiley & Sons (1981)
3. H.V. Keer, Principles of the Solid State, Wiley Eastern Ltd. (1993)
4. A.R. West Solid State Chemistry and Its Applications" John Wiley & Sons (1987)
5. A.K. Cheetham and P. Day Eds. Solid State Chemistry Techniques, Clarendon Press, Oxford (1987)
6. G. Timp Ed. Nanotechnology Springer-verlag (1999)

**SEMESTER–VIII**

**CHEMISTRY**

**PHYSICAL CHEMISTRY-V: Electroanalytical techniques**

**(THEORY)**

**Time: 3 Hrs** **Marks: 75**

**Credits: 3-0-0** **45 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A** **(12 Hrs.)**

Introduction: Electrolytic and galvanic cell, Cell components, Faradaic and Non-Faradaic currents, electrical double layer, mass transfer in cells, schematic representation of cells. Potentials in electroanalytical cells: thermodynamics of cell potential, liquid junction potential. Electrode potentials: nature of electrode potential, sign conventions of electrode potential, standard electrode potential, measurement of electrode potentials, effect of activity on electrode potential, limitation to the use of standard electrode potentials. Calculation of cell potentials from electrode potentials. Currents in electrochemical cells: Ohmic potential, polarization, charge transfer polarization, mechanism of mass transport. Types of electroanalytical methods: interfacial and bulk methods.

**SECTION-B** **(11 Hrs.)**

Voltammetry and Polarography: General introduction, Polarographic cells, Polarograms, polarographic waves, equation of the polarographic waves, Effect of complex formation on polarographic waves. The dropping mercury electrode (DME): advantages and disadvantages of DME. Polarographic diffusion current, Ilkovic equation, capillary characteristics, residual current, anodic Waves, mixed anodic-cathodic waves, oxygen waves, supporting electrolyte. Applications of polarography. Modified voltametric methods: differential pulsed polarography, rapid-scan polarography, cyclic voltammetry, alternating current polarography, stripping methods. Amperometric titrations and its applications.

**SECTION-C** **(11 Hrs.)**

Potentiometric Methods: Reference electrodes (Calomel, Ag/AgCl), Metallic indicator electrodes (Electrodes of the First, second and third types), Metallic redox indicator

electrode. Membrance indicator electrodes: classification of membranes, properties of membranes, glass electrode for pH measurements and cations, crystalline membrane electrode, liquid membrane electrodes. Ion-selective field transistors (ISFET): Mechanism and application of ISFET. Molecular selective electrode systems: gas sensing probes, biosensors. Instruments for measuring cell potential, direct potentiometric measurements and potentiometric titrations.

**SECTION-D (11 Hrs.)**

Conductometric Methods: Electrolytic conductance, variation of equivalent conductance with concentration, measurement of conductance, conductometric titrations, Applications to various types of titrations for detection of end points. Kohlrausch's law and Ostwald's dilution law, conductometric titrations. Coulometry: Current voltage relationships, electrolysis at constant applied voltage, constant current electrolysis. Coulometric methods of Analysis: types of coulometric methods. Controlled-potential coulometry: instrumentation and applications. Coulometric titrations and its applications. Turbidimetry and Nephelometry: Theory of Nephelometry and Turbidimetry, Brief Instruments, applications.

Course Outcome

To provide basic principles, theoretical background, and key applications/examples of various analytical techniques being used in laboratory experiments.

**Books suggested**

1. D. A. Skoog, F. J. Holler, and S. R. Crouch: Principles of Instrumental Analysis-Sixth addition. Thomson Brooks/Cole, 2007.
2. D. A. Skoog and D. M. West: Principles of Instrumental Analysis-Second addition. Saunders College, 1980.
3. G. W. Ewing: Instrumental Methods of Analysis.
4. H. H. Willard, L.L. Marritt & J.A. Dean: Instrumental Methods of Analysis.

**SEMESTER–VIII**

**CHEMISTRY**

**INORGANIC CHEMISTRY–III: Lab**

**(PRACTICAL)**

**Time: 3 Hrs** **Marks: 50**

**Credits: 0-0-2** **30 Hrs.**

1. Preparation tris(ethylenediamine)cobalt(III) chloride. Record and interpret IR and UV visible spectrum of the complex. [Ref. J. Chem. Educ.1976, 53, 10, 667]
2. Preparation of tris(thiourea)mercury(II), record and interpret its IR and how it helps to establish metal-ligand bonding. [Ref. Inorg. Synth. Vol. VI, p.26].
3. Preparation of [chloro(pyridine)cobaloxime(III)], record and interpret its IR, and UV-vis. spectral data. [Inorg. Synth. Vol. XI, p. 61].
4. Preparation of $[Zn(acac)_2]$.HO, record and interpret its IR spectrum TGA/DTA/DSC. [Ref. Inorg. Synth. Vol. X, p.74].
5. Synthesis of Prussian Blue: $Fe_4[Fe(CN)_6]_3.nH_2O$ (n=14-16). Record and interpret its IR and TGA. [Inorg. Chem. 1977, 16, 2704-2710]
6. Preparation of Preparation of sodium tetrathionate, potassium dithionate, and interpretation of their IR spectra. [Ref. Marr and Rockett, 1972, p. 270].
7. Preparation of potassium trioxalatoaluminate(III) trihydrate. Its TGA and DTA studies and its interpretation of its IR spectrum.
8. Preparation of cis-and trans-potassium dioxalatodiaquochromate(III). Interpretation of their IR and electronic absorption spectral data. Calculation of β and 10 Dq values.
9. Preparation of chloropentaamminecobalt(III) chloride from cobalt carbonate. Interpretation of their IR and UV-visible spectra.
10. Preparation of $HgCo(NCS)_4$, its IR and measure its magnetic moment. Explain how the magnetic moment is calculated using the Gouy's balance and the roll of this compoun (ref. Marr and Rockett, 1972, page 365).

Course Outcome:

To familiarize the students with some synthetic methods for the preparation of coordination complexes and their characterization using NMR, IR, UV-Vis, techniques.

**Books suggested**

1. G. Marr and B.W. Rockett: Practical Inorganic Chemistry, Van Nostrand Reinhold Company.
2. W. L. Jolly, The Synthesis and Characterization of Inorganic Compounds. Prentice Hall.

**SEMESTER–VIII**

**Minor Stream Course**

## ATOMIC AND MOLECULAR SPECTROSCOPY

**(THEORY)**

**Time: 3 Hrs** **Marks: 100**

**Credits: 4-0-0** **60 Hrs.**

**Instructions for the Paper Setters**: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION-A (15 Hrs.)

Spectra of one and two valance electron systems: Magnetic dipole moments; Larmor's theorem; Space quantization of orbital, spin and total angular momenta; Vector model for one and two valance electron atoms; Spin-orbit interaction and fine structure of hydrogen, Lamb shift, Spectroscopic terminology; Spectroscopic notations for L-S and J-J couplings in two electron systems, Spectra of alkali and alkaline earth metals, Lande's Internal rule, Interaction energy in L-S and J-J coupling for two electron systems; Selection and Intensity rules for doublets and triplets.

### SECTION-B (15 Hrs.)

Breadth of spectral line and effects of external fields: The Doppler effect; Natural breadth from classical theory; natural breadth and quantum mechanics; External effects like collision damping, asymmetry and pressure shift and stark broadening; The Zeeman Effect for two electron systems; Intensity rules for the zeeman effect; The calculations of Zeeman patterns; Paschen-Back effect; LS coupling and Paschen –Back effect; Lande's factor in LS coupling; Stark effect.

### SECTION-C (15 Hrs.)

Microwave and Infra-Red Spectroscopy: Types of molecules, Rotational spectra of diatomic molecules as a rigid and non-rigid rotator, Intensity of rotational lines, Effect of isotopic substitution, Microwave spectrum of polyatomic molecules, Microwave oven, The vibrating diatomic molecule as a simple harmonic and an harmonic oscillator, Diatomic vibrating rotator, The vibration-rotation spectrum of carbon monoxide, The interaction of rotation and vibrations, Outline of technique and instrumentation, Fourier transform spectroscopy.

**SECTION-D** **(15 Hrs.)**

Raman and Electronic Spectroscopy: Quantum and classical theories of Raman Effect, Pure rotational Raman spectra for linear and polyatomic molecules, Vibrational Raman spectra, Structure determination from Raman and infra-red spectroscopy, Electronic structure of diatomic molecule, Electronic spectra of diatomic molecules, Born Oppenheimer approximation- The Franck Condon principle, Dissociation and pre-dissociation energy, The Fortrat diagram, Example of spectrum of molecular hydrogen. (15 Lectures)

Course Outcome

The students will get the information about the theory and applications of different spectroscopic techniques.

**Books Suggested**

1. Introduction to Atomic Spectra: H.E. White, McGraw Hill, 1934.
2. Fundamentals of Molecular Spectroscopy: C.B. Banwell-Tata McGraw Hill, 1986.
3. Spectroscopy Vol. I, II & III: Walker & Straughen
4. Introduction to Molecular spectroscopy: G.M. Barrow-Tokyo McGraw Hill, 1962.
5. Spectra of diatomic molecules: Herzberg-New York, 1944.
6. Molecular spectroscopy: Jeanne L McHale.
7. Atomic and Molecular Physics by Raj Kumar

# FACULTY OF SCIENCES

SYLLABUS FOR THE

# SUBJECT: MATHEMATICS

for the award of the Degree in

**BACHELOR OF ARTS/ BACHELOR OF SCIENCE/ HONOURS**

(Offered under 4-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

**Batch: 2024–28**

## GURU NANAK DEV UNIVERSITY AMRITSAR

Bachelor of Arts /Bachelor of Science/Honours Mathematics (CBGS)
(under NEP 2020) (Batch 2024-28) (Semester I-VIII)
(Faculty of Sciences)

SCHEME OF SUBJECT MATHEMATICS

| **SEMESTER-I** | | | | |
|---|---|---|---|---|
| **Code** | **Discipline Specific Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Algebra | 4-0-0 | 4 | 100 |
| | Algebra Laboratory | 0-0-1 | 2 | 25 |
| **SEMESTER-II** | | | | |
| **Code** | **Discipline Specific Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Advanced Calculus | 4-0-0 | 4 | 100 |
| | Calculus Laboratory | 0-0-1 | 2 | 25 |
| **SEMESTER-III** | | | | |
| **Code** | **Discipline Specific Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Differential Equations | 4-0-0 | 4 | 100 |
| | Differential Equations Laboratory | 0-0-1 | 2 | 25 |
| **SEMESTER-IV** | | | | |
| **Code** | **Discipline Specific Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Analysis | 4-0-0 | 4 | 100 |
| | Analysis Laboratory | 0-0-1 | 2 | 25 |

| **SEMESTER-V** | | | | |
|---|---|---|---|---|
| **Code** | **Discipline Specific Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Statics and Dynamics | 4-0-0 | 4 | 100 |
| | Statics and Dynamics Laboratory | 0-0-1 | 2 | 25 |
| **Code** | **Summer Internship** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Internship/Community Outreach | 0-0-2 | 4 | 50 |
| **SEMESTER-VI** | | | | |
| **Code** | **Discipline Specific Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Multivariate calculus | 4-0-0 | 4 | 100 |
| | Multivariate calculus Laboratory | 0-0-1 | 2 | 25 |
| **SEMESTER-VII** | | | | |
| **Code** | **Discipline Specific Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Real Analysis | 4-0-0 | 4 | 100 |
| | Complex Analysis | 4-0-0 | 4 | 100 |
| | Algebra-I | 4-0-0 | 4 | 100 |
| | Number Theory | 4-0-0 | 4 | 100 |
| **Code** | **Minor Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Statistics-I | 4-0-0 | 4 | 100 |
| **Code** | **Summer Internship** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Internship/Community Outreach | 0-0-2 | 4 | 50 |

Bachelor of Arts /Bachelor of Science/Honours Mathematics (CBGS)
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| **SEMESTER-VIII** | | | | |
|---|---|---|---|---|
| **Code** | **Discipline Specific Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Measure Theory | 4-0-0 | 4 | 100 |
| | Linear Algebra | 4-0-0 | 4 | 100 |
| | Algebra-II | 4-0-0 | 4 | 100 |
| | Differential Equations and integral Transforms | 4-0-0 | 4 | 100 |
| **Code** | **Minor Course** | **Credits L-T-P** | **Contact Hours** | **Max. Marks** |
| | Statistics-II | 4-0-0 | 4 | 100 |

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## LIST OF MINOR COURSES FOR MAJORS OTHER THAN MATHEMATICS

| Code | MINOR COURSES | Credits L-T-P | Contact Hours | Max. Marks |
|---|---|---|---|---|
| **SEMESTER-VII** | | | | |
| | NUMERICAL METHODS | 3-0-0 | 3 | 75 |
| | NUMERICAL METHODS LABORATORY | 0-0-1 | 2 | 25 |
| **SEMESTER-VIII** | | | | |
| | FOURIER SERIES AND INTEGRAL TRANSFORMS | 4-0-0 | 4 | 100 |

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## SEMESTER I
## MATHEMATICS

## ALGEBRA

**Time: 3 Hours** **L-T-P: 4-0-0**
**Marks: 100**

**Instructions for the Paper Setters: -**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION–A

Partitioning of Matrices, Matrices Partitioned conformably for Multiplication, Rank of a Matrix, Normal form, Row rank, Column rank of a matrix, Equivalence of column and row ranks, rank of product of matrices, Linear independence of row and column vectors Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations.

### SECTION–B

Eigenvalues, Eigenvectors, Hermitian Matrix, Skew Hermitian matrix and unitary matrix and properties of Eigen value, minimal and the characteristic equation of a matrix. Cayley Hamilton theorem and its use in finding inverse of a matrix.

### SECTION–C

Quadratic Forms, quadratic form as a product of matrices. The set of quadratic forms over a field. Congruence of quadratic forms and matrices. Congruent transformations of matrices. Elementary congruent transformations. Congruent reduction of a symmetric matrix. Reduction in the real field. Classification of real quadratic forms in n variables. Definite, semi–definite and indefinite real quadratic forms. Characteristic properties of definite, semi–definite and indefinite forms.

### SECTION–D

Relations between the roots and coefficients of general polynomial equation of degree n in one variable. Vieta ‘s Formula, Fundamental Theorem of Algebra (Statement only) Transformation of equations, Equations of Squared differences, Solution of cubic equations by Cardan method, Discriminant of polynomial equation, Discriminant of Cubic equation, nature of roots of cubic, Solution of Biquadratic by Ferrari’s Method with illustrations, Descartes’s Rules of Signs with illustrations.

**BOOKS RECOMMENDED:-**

1. Shanti Narayan and P.K. Mittal: Text Book of Matrices.
2. K.B. Datta : Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.

**REFERENCE BOOK RECOMMENDED:-**

1. Tom M. Apostol: Calculus: An Indian Adaptation, Wiley India, 2023

## SEMESTER I
## MATHEMATICS

### ALGEBRA LABORATORY

**Time: 3 Hours** **L-T-P: 0-0-1**

**Marks: 25**

### List of Practicals (using any package)

1. Introduction to the computer package in the practicals.
2. Matrix operations: addition, multiplication, inverse. transpose, determinant of matrix.
3. Find Rank of matrix: Row Rank, Column Rank.
4. Find row reduced echelon form
5. Create the coefficient matrix A and vector b. Solve for x using the inverse, using the built-in function.
6. Solving a linear system, using Gauss elimination numerically.
7. Finding eigenvalues and eigenvectors, numerically.

**BOOKS RECOMMENDED:-**

1. S.S. Sastry, Engineering Mathematics - Volume I (4th Edition), PHI, 2008.
2. S.S. Sastry, Engineering Mathematics - Volume II (4th Edition), PHI, 2008.

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## SEMESTER II
## MATHEMATICS

## ADVANCED CALCULUS

**Time: 3 Hours** **L-T-P: 4-0-0**

**Marks: 100**

**Instructions for the Paper Setters: -**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION–A

Real number system and its order properties: lub, glb of sets of real numbers, Completeness property, Archimedean property, Dense property of Rational numbers, Limit of a function of real variable, Properties of Limits, Squeeze Theorem, Continuous function and classification of discontinuities, Differentiability of a function of real variable, Concavity and Convexity of function, Point of inflexion.

### SECTION–B

Derivatives of Hyperbolic and Inverse Hyperbolic functions, nth order derivatives, Leibnitz theorem on nth derivative and its applications, Taylor's and Maclaurin theorem with Lagrange form of remainder, Application of Taylor's theorem in error estimation; Taylor's series expansions of $sinx$ , $\cos x$, $e^{cosx}$, $\log x$ etc. Indeterminate forms and L'Hopital rule.

### SECTION–C

Asymptotes, Horizontal Asymptotes, Vertical Asymptotes, Oblique Asymptotes, Asymptotes of general Rational Algebraic Curve with illustrations, Intersection of curve and its Asymptotes, de Moivre's theorem (for integer and Rational index) and its applications, primitive nth roots of unity.

### SECTION–D

Integration of hyperbolic functions, Properties of definite integral, Reduction formulae of type $\tan^n x\,dx$ , $\int \cot^n x\,dx$ , $\int \sec^n x$ , $\int \operatorname{cosec}^n x\,dx$ , $\int x\cos^n x$ , $\int \cos^m x \sin nx$ , Reduction formulae using Rule of Smaller index +1 of type $\int_0^{\frac{\pi}{2}} \sin^n x \cos^n x\,dx$, $\int_0^{\frac{\pi}{2}} \cos^n x\,dx$ , $\int_0^{\frac{\pi}{2}} \sin^n x\,dx$.

**BOOKS RECOMMENDED: -**

1. S. Narayan and P. K. Mittal: Integral Calculus. Sultan Chand & Sons.
2. Gorakh Prasad, Differential Calculus (19th ed.). Pothishala Pvt. Ltd. Allahabad, 2016.

**REFERENCE BOOKS RECOMMENDED: -**

1. Tom M. Apostol, Calculus: An Indian Adaptation, Wiley India, 2023.
2. Murray R. Spiegel, Theory and Problems of Advanced Calculus, Schaum's outline series, Schaum Publishing Co. New York.

## SEMESTER II
## MATHEMATICS

## CALCULUS LABORATORY

**Time: 3 Hours** **L-T-P: 0-0-1**
**Marks: 25**

### List of Practicals (using any package)

1. Plotting graphs of elementary functions eax+b sin(bx+c) , log(ax+b), 1/(ax+b), sin(ax+b), cos(ax+b), |ax+b| and to illustrate the effect of a and b on the graphs.
2. Plotting the graphs of the polynomial of degree 4 and 5, the derivative graph, the second derivative graph
3. Tracing of conics in Cartesian coordinates and using the general equation of second degree in x and y.
4. Tracing of conicoids: Ellipsoid, Hyperbolic paraboloid, Elliptic paraboloid, Hyperboloid of one and two sheets etc.
5. Graphs of hyperbolic functions.
6. Approximation of limit.
7. Approximations of derivatives.

**BOOKS RECOMMENDED:-**

1. S.S. Sastry, Engineering Mathematics - Volume I (4th Edition), PHI, 2008.
2. S.S. Sastry, Engineering Mathematics - Volume II (4th Edition), PHI, 2008.

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## SEMESTER III
## MATHEMATICS

## DIFFERENTIAL EQUATIONS

**Time: 3 Hours** **L-T-P: 4-0-0**
**Marks: 100**

**Instructions for the Paper Setters: -**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION–A

Differential equation of first order and first degree, Linear differential equation reducible to Linear Bernoulli's equation Ordinary differential equation of first order. Exact differential equations. Necessary and sufficient conditions for Mdx + Ndy to be Exact, integrating factors by inspections, special rules to find integrating factors with proof.

### SECTION–B

Geometrical meaning of a complete solution of the differential equations, General solution of homogeneous equation of second order, Orthogonal trajectories of cartesian and polar curve, Homogeneous differential equations, Linear differential equations with constant coefficients.

### SECTION–C

Singular solution, p-discriminant, c- discriminant, illustrations of singular solutions Variation of Parameters method, Reduction of order. Linear differential equations with variable coefficients, Define Cauchy's linear equations, Legendre's Linear equation.

### SECTION–D

First order and higher degree equations, equations solvable for y, x, p, equations not containing x, equations not containing y, Clairaut's equation and equations reducible to Clairaut's form.

System of ordinary simultaneous equations, Power Series, convergence of power series, Radius of convergence, Power Series solution about an ordinary point, solutions about singular points, Frobenius method when roots of indicial equations differ by non-integers, and when roots are equal.

**TEXT BOOK RECOMMENDED: -**

1. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand, (20th edition)

**REFERENCE BOOK RECOMMENDED:-**

1. Tom M. Apostol: Calculus: An Indian Adaptation, Wiley India, 2022

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## SEMESTER III
## MATHEMATICS

### DIFFERENTIAL EQUATIONS LABORATORY

**Time: 3 Hours** **L-T-P: 0-0-1**

**Marks: 25**

### List of Practicals (using any package)

1. Plotting solution of first order differential equation.
2. Solve the first-order differential equation $\frac{dy}{dx} =$ ay, numerically using Runge-Kutta method.
3. Solve the second-order differential equation $\frac{d^2y}{dt^2} =$ ay, numerically using Runge-Kutta method.
4. Plotting of solution of family of second order differential equation.
5. Solution of system of ordinary differential equations, numerically using Runge-Kutta method.
6. Numerical solution of the nonlinear simple pendulum equation.

**BOOKS RECOMMENDED:**

1. S.S. Sastry, Engineering Mathematics - Volume I (4th Edition), PHI, 2008.
2. S.S. Sastry, Engineering Mathematics - Volume II (4th Edition), PHI, 2008.

## SEMESTER IV
## MATHEMATICS

## ANALYSIS

**Time :3 Hours** **L-T-P: 4-0-0**
**Marks: 100**

**Instructions for the Paper Setters :-**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION–A

Sequence, Subsequence, Limit point of a sequence, Theorems on limits of sequences, Convergence and divergence of a sequence, Bounded and monotonic sequences and their behavior, Squeeze Theorem on sequences, Bolzano-Weierstrass theorem (statement only), Definition of Cauchy sequence, Cauchy's convergence Criterion, Cauchy's first theorem on limits with its applications, Cauchy's second theorem on limits with its applications.

### SECTION–B

Series of non-negative terms, Convergence and divergence of infinite series, Cauchy convergence criterion for series, Comparison tests for convergence. Cauchy's condensation test, Cauchy's integral test, Cauchy's root test, D'Alembert's ratio test, Comparison between Cauchy's root test and D'Alembert's ratio test, Logarithmic test, Gauss test, Alternating series, Leibnitz's test.

### SECTION–C

Partition of an interval, Riemann upper and lower sums, Riemann upper and lower integrals, Riemann integrability, Necessary and sufficient conditions for a bounded function to be Riemann integrable, Riemann integrability of continuous functions, monotone functions, and composition of functions, Darboux theorem, Fundamental Theorem of calculus.

### SECTION–D

Improper integrals, Conditions for existence of improper integrals, Tests for the convergence of the improper integrals of different kinds, Absolute convergence.

**TEXT BOOK RECOMMENDED:-**

1. S.C. Malik, Mathematical Analysis, Wiley Eastern Ltd. (1991).

**REFERENCE BOOK RECOMMENDED:-**

1. Tom M. Apostol, Calculus: An Indian Adaptation, Wiley India, 2022.

## SEMESTER IV
## MATHEMATICS

### ANALYSIS LABORATORY

**Time: 3 Hours** **L-T-P: 0-0-1**

**Marks: 25**

### List of Practicals (using any package)

1. Generate bounded sequences.
2. Visualize bounded sequences using plots.
3. Study the convergence of sequences through plotting.
4. Visualize monotonic sequences using plots.
5. Investigate convergence of series.
6. Visualization of convergence tests: Cauchy Root test and D' Alembert Ratio test.
7. Approximating radius of convergence of a power series.

**BOOKS RECOMMENDED:-**

1. S.S. Sastry, Engineering Mathematics - Volume I (4th Edition), PHI, 2008.
2. S.S. Sastry, Engineering Mathematics - Volume II (4th Edition), PHI, 2008.

## SEMESTER V
## MATHEMATICS

## STATICS AND DYNAMICS

**Time :3 Hours** **L-T-P: 4-0-0**
**Marks: 100**

**Instructions for the Paper Setters:-**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION–A

Composition and resolution of forces, parallelogram law, triangle law, polygon law, Lami's Theorem and its converse, (ג-µ) theorem, Resultant of a number of coplanar forces, Condition of equilibrium of a number of coplanar forces.

### SECTION–B

Parallel forces, Moment of a force about a point, Varignon’s theorem of moments, Friction, Kinds of Friction, Laws of friction, Problems of a body placed on a rough inclined plane, Equilibrium of a particle on a rough plane.

### SECTION–C

Definition of velocity and acceleration, Newton’s laws of motion. Weight carried by a lift, Motion of two particles connected by a string, Motion of two bodies connected by a string. Curvilinear motion of particle in a plane, Projectile and its equation of motion, time of flight, horizontal range, greatest height attained.

### SECTION–D

Simple Harmonic Motion, Work, Power and Energy; work done in stretching an elastic string, Conservative forces, Kinetic energy, Potential energy, Work done against gravity, Potential energy of a gravitational field, Principle of work and energy, Principle of conservation of energy.

**BOOKS RECOMMENDED:-**

1. R. S. Verma: A Text Book on Statics, Optical Pvt. Ltd., Allahabad.
2. S. R. Gupta: A text book of Dynamics

## SEMESTER V
## MATHEMATICS

### STATICS AND DYNAMICS LABORATORY

**Time: 3 Hours** **L-T-P: 0-0-1**

**Marks: 25**

### List of Practicals (using any package)

1. To simulate the motion of a particle under various forces using Newton's second law F=ma (Students can input different forces and masses to see how the particle's acceleration and trajectory change).
2. Create a simulation that analyzes the motion of a simple pendulum (Students can explore how the period and amplitude of oscillation vary with different parameters).
3. Calculate the equilibrium of forces acting on an object. (Given the forces' magnitudes, directions, and points of application, determine whether the object is in equilibrium or not).
4. Calculate the moment of force (torque) around a specified point. (Input the force magnitude, distance from the point, and direction. Compute the resulting moment).
5. Simulate the motion of particles or rigid bodies using numerical integration methods (e.g., Euler's method). ( Input initial conditions (position, velocity, mass) and external forces. Observe the dynamic behavior over time).
6. Predict the trajectory of a projectile given initial conditions such as angle, velocity, and height. (This can include air resistance and show the path of the projectile in real-time.)

**BOOKS RECOMMENDED:-**

1. Roberts P. Adrian, Statics and Dynamics with Background Mathematics.
2. T. M. Faure and R. Nikoukhah, Numerical Methods in Engineering with Scilab.

## SEMESTER VI
## MATHEMATICS

## MULTIVARIATE CALCULUS

**Time: 3 hrs.** **L-T-P: 4-0-0**

**Marks: 100**

**Instructions for the Paper Setters:-**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding three). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION–A

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, Differentiability of real valued functions of two variables, Total differentiability, sufficient condition for differentiability, Schwarz's Theorem, Young's Theorem, Euler's Theorem on homogeneous functions of two variables, Euler's Theorem on homogeneous functions of three variables, Taylor's theorem for functions of two variables.

### SECTION–B

Double integration over rectangular and non-rectangular region, Change of variables in double integrals, Triple integrals, Triple integral over a parallelepiped and solid regions, Change of variables in triple integrals, Area by use of double integrals, Volume by use of triple integration, Surface Area by use of double integrals, Centre of Gravity (or Centre of Mass) in $R^2$, Centre of Mass in $R^3$.

### SECTION–C

Definition of vector field, divergence and curl, directional derivatives, Divergence of a vector point function, Solenoidal Vector, Irrotational Vector, Physical interpretation of Curl of a vector point function, Laplacian operator, Integration of Vectors, the gradient, Tangential Line integrals, Applications of line integrals: Mass and Work, conservative vector fields, Circulation, Volume Integral .

### SECTION–D

The Divergence theorem, Green's theorem in a plane, Stoke's theorem and problems based on these theorems.

**BOOKS RECOMMENDED:-**

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt.Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
4. James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

## SEMESTER VI
## MATHEMATICS

### MULTIVARIATE CALCULUS LABORATORY

**Time: 3 Hours** **L-T-P: 0-0-1**

**Marks: 25**

### List of Practicals (using any package)

1. Finding and visualizing extremes of function of two variables.

2. Approximating area and volume using double integration.

3. Plotting graph of the surface z=f (x, y).

4. Approximating triple Integrals.

5. Draw vector fields in plane.

**BOOKS RECOMMENDED:-**

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt.Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
4. James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

## SEMESTER VII
## MATHEMATICS

## REAL ANALYSIS

**Time: 3 Hrs** **L-T-P: 4-0-0**
**Marks: 100**

**Instructions for the Paper Setters:**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

### SECTION–A

Sequence and Series of functions: Discussion of main problem, Uniform Convergence, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinuous families of functions, Arzela's Theorem, Weierstrass Approximation theorem

### SECTION–B

Separated sets, connected sets in a metric space, Connected subsets of real line, Components, Functions of Bounded Variation, Sequences in Metric Spaces: Convergent sequences (in Metric Spaces), subsequences, Cauchy sequences, Complete metric spaces, Cantor's Intersection Theorem

### SECTION–C

Baire's theorem, Banach contraction principle, Continuity: Limits of functions (in metric spaces) Continuous functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic functions, Uniform Continuity.

### SECTION–D

The Riemann Stieltje's Integral: Definition and existence of Riemann Stieltje's integral, Properties of integral. Integration and Differentiation. Fundamental Theorem of Calculus, 1$^{st}$ and 2$^{nd}$ Mean Value Theorems of Riemann Stieltje's integral.

**TEXT BOOK RECOMMENDED:-**

1. Walter Rudin: Principles of Mathematical Analysis (3$^{rd}$ Edition) McGraw-Hill Ltd Ch.2, Ch.3, (3.1-3.12), Ch.4, Ch.6, (6.1-6.22)

**REFERENCE BOOKS RECOMMENDED:-**

1. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Ltd (App.1) pp 337-338, Ch.2(9-13)
2. Shanti Narayan, A course of Mathematical Analysis.
3. T. M. Apostol, Mathematical Analysis 2$^{nd}$ Edition 7.18 (Th.7.30 &7.31)
4. S. C. Malik, and Savita Arora.: Mathematical Analysis, Wiley Eastern Ltd.

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## SEMESTER VII
## MATHEMATICS

## COMPLEX ANALYSIS

**Time: 3Hrs** **L-T-P: 4-0-0**
**Marks: 100**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

### SECTION–A

Functions of complex variables, continuity and differentiability. Analytic functions, Conjugate function, Harmonic function. Cauchy Riemann equations (Cartesian and Polar form). Construction of analytic functions, Complex line integral, Cauchy's theorem, Cauchy's integral formula and its generalized form.

### SECTION–B

Cauchy's inequality. Poisson's integral formula, Morera's theorem. Liouville's theorem, Conformal transformations. Bilinear transformations. Critical points, fixed points, cross-ratio. Problems on cross-ratio and bilinear transformation, Analytic Continuation, Natural Boundary, Schwartz Reflection Principle.

### SECTION–C

Power Seires, Taylor's theorem, Laurent's theorem. Maximum Modulus Principle. Schwarz's lemma. Theorem on poles and zeros of meromorphic functions. Argument principle. Fundamental theorem of Algebra and Rouche's theorem.

### SECTION–D

Zeros, Singularities, Residue at a pole and at infinity. Cauchy's Residue theorem, Jordan'slemma. Integration round Unit circle. Evaluation of integrals of the type of $\int_{-\infty}^{\infty} f(x)dx$ and integration involving many valued functions.

**BOOKS RECOMMENDED:**

1. E.T. Copson, Theory of functions of complex variables.
2. D. V. Ahlfors, Complex analysis.
3. H. S. Kasana, Complex variables theory and applications.
4. J. B. Conway, Functions of one complex variable
5. Shanti Narayan: Functions of Complex Variables.

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## SEMESTER VII
## MATHEMATICS

### ALGEBRA-I

**Time: 3Hrs** **L-T-P: 4-0-0**
**Marks 100**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

### SECTION–A

Groups: Definition & examples, Subgroups, Normal subgroups and Quotient Groups, Lagrange's Theorem, Generating sets, Cyclic Groups.

### SECTION–B

The Commutator subgroups, Homomorphism, Isomorphism Theorems, Automorphisms, inner Automorphisms, Permutation groups, the alternating groups, Simplicity of $A_n$, $n \geq 5$, Cayley's theorem.

### SECTION–C

Structure of finite Abelian groups. Conjugate elements, class equation with applications, Cauchy's Theorem, Sylow's Theorems and their simple applications, Composition Series, and Jordan Holder Theorem, Solvable Groups.

### SECTION–D

Direct Products: External and Internal. Fundamental theorem of finite Abelian groups and its applications; Semidirect Products, Recognition Theorems on semidirect products.

**TEXT BOOK RECOMMENDED:-**

1. J.B. Fraleigh, An Introduction to Abstract Algebra.

**REFERENCE BOOKS RECOMMENDED:-**

1. I. N. Herstein, Topics in Algebra, Willey Eastern 1975.
2. Surjit Singh and Qazi Zameeruddin. Modern Algebra.
3. M. Artin, Algebra

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## SEMESTER VII

## MATHEMATICS

## NUMBER THEORY

**Time: 3Hrs** **L-T-P: 4-0-0**
**Marks :100**

**Instructions for the Paper Setters:**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

### SECTION–A

Simultaneous Linear Congruences, Chinese Remainder theorem with applications, Wolsten-Holme's theorem, Lagrange's proof of Wilson theorem, Fermat numbers, The order of an integer modulo *n*. Primitive roots, Existence and number of primitive roots.

### SECTION–B

Indices and their applications, Quadratic residues , Euler's criterion, Product of quadratic residues and quadratic non-residues, The Legendre symbol and its properties, Gauss's Lemma, Quadratic reciprocity law, Jacobian symbol and its properties.

### SECTION–C

Arithmetic functions $\tau(n)$, $\phi(n)$, $\sigma_k(n)$, $\mu(n)$, Perfect numbers, Mobius inversion formula, Diophantine equation $x^2+y^2=z^2$ and its applications to $x^n+y^n=z^n$ when n = 4. Criterion for an integer to be expressible as sum of two squares.

### SECTION–D

Farey series, Farey dissection of a circle and its applications to approximations of irrationals by rationals, Finite and Infinite simple continued fractions, periodic and purely periodic continued fractions, Lagrange's Theorem on periodic continued fractions. Applications to Pell's equation. The fundamental solution of Pell's equation.

**BOOKS RECOMMENDED**:

1. G.H. Hardy and H.S. Wright, Theory of Numbers.
2. I. Niven and E.M. Zuckerman, An introduction to number theory.
3. David M. Burton, Elementary Number Theory, McGraw Hill 2002.

## SEMESTER VII
## MATHEMATICS
## (MINOR COURSE)

## STATISTICS-I

**Time: 3 Hours** **L-T-P: 4-0-0**
**Marks 100**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

### SECTION-A

Random experiment, sample space, sigma field, probability axioms, elementary properties, Combinatorics: probability on finite sample space, conditional probability and Bayes theorem. Random variable, probability mass function, probability density function, cumulative distribution function, Distribution of functions of random variable.

### SECTION-B

Two and higher dimensional random variables, joint distribution, marginal and conditional distributions, bivariate and multivariate transformation of random variables Stochastic independence. Expectations, moments, moment generating function, characteristic function, Conditional expectation, Chebyshev's and Cauchy Schwartz Inequality, Jenson's inequality.

### SECTION-C

Discrete Distribution: Uniform, Binomial, Poisson, Geometric, Hyper geometric, Multinomial. Continuous Distributions: Uniform, Exponential, Normal distributions, Gamma distribution, Beta distribution, Bivarirte normal distribution.

### SECTION-D

Chi-square distribution, t-distribution, F-distribution, sampling distribution of mean and variance of sample from normal distribution, Convergence in probability and convergence in distribution, central limit theorem (Laplace theorem Linderberg, Levy's Theorem).

**BOOKS RECOMMENDED:-**

1. R.V.Hogg, J.W. Mckean, and A.T. Craig, Introduction to Mathematical Statistics.
2. V.K. Rohtagi, A.K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics
3. G. Casella and R.L. Berger, Statistical Inference.

## SEMESTER VIII
## MATHEMATICS

### MEASURE THEORY

**Time: 3Hrs** **L-T-P: 4-0-0**
**Marks :100**

**Instructions for the Paper Setters:**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**SECTION–A**

Review of the topology of real line, the extended real numbers, σ-algebra, Borel-algebra and Borel sets, Lebesgue Outer Measure, Measurable Sets and their properties, σ-algebra of Lebesgue measurable sets, Outer and Inner Approximation of the Lebesgue Measurable Sets, Countable additivity of Lebesgue measure, Continuity of measure, Non-Measurable Sets, The Cantor set and The Cantor-Lebesgue function, Comparison of σ-algebra of measurable sets and the Borel σ-algebra of subsets of real line.

**SECTION–B**

Motivation behind Lebesgue Measurable Functions, various Characterizations and Properties of Measurable functions: Sum, Product and Composition, Sequential Point-wise Limits and Simple Approximations to Measurable Functions, Littlewood's three Principles.

**SECTION–C**

Lebesgue Integral (**Stage I**): Lebesgue Integral of a simple function, Comparison of Riemann and Lebesgue Integral, linearity and monotonicity of Lebesgue integration. Lebesgue Integral (**Stage II**): Lebesgue Integral of a bounded measurable function over a set of finite measure, linearity, monotonicity, and additivity over domain of integration, The Bounded Convergence Theorem. Lebesgue Integral (**Stage III**): Lebesgue Integral of a measurable function of finite support, Lebesgue Integral of a non-negative measurable function, linearity, monotonicity, and additivity over domain of integration, Fatou's Lemma, The Monotone convergence Theorem.

**SECTION–D**

Lebesgue Integral (**Stage IV**): The General Lebesgue Integral, the integral comparison test, linearity, monotonicity, and additivity over domain of integration, The Lebesgue Dominated Convergence Theorem, Countable Additivity and Continuity of Integration. Uniformly integrable family of functions, The Vitali convergence Theorem. Characterizations of Riemann and Lebesgue integrability.

**TEXT BOOK RECOMMENDED:-**

1. H.L. Royden and P.M. Fitzpatrick, Real Analysis (Fourth Edition), Pearson Education Inc. New Jersey, U.S.A. (2010). (Scope as in Ch.1-6)

## SEMESTER VIII
## MATHEMATICS

## LINEAR ALGEBRA

**Time: 3Hrs** **L-T-P: 4-0-0**
**Marks :100**

**Instructions for the Paper Setters:**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

### SECTION–A

Vector spaces, Subspaces, Quotient Spaces, Basis and Dimension Theorems, Sum of subspaces, Direct sum decompositions, Linear transformations, The Algebra of linear transformations.

### SECTION–B

Matrices associated with linear transformations, effect of change of ordered bases on the matrix of linear transformation, Elementary matrix operations and Elementary matrices, Row rank, Column rank and their equality, system of linear equations

### SECTION–C

Eigen values and Eigen vectors of linear operators, Characteristic and minimal polynomials, companion matrix, subspaces invariant under linear operators, triangulation, Diagonalization, Linear Functionals, Dual Spaces and dual basis, the double dual

### SECTION–D

Inner Product Spaces, The Gram-Schmidt Orthogonalization, Orthogonal Complements, The Adjoint of a linear operator on an inner product space, Normal and Self-Adjoint Operators, Unitary and Normal Operators, Spectral Theorem

**BOOKS RECOMMENDED:-**

1. K. Hoffman and R. Kunze, Linear Algebra, Second Edition, Prentice Hall, 1971.
2. S. Axler, Linear Algebra Done Right, Second Edition, Springer-Verlag, 1997.
3. S.H. Friedberg, A.J. Insel, and L.E. Spence, Linear Algebra, Fourth Edition, Prentice Hall, 2003.
4. S. Lang, Linear Algebra, Third Edition, Springer-Verlag, 1987.
5. Vivek Sahai and Vikas Bist, Linear Algebra, Narosa Publishing House, 2008

## SEMESTER VIII
## MATHEMATICS

## ALGEBRA-II

**Time: 3 Hrs** **L-T-P: 4-0-0**
**Marks:100**

**Instructions for the Paper Setters:**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

### SECTION-A

Rings, Subrings, Ideals, Factor Rings, Homomorphism, Integral Domains. Maximal and prime ideals.

### SECTION-B

The field of Quotients of an integral domain. Principal Ideal domains, Euclidean Rings. The ring of Gaussian Integers, Unique Factorization domains, Polynomial Rings, Gauss's theorem and irreducibility of a polynomial.

### SECTION-C

Extension Fields: Finite and Infinite, Simple and Algebraic Extensions, Splitting fields: Existence and uniqueness theorem.

### SECTION-D

Separable and inseparable extensions, perfect fields, finite fields, Existence of GF ($p^n$), construction with straight edge ruler and compass.

**BOOKS RECOMMENDED:-**

1. I.N. Herstein, Topics in Algebra, Willey Eastern1975.
2. J.B. Fraleigh, An Introduction to Abstract Algebra.

**REFERENCE BOOKS RECOMMENDED**:-

1. Surjit Singh, Modern Algebra.
2. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpal, Basic Abstract Algebra (1997); Ch-14 (Sec.1-5).

## SEMESTER VIII
## MATHEMATICS

### DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS

**Time: 3Hrs** **L-T-P: 4-0-0**

**Marks:100**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**SECTION-A**

Existence and uniqueness theorem for IVP in ODE's, The method of successive approximation, general properties of solution of linear differential equation of order n, adjoint and self-adjoint equations, Total differential equations. Simultaneous differential equations, orthogonal trajectories, Sturm Liouville's boundary value problems. Sturm comparison and Separation theorems, Orthogonality solution.

**SECTION-B**

Laplace Transform: Definition, existence, and basic properties of the Laplace transform, Inverse Laplace transform, Convolution theorem, Laplace transform solution of linear differential equations and simultaneous linear differential equations with constant coefficients.

**SECTION-C**

Fourier Transform: Definition, existence, and basic properties, Convolution theorem, Fourier transform of derivatives and Integrals, Inverse Fourier transform, solution of linear ordinary differential equations, Complex Inversion formula.

**SECTION-D**

Special Functions: Solution, Generating function, recurrence relations and othogonality of Legendre polynomial, Bessel functions, Hermite and Laguerre polynomials.

**BOOKS RECOMMENDED**:-

1. E.D. Rainvile, Special Functions.
2. H. T. H. Piaggio, Differential equations.
3. S.L. Ross, Differential equations.
4. Allan Pinkus & Samy Zafrany, Fourier series and Integral Transforms, Cambridge University Press, 1997.

## SEMESTER -VIII
## MATHEMATICS
## (MINOR COURSE)

## STATISTICS-II

**Time: 3 Hours** **L-T-P: 4-0-0**

**Marks 100**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

### SECTION-A

Point Estimation: Sufficient statistics, Neyman factorization theorem, minimal sufficient statistics, ancillary statistics, complete statistics, Basu's theorem, unbiasedness, Consistent estimator.

### SECTION-B

Mean squared error, Minimum variance unbiased estimators, Rao Blackwell Theorem, Lehmann-Scheffe theorem, Cramer-Rao lower bound., efficiency, Methods of estimation: maximum likelihood estimator (restricted and non-restricted), properties of MLE (without proof).

### SECTION-C

Concepts of testing of hypotheses, critical region, test function, two types of errors, power function, level of significance, p-value, most powerful test, Neyman-Pearson theory, Uniformly most powerful test.

### SECTION-D

Likelihood ratio property, Karlin Rubin theorem and its applications. Likelihood tests (excluding properties of Likelihood Ratio Tests), Confidence intervals, confidence level, construction of confidence intervals using pivots and inverting a test statistic.

**BOOKS RECOMMENDED:-**

1. R.V.Hogg, J.W. Mckean, and A.T. Craig, Introduction to Mathematical Statistics.
2. V.K. Rohtagi, A.K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics
3. G. Casella and R.L. Berger, Statistical Inference.

## SEMESTER VII
## MATHEMATICS
## (MINOR COURSE FOR MAJORS OTHER THAN MATHEMATICS)

## NUMERICAL METHODS

**Time: 3Hours** **L-T-P: 3-0-0**

**Marks: 75**

**Instructions for the Paper Setters: -**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION–A

Solution of non-linear equations, Bisection method, Iteration method, Newton-Raphson Method, Method of false position, Secant method, Order of convergence of these methods.

### SECTION–B

Solution of linear system of equations: Direct method, Gauss elimination method, Jordon's method, Triangular Method, Jacobi's Method, Gauss Seidel Method.

### SECTION–C

Finite Differences: Forward difference, Backward difference, Divided difference, Shift operator, Interpolation, Numerical differentiation, Method based on interpolation. Numerical Integration, Trapezoidal rule, Simpson's1/3$^{rd}$ and 3/8$^{th}$ rules, Weddle rule, Error analysis of Trapezoidal and Simpson's 1/3$^{rd}$ rules.

### SECTION–D

Gaussian integration method, Gaussian Legendre integration. Double numerical integration. Numerical solution of Initial value problems in ODEs: Taylor's method, Euler's method, Modified Euler's method, Runge-Kutta method.

**BOOKS RECOMMENDED:-**

1. S. S. Sastry: Introductory Methods of Numerical Analysis, 2003 (3rdEdition), Prentice Hall of India.
2. G. Shanker Rao: Numerical Analysis, 2006 (Revised 3$^{rd}$ Edition).

## SEMESTER VII
## MATHEMATICS
## (MINOR COURSE FOR MAJORS OTHER THAN MATHEMATICS)

## NUMERICAL METHODS LABORATORY

**Time: 3 Hours** **L-T-P: 0-0-1**

**Marks 25**

### List of Practicals (using any package)

1. Solution of algebraic equations in one variable: Bisection method, Regula Falsi method, Newton Raphson method, and Secant method.
2. Solution of system of Linear Equations: Gauss Elimination method, Gauss Seidel iterative method.
3. Interpolation: Newton's forward & backward interpolation, Lagrange's interpolation.
4. Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules, Weddle rule.
5. Numerical solutions of Initial value problems in ODEs: Euler's method, Modified Euler's method, Runge Kutta method.
6. Error Analysis of the practicals at no. 5.

**TEXT BOOK RECOMMENDED:-**

1. S. S. Sastry, Introductory Methods of Numerical Analysis, 2003 (3rdEdition), Prentice Hall of India.

**REFERENCE BOOK RECOMMENDED:-**

1. Ralston, A first course in Numerical Analysis, McGraw Hill, 1985.

## SEMESTER VIII
## MATHEMATICS
## (MINOR COURSE FOR MAJORS OTHER THAN MATHEMATICS (MINOR 2))

## FOURIER SERIES AND INTEGRAL TRANSFORMS

**Time: 3 Hours** **L-T-P: 4-0-0**
**Marks: 100**

**Instructions for the Paper Setters: -**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION-A
Norm, Cauchy-Schwartz inequality, Inner Product Space, orthogonal and orthonormal systems, Pythagorean theorem, Orthogonal Projections, The Gram-Schmidt Process, Infinite orthonormal systems.

### SECTION-B
Fourier Series: Periodicity and orthogonality of the Sine and Cosine functions, the Euler-Fourier formulas, the Fourier Convergence Theorems, Evenness and oddness Fourier Sine Series, Fourier Cosine Series.

### SECTION-C
Fourier Transform: Definition, existence, and basic properties, Convolution theorem, Fourier transform of derivatives and Integrals, Inverse Fourier transform, solution of linear ordinary differential equations

### SECTION-D
Laplace Transform: Definition, existence, and basic properties of the Laplace transform, Inverse Laplace transform, Convolution theorem, Laplace transform solution of linear differential equations and simultaneous linear differential equations with constant coefficients.

**TEXT BOOK RECOMMENDED: -**

1. A.Pinkus, S.Zafrany, Fourier Series and Integral Transforms, Cambridge University Press (1997)

**REFERENCE BOOKS RECOMMENDED:-**

1. V. Serov, Fourier Series, Fourier Transform and their applications to Mathematical Physics.
2. A.R. Vasishtha and R.K. Gupta, Integral Transforms,$10^{th}$ edition.

# FACULTY OF SCIENCES

SYLLABUS FOR THE

# SUBJECT: PHYSICS

for the award of the Degree in

**BACHELOR OF ARTS/ BACHELOR OF SCIENCE/ HONOURS**

(Offered under 4-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

**Batch: 2024–28**

## GURU NANAK DEV UNIVERSITY AMRITSAR



**(ii)** Syllabi are subject to change at the discretion of the authority.
Please visit the University website from time to time.

Bachelor of Arts /Bachelor of Science/Honours Physics (CBGS)
(Under NEP 2020) *(Batch 2024-28) (Semester I-VIII)*
*(Faculty of Sciences)*

# COURSE SCHEME

# PHYSICS

| **FIRST SEMESTER** | | |
|---|---|---|
| **Course Code** | **Course Title** | **Credits L-T-P** |
| | **Major Core Course** | |
| | Electricity and Magnetism (Theory) | 4-0-0 |
| | Electricity & Magnetism Lab (Practical) | 0-0-1 |
| | | |
| **SECOND SEMESTER** | | |
| **Course Code** | **Course Title** | **Credits L-T-P** |
| | **Major Core Course** | |
| | Mechanics, Vibrations & Waves (Theory) | 4-0-0 |
| | Mechanics Lab (Practical) | 0-0-1 |
| **THIRD SEMESTER** | | |
| **Course Code** | **Course Title** | **Credits L-T-P** |
| | **Major Core Course** | |
| | Statistical Physics & Thermodynamics (Theory) | 4-0-0 |
| | Optics Lab (Practical) | 0-0-1 |

| **FOURTH SEMESTER** | | |
|---|---|---|
| **Course Code** | **Course Title** | **Credits L-T-P** |
| | **Major Core Course** | |
| | Quantum Physics (Theory) | 4-0-0 |
| | Thermal & Modern Physics Lab (Practical) | 0-0-1 |

| **FIFTH SEMESTER** | | |
|---|---|---|
| **Course Code** | **Course Title** | **Credits L-T-P** |
| | **Major Core Course** | |
| | Solid State Physics & Electronics (Theory) | 4-0-0 |
| | Electronics Lab (Practical) | 0-0-1 |
| **Summer Internship** | | |
| | Summer Internship (02 Weeks) | 0-0-2 |
| **SIXTH SEMESTER** | | |
| **Course Code** | **Course Title** | **Credits L-T-P** |
| | **Major Core Course** | |
| | Nuclear Physics (Theory) | 4-0-0 |
| | Nuclear Physics & Materials Lab (Practical) | 0-0-1 |

| **SEVENTH SEMESTER** | | |
|---|---|---|
| **Course Code** | **Course Title** | **Credits L-T-P** |
| | **Major Core Course** | |
| | Analog & Digital Electronics (Theory) | 3-0-0 |
| | Mathematical Physics (Theory) | 3-0-0 |
| | Classical Mechanics (Theory) | 3-0-0 |
| | Computational Techniques(Theory) | 3-0-0 |
| | Electronics Lab (Practical) | 0-0-2 |
| | Computer Lab (Practical) | 0-0-2 |
| **Minor Course** | | |
| | Synthesis and Characterization of Materials (Theory) | 4-0-0 |

| **EIGHTH SEMESTER** | | |
|---|---|---|
| **Course Code** | **Course Title** | **Credits L-T-P** |
| | **Major Core Course** | |
| | Quantum Mechanics-I (Theory) | 3-0-0 |
| | Electrodynamics-I (Theory) | 3-0-0 |
| | Atomic and Molecular Spectroscopy (Theory) | 3-0-0 |
| | Condensed Matter Physics-I (Theory) | 3-0-0 |
| | Condensed Matter Physics Lab (Practical) | 0-0-2 |
| | Spectroscopy Lab (Practical) | 0-0-2 |

| **Minor Course** | | |
|---|---|---|
| | Fabrication of Electronic Devices (Theory) | 4-0-0 |

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**SEMESTER–I**
**PHYSICS**
**ELECTRICITY AND MAGNETISM**
**(THEORY)**

**Time: 3 Hrs.** **Marks: 100**
**Credit: 4**
**(4Hrs./week)**
**Course Hrs: 60**

**Note: There should be 20% numerical in each paper.**

**Instructions for the Paper Setters:-**

Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION–A**

Basic ideas of Vector Calculus Gradient, Divergence, curl and their physical significance. Laplacian in rectangular, cylindrical and spherical coordinates. Coulomb's Law for point charges and continuous distribution of charges. Electric field due to dipole, line charge and sheet of charge. Electric flux, Gauss's Law and its applications. Gauss's divergence theorem and differential form of Gauss's Law. Green's theorem.

**Lectures 15**

**SECTION–B**

Work and potential difference. Potential difference as line integral of field. Electric potential due to a point charge, a group of point charges, dipole and quadrupole moments, long uniformly charged wire, charged disc. Stokes' Theorem and its applications in Electrostatic field, curl E=0. Electric fields as gradient of scalar potential. Calculation of E due to a point charge and dipole from potential. Potential due to arbitrary charge distribution and multipole moments.

**Lectures 15**

**SECTION–C**

Poisson and Laplace's equation and their solutions in Cartesian and spherical coordinates. Concept of electrical images. Calculation of electric potential and field due to a point charge placed near an infinitely conducting sheet.Current and current density, equation of continuity. Microscopic form of Ohm's Law ($J=\sigma E$) and conductivity, Failure of Ohm's Law.

**Lectures 15**

**SECTION–D**

Interaction between moving charges and force between parallel currents. Behaviour of various substances in magnetic field. Definition of M and H and their relation to free and bound currents. Permeability and susceptibility and their interrelationship. Orbital motion of electrons and diamagnetism, Paramagnetism and Ferromagnetism, Maxwell's equations, boundary conditions, electromagnetic induction and applications. **Lectures 15**

**Books Suggested:**

**1.** Fundamentals of Electricity and Magnetism: Arthur F. Kipp.
**2.** Electricity and Magnetism, Berkeley Physics Course: Vol. II, E.M. Purcell.
**3.** Introduction to Classical Electrodynamics: David Griffith.
**4.** EM Waves and Radiating System: Edward C. Jordan and K.G. Balmain.
**5.** Fields and Waves Electromagnetic: David K. Cheng.

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**SEMESTER–I**

**PHYSICS**

## ELECTRICITY AND MAGNETISM LAB

## (PRACTICAL)

**Time: 2 Hrs.** **Credit: 1**
**(2 Hrs./week)**
**Marks: 25**

**General Guidelines for Practical Examination:**

I. The distribution of marks is as follows :

| | |
|---|---|
| i) One experiment | **10 Marks** |
| ii) Brief Theory | **5 Marks** |
| iii) Viva–Voce | **5 Marks** |
| iv) Record (Practical file) | **5 Marks** |

II. There will be one sessions of 2 hours duration. The paper will have one session. Paper will consist of 8 experiments, out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. The number of candidates in a group for practical examination should not exceed 12.

IV. In a single group, no experimentshould be allotted to more than three examinees.

1. To determine low resistance with Carey-Foster's Bridge.
2. To study the magnetic field produced by a current carrying solenoid using a search coil and calculate permeability of air.
3. To study the induced e.m.f. as a function of the velocity of the magnet.
4. Study of phase relationships using impedance triangler for LCR circuit and calculate impedance.
5. Resonance in a series LCR circuits for different R–value and calculate Q–value.
6. Resonance in a parallel LCR circuits for different R-value and calculate Q-value.
7. Capacitance by flashing and quenching of a neon lamp.
8. To compare capacitance of two capacitors by de–Sauty's bridge.
9. To determined L using Anderson Bridge.
10. To find the value of $B_H$,the horizontal component of earth's magnetic field in the lab using a deflection & vibration magnetometer.
11. To study the variation of the magnetic field with distance along the axis of a coil carrying current by plotting a graph.

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**SEMESTER–II**
**PHYSICS**
**MECHANICS, VIBRATIONS & WAVES**
**(THEORY)**

**Time: 3 Hrs.** **Marks: 100**
**Credit: 4**
**(4Hrs./week)**
**Course Hrs: 60**

**Note: There should be 20% numerical in each paper.**
**Instructions for the Paper Setters:-**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

## SECTION–A

Cartesian and spherical polar co–ordinate systems, area, volume, velocity and acceleration in these systems. Solid angle, relationship of conservation laws and symmetries of space and time.
Various forces in nature (Brief introduction)centre of mass, equivalent one-body problem, central forces, equation of motion under central force, equation of orbit and turning points. Kepler's Laws. Inertial frame of reference. Galilean transformation and invariance. Non-inertial frames, Coriolis force and its applications. Variation of acceleration due to gravity with latitude. Foucault pendulum, elastic collision in Lab and C.M. system, Rigid body motion; rotational motion, principal moments and axes, moments of Inertia, Euler's equations, precession and elementary gyroscope.

**Lectures 15**

## SECTION-B

Newtonian relativity and Galilean transformations, attempts to locate the absolute frame of reference; Fizeau's experiment; Michelson-Morley experiment & ether drag hypothesis; Lorentz-Fitzgerald contraction; Einstein's basic postulates of relativity and geometric derivation of Lorentz transformations; length contraction; relativity of simultaneity; synchronization and time dilation; Einstein's velocity addition rule; transformation of acceleration; Aberration (relativistic) of star light and relativistic Doppler effect; variation of mass with velocity; mass-energy equivalence; relativistic formulae for momentum and energy; transformation of momentum, energy and force.

**Lectures 15**

## SECTION-C

Simply harmonic motion, energy of an SHO. Compound pendulum. Torsional pendulum Electrical oscillations Transverse vibrations of a mass on string, superposition of two perpendicular SHMs having periods in the ratio 1:1 and 1:2, Decay of free Vibrations due to damping. Differential equation of damped harmonic motion, types of motion, types of damping. Determination of damping coefficient logarithmic decrement, relaxation time and Q–Factor.

**Lectures 15**

## SECTION-D

Differential equation for forced mechanical and electrical oscillators. Transient and steady state behaviour. Displacement and velocity variation with driving force frequency, variation of phase with frequency, resonance. Power supplied to an oscillator and its variation with frequency. Coupled oscillators, Normal co–ordinates and normal modes of vibration. Inductive coupling of electrical oscillators.Types of waves, wave equation (transverse) and its solution, characteristic impedance of a string. Impedance matching. Reflection and transmission of waves at boundary. Reflection and transmission of energy. Reflected and transmitted energy coefficients. Standing waves on a string of fixed length. Energy of vibrating string. Wave and group velocity.

**Lectures 15**

**Books Suggested:-**

1. 1. Mechanics, Berkeley Vol.–I, C. Kittle.
2. Mechanics, H.S. Hans &S.P. Puri
3. Introduction to Relativity, Robert Resnick
4. Fundamentals of Vibrations and Waves: S.P. Puri.
5. Physics of Vibrations and Waves: H.J. Pain

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**SEMESTER–II**

**PHYSICS**

# MECHANICS LAB

**(PRACTICAL)**

**Time: 2 Hrs.** **Marks: 25**
**Credit: 1**
**(2Hrs./week)**

**General Guidelines for Practical Examination:**

I. The distribution of marks is as follows:

| | | |
|---|---|---|
| i) | One experiment | **10Marks** |
| ii) | Brief Theory | **5 Marks** |
| iii) | Viva–Voce | **5Marks** |
| iv) | Record (Practical file) | **5Marks** |

II. There will be one sessions of 2 hours duration. The paper will have one session. Paper will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

1. To study the dependence of moment of inertia on distribution of mass (by noting time periods of oscillations using objects of various geometrical shapes but of same mass).
2. To establish relationship between torque and angular acceleration using flywheel.
3. To find the moment of inertia of a flywheel.
4. Study of bending of beams and determination of Young's modulus.
5. Determination of Poisson's ratio for rubber.
6. To determine energy transfer, coefficient of restitution and verify laws of conservation of linear momentum and kinetic energy in elastic collisions using one dimensional collisions of hanging spheres.
7. To verify the laws of vibrating string by Melde's experiment.
8. Measure time period as a function of distance of centre of suspension (oscillation) from centre of mass, plot relevant graphs, determine radius of gyration and acceleration due to gravity.
9. Find the value of 'g' by Kater's pendulum.
10. Measure time period of oscillation of a Maxwell needle and determine modulus of rigidity of the material of a given wire.
11. To measure logarithmic decrement, coefficient of damping, relaxation time, and quality factor of a damped simple pendulum.

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**SEMESTER–III**

**PHYSICS**

**STATISTICAL PHYSICS & THERMODYNAMICS**

**(THEORY)**

**Time : 3 Hrs.** **Marks: 100**
**Credit: 4**
**(4Hrs./week)**
**Course Hrs: 60**

**Note : There should be 20% numericals in each paper.**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

## SECTION-A

Basic ideas of Statistical physics, Scope of Statistical physics, basic ideas about probability, distribution of four distinguishable particles into compartments of equal size. Concept of macrostates, microstates, thermodynamic probability, effects of constraints on the system. Distribution of particles in two compartments. Deviation from the state of maximum probability. Equilibrium state of dynamic system. Distribution of distinguishable n particles in k compartments of unequal sizes.

**Lectures 15**

## SECTION-B

Phase space and division into elementary cells. Three kinds of statistics. The basic approach in three statistics. Maxwell Boltzmann (MB) statistics applied to an ideal gas in equilibrium. Experimental verification of law of distribution of molecular speeds. Need for Quantum Statistics – B.E. Statement of Planck's law of Radiation Wien's Displacement and Stefan's law. Fermi Dirac (FD) statistics. Comparison of M.B, B.E and F.D statistics.

**Lectures 15**

## SECTION-C

Statistical definition of entropy, change of entropy of system, additive nature of entropy, Law of increase of entropy, reversible and irreversible processes, and their examples, work done in reversible process, examples of increase in entropy in natural processes, entropy and disorder, brief review of terms, laws of thermodynamics, Carnot Cycle, Entropy changes in Carnot cycle, applications of thermodynamics to thermoelectric effect, change of entropy along reversible path in P-V diagram. Heat death of universe.

**Lectures 15**

## SECTION-D

Derivation of Maxwell thermodynamics relations, Cooling produced by adiabatic stretching, Adiabatic Compression, change of internal energy with volume, specific heat and constant pressure and constant volume. Joule-Thomson effect, Expression for $C_P$-$C_v$, Change of state and Claussis-Claypron equation

**Lectures 15**

**Books Suggested:-**

1. Statistical Mechanics: B.B. Laud, (Macmillan India Ltd.) 1981.
2. Statistical Physics: J. K. Bhattacharjee, (Allied Pub., Delhi) 2000.
3. Statistical Physics and Thermodynamics: V.S. Bhatia
4. A Treatise on Heat: M.N. Saha & B.N. Srivastava (The Indian Press Pvt. Ltd., Allahabad), 1965.
5. Heat and Thermodynamics, Mark Zemansky and Richard Dittman McGraw Hill and Co.
6. Thermal and Statistical Physics-Concepts and Applications : S. Sharma, (Ane Books Pvt. Ltd. 2021)

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**SEMESTER–III**

**PHYSICS**

**OPTICS LAB**

**(PRACTICAL)**

**Time : 2 Hrs.** **Marks: 25**
**Credit: 1**
**(2Hrs./week)**

**General Guidelines for Practical Examination:**

I. The distribution of marks is as follows :

| | | |
|---|---|---|
| i) | One experiment | **10Marks** |
| ii) | Brief Theory | **5 Marks** |
| iii) | Viva–Voce | **5Marks** |
| iv) | Record (Practical file) | **5 Marks** |

II. There will be one sessions of 2 hours duration. The paper will have one session. Paper will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

1. To determine refractive index of glass and liquid using spectrometer.
2. To determine the Cauchy's constants.
3. To study the refractive index of a doubly refracting prism.
4. To set up Newton's rings to determine wavelength of sodium light.
5. To determine the wavelength of light by using plane diffraction grating (Use Hg source)
6. To determine dispersive power of plane diffraction grating.
7. To determine resolving power of a telescope.
8. To determine resolving power of a grating.
9. To measure an accessible (Horizontal and vertical) height using sextant.
10. To measure inaccessible height by using sextant.

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**SEMESTER–IV**

**PHYSICS**

**QUANTUM PHYSICS**

**(THEORY)**

**Time : 3 Hrs.** **Marks: 100**
**Credit: 4**
**(4Hrs./week)**
**Course Hrs: 60**

**Note : There should be 20% numericals in each paper.**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

**Formalism of Wave Mechanics:**
Brief introduction to the need and development of quantum mechanics, photoelectric effect, Compton effect, wave-particle duality, De broglie hypothesis, Uncertainity principle, Gaussian wave packet. Operator correspondence. Normalization and probability interpretation of wave function. Superposition principle.

**Lectures 15**

**SECTION-B**

Expectation value, probability current and conservation of probability. Admissibility conditions or wave function. Ehrenfest theorem, eigenfunction and eigenvalue. Operator formalism, orthogonal system, expansion in eigen functions, Hermitian operator, simultaneous eigen function, equation of motion.

**Lectures 15**

**SECTION-C**

**Application of Schrodinger wave equation to one dimensional problems:** Fundamental postulates of wave mechanics, Schrodinger's wave equation for a free particle and equation of a particle subject to forces. One-dimensional step potential for $E>V_0$ , one-dimensional step potential for $0<E<V_0$, one dimensional potential barrier of finite height and width, Quantum mechanical tunnelling effect, particle in one dimensional box with infinitely hard walls, one dimensional square well of finite depth

**Lectures 15**

## SECTION-D

**Application of Schrodinger equation to three dimensional problems:** Free particle in three dimensional rectangular box, eigen wave function, eigenvalues of momentum, energy and degeneracy, three dimensional harmonic oscillator (Cartesian coordinates) wave function, energy levels,degeneracy,Schrodinger's wave equation in spherical polar coordinates, Schrsodinger wave equation for spherically symmetric potential for hydrogen atom, wave function of H atom, solution of $R(r), \Theta(\bar{}), \Phi(¤)$ equations.

**Lectures 15**

**Books Suggested:-**

1. A Text book of Quantum Mechanics: P.M. Mathews and K. Venkatesan, (Tata McGraw Hill Pub. Co, Delhi) 2002.
2. Quantum Mechanics: J.L. Powell and B. Craseman (Narosa Pub. House, New Delhi) 1997.
3. Elements of Modern Physics: S.H. Patil, (McGraw Hill), 1998.
4. Introduction to Quantum Mechanics, L. Pauling and E.B. Wilson (Tata McGraw Hill Pub.Co., Delhi), 2002.

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**SEMESTER–IV**

**PHYSICS**

**THERMAL & MODERN PHYSICS LAB**

**(PRACTICAL)**

**Time : 2 Hrs.** **Marks: 25**
**Credit: 1**
**(2Hrs./week)**

**General Guidelines for Practical Examination:**

I The distribution of marks is as follows:

| | |
|---|---|
| One experiment | **10Marks** |
| i) Brief Theory | **5 Marks** |
| ii) Viva–Voce | **5 Marks** |
| iii) Record (Practical file) | **5 Marks** |

II. There will be one sessions of 2 hours duration. The paper will have one session. Paper will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

1. To study adiabatic expansion of gas and hence to calculate value of Volume.
2. To find the coefficient of Thermal Conductivity of a bad conductor by Lee's method.
3. To plot a calibration curve of a given thermocouple (copper constantan) using a potentiometer.
4. To study the photoelectric effect and determine the value of Planck's constant.
5. To determine the ionization potential of mercury.
6. Study of variation of light intensity with distance using photovoltaic cell (Inverse Square Law)
7. To determine the heating efficiency of an electric kettle with varying voltage.
8. To study the absorption spectra of iodine vapours.
9. To study the rotation of plane of polarization by using polarimeter.
10. To determine the specific rotation of sugar using Laurent's half shade polarimeter
11. To study the characteristics of Photovoltaic cell.

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**SEMESTER–V**
**PHYSICS**
**SOLID STATE PHYSICS& ELECTRONICS**

**(THEORY)**

**Time : 3 Hrs.** **Marks: 100**
**Credit: 4**
**(4Hrs./week)**
**Course Hrs: 60**

**Note : There should be 20% numericals in each paper.**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION–A**

Crystal structure, symmetry operations for a two and three dimensional crystal, two-dimensional Bravais lattices, three dimensional Bravais lattices, basic primitive cells, crystal planes and miller indices, diamond and NaCl structure, Crystal Diffraction: Bragg's law, Experimental methods for crystal structure studies, Laue equations, reciprocal lattices of SC, BCC and FCC, Bragg's law in reciprocal lattice, Brillouin zones and their construction in two and three dimensions, structure factor and atomic form factor.

**Lectures 15**

**SECTION–B**

Lattice vibrations, concepts of phonons, scattering of photons by phonons, vibration and mono-atomic, linear chains, density of modes, Einstein and Debye models of specific heat. Free electron model of metals, Free electron, Fermi gas and Fermi energy, band Theory: Kronig-Penney model, metals and insulators, qualitative discussion of the following: conductivity and its variation with temperature in semiconductors, Fermi levels in intrinsic and extrinsic semiconductors, band gap in semiconductors.

**Lectures 15**

**SECTION-C**

Concepts of current and voltage sources, p-n junction, biasing of diode, V-I characteristics, rectification: half wave, full wave rectifiers and bridge rectifiers, efficiency, ripple factor, qualitative ideas of filter circuits (LC and π filters), Zener diode and voltage regulation, introduction to Photonic devices (solar cell, photodiode and LED). Basic concepts of Boolean algebra, AND OR NOT and NAND Gates.Junction transistor : structure and working relation between different currents in transistors, sign conventions, amplifying action, different configurations of a transistor and their comparison, CB and CE characteristics, structure and characteristics of JEFT, transistor biasing and stabilization of operating point.

**Lectures 15**

## SECTION-D

Working of CE amplifier, amplifier analysis using h-parameters, equivalent circuits, determination of current gain, power gain, input impedance, FET amplifier and its voltage gain, feedback in amplifiers, different types, voltage gain, advantage of negative feedback, emitter follower as negative feedback circuit. Barkausen criterion of sustained oscillations, LC oscillator (tuned collector, tuned base Hartley), RC oscillators, phase shift and Wein bridge.

**Lectures 15**

**Books Suggested:**

1. Introduction to Solid State Physics: C. Kittel (Wiley Eastern)
2. Elements of Modern Physics: S.H. Patil (Tata McGraw Hill, 1985.
3. Solid State Physics: R. K. Puri and V. K. Babbar, S. Chand and Co.
4. Basic Electronics and Linear Circuits by N.N. Bhargave, D.C. Kulshreshtha and S.C. Gupta.
5. Electronic Devices & Circuits: Millman & Halkias
6. Solid State Electronic Devices: Ben G. Streetman
7. Electronics, D. C. Dube
8. Physics of Semiconductor Devices: S.M. Sze and Kwok K. Ng.

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**SEMESTER–V**

**PHYSICS**

**ELECTRONICS LAB**

**(PRACTICAL)**

**Time : 2 Hrs.** **Marks: 25**
**Credit: 1**
**(2Hrs./week)**

**General Guidelines for Practical Examination:**

I. The distribution of marks is as follows :
   (i) One experiment **10 Marks**
   (ii) Brief Theory **5 Marks**
   (iii) Viva–Voce **5 Marks**
   (iv) Record (Practical file) **5 Marks**

II. There will be one sessions of 2 hours duration. The paper will have one session. Paper will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

1. Measurement of reverse saturation current in p-n-junction diode at various temperatures and to find the approximate value of energy gap.
2. To draw forward and reverse bias characteristics of a p-n junction diode.
3. Study of a diode as a clipping element.
4. To measure the efficiency and ripple factors for (a) halfwave (b) full wave and (c) bridge rectifier circuits.
5. To draw the characteristics of a Zener diode.
6. To study characteristics of Common Base transistor.
7. To study characteristics of Common Emitter transistor.
8. To study the gain of an amplifier at different frequencies and to find Band width
9. To study the reduction in the ripple in the rectified output with RC, LC and л filters.
10. To study logic gates (OR, AND, NOT and NAND).

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**SEMESTER–V**
**PHYSICS**

## Summer Internship (02 Weeks)

**Credit: 2**

- Students will undergo training / Internship for a period of 2 weeks in academic institutes/ industries.

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## SEMESTER–VI
## PHYSICS
## NUCLEAR PHYSICS
## (THEORY)

**Time : 3 Hrs.** **Marks: 100**

**Credit: 4**
**(4Hrs./week)**
**Course Hrs: 60**

**Instructions for the Paper Setters:-**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION-A

**Nuclear Properties:** Constituents of nucleus, non-existence of electrons in nucleus, nuclear mass and binding energy, features of binding energy versus mass number curve, nucleus radius, angular momentum and parity, nuclear moments: magnetic dipole moment and electric quadruple moment, properties of nuclear forces, Yukawa theory.

**Lectures 15**

### SECTION-B

**Radioactive Decays:** Modes of decay of radioactive nuclides and decay Laws, radioactive series and displacement law, radioactive dating, constituents of Cosmic rays, Alpha decay: Gamow's theory of alpha decay, barrier penetration as applied to alpha decay, Geiger Nuttal law, Beta decays: $\beta^-$, $\beta+$ and electron capture decays, Neutrino hypothesis and its detection, parity violation in $\beta$ decay, Gamma transitions: Excited levels, isomeric levels, Gamma transitions, internal conversion.

**Lectures 15**

### SECTION-C

**Nuclear Reactions:** Types of nuclear reactions, reactions cross section, conservation laws, Kinematics of nuclear reaction, examples of nuclear reactions, Q-value and its physical significance, compound nucleus, level width.

**Lectures 15**

### SECTION-D

**Nuclear Models:** Liquid drop model, semi-empirical mass formula, condition of stability, evidence for nuclear magic numbers, Shell Model, energy level scheme, angular momenta of nuclear ground states, parity and magnetic moment of nuclear ground states.

**Lectures 15**

**Books Suggested:-**

1. Basic Ideas and Concepts in Nuclear Physics: K. Hyde
2. Introduction to Nuclear Physics: H.A. Enge
3. Nuclear Physics: I. Kaplan (Addison Wesley)
4. Nuclei and Particles: E. Segre
5. Atomic Nucleus, R. D. Evans

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**SEMESTER–VI**

**PHYSICS**

**NUCLEAR PHYSICS & MATERIALS LAB**

**(PRACTICAL)**

**Time : 2 Hrs.** **Marks: 25**
**Credit: 1**
**(2Hrs./week)**

**General Guidelines for Practical Examination:**

I. The distribution of marks is as follows :
   i) One experiment **10Marks**
   ii) Brief Theory **5 Marks**
   iii) Viva–Voce **5 Marks**
   iv) Record (Practical file) **5Marks**

II. There will be one sessions of 2 hours duration. The paper will have one session. Paper will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

**List of Experiments**

1. To trace the B-H curves for different materials using CRO and find the magnetic parameters from these
2. To study the stabilization of output voltage of a power supply with Zener diode.
3. To draw output and mutual characteristics of an FET (Experiments) and determine its parameters.
4. To set up an oscillator and to study its output on CRO.
5. To draw the plateau of a GM counter and find its dead time.
6. To study the statistical fluctuations using GM counter.
7. To study the absorption of beta particles in aluminium using GM counter and determine the absorption coefficient of beta particles from it.
8. To study the characteristics of a thermistor and find its parameters.
9. To study the response of RC circuit to various input voltage (square, sine and triangular).

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**SEMESTER–VII**
**PHYSICS**
**ANALOG & DIGITAL ELECTRONICS**
**(THEORY)**

**Time : 3 Hrs.** **Marks: 75**
**Credit: 3**
**(3Hrs./week)**
**Course Hrs: 45**

**Instructions for the Paper Setters:**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

**Electronic Devices:** MOSFETs, construction and working of U.J.T. and SCR and their application in wave generation and power control, Multivibrators (astable, monostable and bistable)

**Lectures 15**

**SECTION-B**

**Electronic Circuits:** Differential amplifier, Operational amplifier (OP-AMP), OP-AMP as inverting and non-inverting, scalar, summer, integrator, differentiator. Schmitt trigger and logarithmic amplifier, Electronic analog computation circuits.

**Lectures 10**

**SECTION-C**

**Digital Principles:** Binary and Hexadecimal number system, Binary arithmetic, Logic gates, Boolean equation of logic circuits, Karnaugh map simplifications for digital circuit analysis, and design, Encoders & Decoders, Multiplexers and Demultiplexers, Parity generators and checkers, Adder-Subractor circuits.

**Lectures 10**

**SECTION-D**

**Sequential Circuits:** Flip Flops, Registers, Up/Down counters, D/A conversion using binary weighted resistor network, Ladder, D/A converter, A/D converter using counter, Successive approximation A/D converter.

**Lectures 10**

**Books Suggested:**

1. Electronic Devices and Circuits- Millman and Halkias-Tata McGraw Hill, 1983.
2. Digital Principles and Applications- A.P.Malvino and D.P.Leach-Tata Mc Graw Hill, New Delhi, 1986.
3. Digital Computer Electronics- A P Malvino-Tata McGraw Hill, New Delhi, 1986
4. Electronic Devices and Circuit Theory 10e- Robert L. Boylestad; Louis Nashelsky 2009.

**SEMESTER - VII**
**PHYSICS**
**MATHEMATICAL PHYSICS**
**(THEORY)**

**Time : 3 Hrs.** **Marks: 75**
**Credit: 3**
**(3Hrs./week)**
**Course Hrs: 45**

**Instructions for the Paper Setters:**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

**Fourier Transformation:** Fourier decomposition, Fourier series and convolution theorem. Fourier transformations and its applications to wave theory.
**Coordinate Systems:** Curvilinear coordinates, differential vector operators in curvilinear coordinates. Spherical and cylindrical coordinate systems. General coordinate transformation, **Tensors:** covariant, contravariant and mixed, Algebraic operations on tensors, Illustrative applications. **Lectures 10**

**SECTION-B**

**Differential Equations:** Second order differential equations. Frobenius method. Wronskian and a second solution, the Sturm Lioville problem. One dimensional Greens function.
**Special functions:** Gamma function. The exponential integral and related functions. Bessel functions of the first and second kind. Legendre polynomials, associated Legendre polynomials and spherical harmonics. Generating functions for Bessel, Legendre and associated Legendre polynomials. **Lectures 15**

**SECTION-C**

**Complex Analysis:** The Cauchy-Reimann conditions, Cauchy integral theorem, Cauchy integral formula. Taylor, and Lorent series, singularities and residues. Cauchy residue theorem. Calculation of real integrals.

**Lectures 10**

**SECTION-D**

**Group Theory:** Definition of a group, multiplication table, conjugate elements and classes of groups, direct product. Isomorphism, homomorphism, permutation group. Definitons of the three dimensional rotation group and SU(2).

**Lectures 10**

**Suggested Books:**

1. Mathematical Methods for Physicists: George Arfken-New York Academic Press, 1970.
2. Advanced Mathematical Methods for Engg. and Science Students: George Stephenson and P.M. Radmore-Cambridge University Press, 1990.
3. Applied Mathematics for Engineers & Physicists: L. A. Pipes and L. R. Harvil
4. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons

## SEMESTER VII
## PHYSICS
## CLASSICAL MECHANICS
## (THEORY)

**Time : 3 Hrs.** **Marks: 75**

**Credit: 3**
**(3Hrs./week)**
**Course Hrs: 45**

**Instructions for the Paper Setters:**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION-A

**Lagrangian Mechanics**: Newton's laws of motion, mechanics of a system of particles, constraints, D'Alembert's principle and Lagrange equations of motion. Velocity-dependent potentials and dissipation function. Some applications of Lagrangian formulation, Hamiltons principle, derivation of Lagrange equations from Hamilton's principle. Conservation theorems and symmetry properties.

**Lectures 15**

### SECTION-B

**Central Force Problem:** Two body central force problem, reduction to equivalent one-body problem, equation of motion and first integrals, the equivalent one dimensional problem, and classification of orbits. The differential equation for the orbit and integrable power-law potential. The Kepler problem. Scattering in a central force.

**Lectures 10**

### SECTION-C

**Rigid Body Dynamics:** The independent coordinates of a rigid body, orthogonal transformation, the Euler's angles. Eulers 's theorem on the motion of rigid body, finite and infinitesimal rotations, rate of change of a vector, angular momentum and kinetic energy about a point for a rigid body, the inertia tensor and moment of inertia, the eigen values of the inertia tensor and the principal axis transformation. Euler's equations of motion, torque free motion of a rigid body.

**Lectures 10**

### SECTION-D

**Canonical Transformations**: Legendre transformation and Hamilton equations of motion, cyclic coordinates and conservation theorems, derivation of Hamiltons equations from a variational principle, the principle of least action. The equations of canonical transformation, examples of canonical transformations, Poisson brackets, equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation

**Lectures 10**

**Suggested Books:**

1. Classical Mechanics: Herbert Goldstein-Narosa Pub. House, New Delhi, 1970.
2. Mechanics : L.D. Landau-Pergamon Press, Oxford, 1982.
3. Classical Mechanics Rana and Joag-Tata McGraw Hill, New Delhi, 1995.

**SEMESTER–VII**
**PHYSICS**
**COMPUTATIONAL TECHNIQUES**
**(THEORY)**

**Time : 3 Hrs.** **Marks: 75**
**Credit: 3**
**(3Hrs./week)**
**Course Hrs: 45**

**Instructions for the Paper Setters:**
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

**Introduction of MATLAB**
Introduction: Basics of MATLAB, working with arrays, creating and printing plots, Interacting Computations: Matrices and Vectors, Matrices and Array Operations, built in functions, saving and loading data, plotting simple graphs Programming in MATLAB: Script files, function files, Compiled files, p-code, variables, loops, branches, and control flow, Input/Output, Advanced data objects, structures, cells.

**Lectures 15**

**SECTION-B**

**Interpolation**
Interpolation, Newton's formula for forward and backward interpolation, Divided differences, Symmetry of divided differences, Newton's general interpolation formula, Lagranges interpolation formula.

**Lectures 10**

**SECTION-C**

**Numerical Differentiation and integration**
Numerical integration, A general quadrature formula for equidistant ordinates, Simpson, Weddle and Trapezoidal rules, Monte- Carlo Method, Euler's method, Modified Euler's method, Runge-Kutta Method. **Lectures 10**

**SECTION-D**

**Roots of Equation**
Approximate values of roots, Bisection Method, Regula-Falsi Method, Newton-Raphson method, Bairstow method. Simultaneous Linear Algebraic Equations: Solution of Simultaneous Linear equations, Gauss elimination method, Gauss-Jordon method, Matrix inversion.

**Lectures 10**

**Suggested Books:**
1. Getting started with MATLAB- Rudra Pratap-Oxford University Press-2005.
2. A concise introduction to MATLAB- William J Palm III- McGraw Hill-2008.
3. James Scarborough- Numerical Mathematical Analysis (Oxford and IBH), 1966.
4. S.D.Conte- Elementary Numerical Analysis (McGraw Hill), 1965.
5. John. H. Mathews, Numerical Methods for Mathematics, Science and Engineering (Prentice Hall of India).

## SEMESTER–VII
## PHYSICS
## ELECTRONICS LAB
## (PRACTICAL)

**Time : 2 Hrs.** **Max. Marks: 50**
**Credits: 2**
**(4Hrs./week)**

1. To Study the D C characteristics and applications of DIAC.
2. To study the D C characteristics and applications of SCR.
3. To study the D C characteristics and applications of TRIAC.
4. Investigation of the D C characteristics and applications of UJT.
5. Investigation of the D C characteristics of MOSFET.
6. Study of bi-stable, mono-stable and astable, multivibrators.
7. Study of Op-Amps and their applications such as an amplifier (inverting, non-inverting), scalar, summer, differentiator and integrator.
8. Study of logic gates using discrete elements and universal gates.
9. Study of encoder, decoder circuit.
10. Study of arithmetic logic unit (ALU) circuit.
11. Study of shift registers.
12. Study of half and full adder circuits.
13. Study of A/D and D/A circuits.

**SEMESTER–VII**

**PHYSICS**

**COMPUTER LAB**

**PRACTICAL**

**Time : 2 Hrs.** **Max. Marks: 50**
**Credits: 2**
**(4Hrs./week)**

**Perform the following problems using any of one softwares : Fortran/Matlab/Python**

**1. Determination of Roots**

a) Bisection Method

b) NewtonRaphson Method

c) Secant Method

**2. Integration**

a) Trapezoidal rule

b) Simpson 1/3 and Simpson 3/8 rules

c) Gaussian Quadrature

**3. Differential Equations**

a) Euler's Method

b) RungeKutta Method

**4. Interpolation**

a) Forward interpolation, Backward interpolation.

b) Lagrange's interpolation.

**5. Applications**

a) Chaotic Dynamics, logistic map

b) One dimensional Schrondinger Equation

c) Time period calculation for a potential

**d)** Luminous intensity of a perfectly black body vs. temperature

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## SEMESTER-VII
## PHYSICS
## (MINOR COURSE)
## SYNTHESIS AND CHARACTERIZATION OF MATERIALS
## (THEORY)

**Time: 3hrs** **M. Marks: 100**
**Credit: 4**
**(4hrs/week)**
**Course Hrs: 60**

**Instructions for the Paper Setters:** Eight questions of equal marks are tobe set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceedingfour). Candidates are required to attempt five questions, selecting at least one question from eachSection. The fifth question may be attempted from any Section.

### SECTION-A

Single crystal growth: Czochlralski, Bridgmann and float zone methods, Preparation of bulk polycrystalline materials by solid state reaction, sintering, calcination and annealing. Glass synthesisby melt-quenching, Preparation of nanomaterials by Inert gas condensation, Ball Milling, Thin film deposition by evaporation, sputtering, Molecular beam epitaxy, Chemical vapour deposition method, Electro deposition. **Lectures 15**

### SECTION-B

Metal nanocrystals by reduction, Solvothermal synthesis, Nanocrystals of semiconductors and othermaterials by arrested precipitation, Thermolysis routes, Sonochemical routes, Liquid-liquid interface,Hybrid methods, Solvated metal atom dispersion, Post-synthetic size-selective processing. Sol-gel,Micelles and microemulsions, Cluster compounds. **Lectures 15**

### SECTION-C

X-ray and neutron diffraction, Atomic Force Microscopy, Scanning Electron Microscopy,Transmission Electron Microcopy,Scanning Tunneling Microscope, Optical transmission and
metallurgical microscope; their description, operational principle and application for analysis of materials, UV-VIS-IR Spectrophotometers, Principle of operation and application for band gap measurements, Raman spectroscopy, Magnetic measurements, electrical conductivity measurementby two probe, four probe and Van-der-Pauw methods.

**Lectures 15**

### SECTION-D

AFM based nanolithography and nanomanipulation, electron beam lithography and SEM based nanolithography and nanomanipulation, Ion beam lithography, oxidation and metallization. Mask andits application. Deep UV lithography, X-ray based lithography. Fabrication of nanostructures.

**Lectures 15**

**Suggested Books:**

1. Thin film phenomena, K.L. Chopra-McGraw-HillInc. 1969.
2. Vacuum Technology, A. Roth-Elsevier Science, 2012.
3. Material Science of Thin Films, Milton Ohring, Academic Press, 2001.
4. Thin Films fundamentals: A. Goswami-New age International, 2007.
5. Introduction to Nanotechnology: Charles P. Poole Jr. and Franks J. Qwens –John and Wiley & Sons, 2003.
6. Solid State Physics: J.P. Srivastava-Prentice Hall, 2007.
7. Nanotubes and Nanowires: CNR Rao and A Govindaraj –Royal Society of Chemistry, 2005.
8. The Science and Engineering of Microelectronics Fabrication - SA Campbell-Oxford University Press–1996
9. VLSI Technology - SM Size - - McGraw Hill International Editions –1988

Bachelor of Arts /Bachelor of Science/Honours Physics (CBGS)
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*(Faculty of Sciences)*

**SEMESTER - VIII**
**PHYSICS**
**QUANTUM MECHANICS - I**
**(THEORY)**

**Time: 3 Hrs.** **Max. Marks: 75**
**Credits: 3**
**(3Hrs./week)**
**Course Hrs: 45**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

**Basic Formulation and quantum Kinematics:** Stern Gerlach experiment as a tool to introduce quantum ideas.Analogy of two level quantum system with polarisation states of light. Complex linear vector spaces, ket space, bra space and inner product, operators and properties of operators. Eigenkets of an observable, eigenkets as base kets, matrix representations. Measurement of observable, compatible vs. incompatible observable, commutators and uncertainty relations. Change of basis and unitary transformations. Diagonalisation of operators. Position, momentum and translation, momentum as a generator of translations, canonical commutation relations.

**Lectures 15**

**SECTION-B**

**Quantum Dynamics:**Wave functions as position representation of ket vectors. Momentum operator in position representation, momentum space wave function.Time evolution operator and Schrodinger equation, special role of the Hamiltonian operator, energy eigenkets, time dependence of expectation values, spin precession. Schrodinger vs. Heisenberg picture, unitary operators, state kets and observable in Schrodinger and Heisenberg pictures, Heisenberg equations of motion, Ehrenfest's theorem. **Lectures 15**

**SECTION-C**

**One Dimensional Systems:**Potential Step, potential barrier, potential well. Scattering vs. Bounds states. Simple harmonic oscillator, energy eigen states, wave functions and coherent states. **Lectures 15**

**SECTION-D**

**Spherical Symmetric Systems and Angular momentum:** Schrodinger equation for a spherically symmetric potential. Orbital angular momentum commutation relations. Eigenvalue problem for $L^2$, spherical harmonics. Three dimensional harmonic oscillator, three dimensional potential well and the hydrogen atom. Angular momentum algebra, commutation relations. Introduction to the concept of representation of the commutation relations in different dimensions. Eigen vectors and eigen functions of $J^2$ and $J_z$. Addition of angular momentum and Clebsch Gordan (C.G.) coefficients.

**Lectures 15**

**Suggested Books:**

1. Modern Quantum Mechnics: J.J. Sakurai-Pearson Educaton Pvt. Ltd., New Delhi, 2002.
2. Quantum Mechanics :L I Schiff-Tokyo McGraw Hill, 1968.
3. Feynmann lectures in Physics Vol. III-Addison Wesly, 1975.
4. Quantum Mechanics :Powel and Craseman-Narosa Pub. New Delhi, 1961.
5. Quantum Mechanics : E. Merzbacher-John Wiley & Sons, New York, 1970.
6. Quantum Mechanics and Applications, A. K. Ghatak and S. Lokanathan, McMillan India

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*(Faculty of Sciences)*

**SEMESTER- VIII**
**PHYSICS**
**ELECTRODYNAMICS-I**
**(THEORY)**

**Time: 3 Hrs.** **Max. Marks: 75**
**Credits: 3**
**(3Hrs./week)**
**Course Hrs: 45**

**Instructions for the Paper Setters:**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

**Electrostatics:** Coulomb's law, Guass's law, Poisson's equation, Laplace equation. Solution of boundary value problem: Green's function, method of images and calculation of Green's function for the image charge problem in the case of a sphere, Laplace equation, uniqueness theorem. Electrostatics of dielectric media, multipole expansion. Boundary value problems in dielectrics; molecular polarisability, electrostatic energy in dielectric media.

**Lectures 15**

**SECTION-B**

**Magnetostatics:** Biot and Savart's law. The differential equation of Magnetostatics and Ampere's law, vector potential and magnetic fields of a localised current distribution. Magnetic moment, force and torque on a magnetic dipole in an external field. Magnetic materials, Magnetisation and microscopic equations.

**Lectures 10**

**SECTION-C**

**Time-varying fields:** Time varying fields, Maxwell's equations, conservation laws: Faraday's law of induction, Energy in a magnetic field. Maxwell's displacement current, vector and scalar potential, Gauge transformations; Lorentz gauge and Coulomb gauge. Poynting theorem, conservation laws for a system of charged particles and electromagnetic field, continuity equation.

**Lectures 10**

**SECTION-D**

**Electromagnetic Waves:**Plane wave like solutions of the Maxwell equations. Polarisation, linear and circular polarisation. Superposition of waves in one dimension. Group velocity. Illustration of propagation of a pulse in dispersive medium. Reflection and refraction of electromagnetic waves at a plane surface between dielectrics. Polarisation by reflection and total internal reflection. Waves in conductive medium, Simple model for conductivity.

**Lectures 10**

**Books Suggested:**

1. Classical Electrodynamics - J.D. Jackson-John & Wiley Sons Pvt. Ltd. New York, 2004.
2. Introduction to Electrodynamics - D.J. Griffiths-Pearson Education Ltd., New Delhi, 1991.
3. Classical Electromagnetic Radiation - J.B. Marion-Academic Press, New Delhi, 1995.

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## SEMESTER - VIII
## PHYSICS
## ATOMIC AND MOLECULAR SPECTROSCOPY
## (THEORY)

**Time: 3 Hrs.** **Max. Marks: 75**
**Credits: 3**
**(3Hrs./week)**
**Course Hrs: 45**

**Instructions for the Paper Setters:**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

### SECTION-A

**Spectra of one and two valance electron systems:** Magnetic dipole moments; Larmor's theorem; Space quantization of orbital, spin and total angular momenta; Vector model for one and two valance electron atoms; Spin-orbit interaction and fine structure of hydrogen, Lamb shift, Spectroscopic terminology; Spectroscopic notations for L-S and J-J couplings; Spectra of alkali and alkaline earth metals; Interaction energy in L-S and J-J coupling for two electron systems; Selection and Intensity rules for doublets and triplets

**Lectures15**

### SECTION-B

**Breadth of spectral line and effects of external fields:** The Doppler effect; Natural breadth from classical theory; natural breadth and quantum mechanics; External effects like collision damping, asymmetry and pressure shift and stark broadening; The Zeeman Effect for two electron systems; Intensity rules for the Zeeman effect; The calculations of Zeeman patterns; Paschen-Back effect; LS coupling and Paschen –Back effect; Lande's factor in LS coupling; Stark effect

**Lectures10**

### SECTION-C

**Microwave and Infra-Red Spectroscopy:** Types of molecules, Rotational spectra of diatomic molecules as a rigid and non-rigid rotator, Intensity of rotational lines, Effect of isotopic substitution, Microwave spectrum of polyatomic molecules, The vibrating diatomic molecule as a simple harmonic and anharmonic oscillator, Diatomic vibrating rotator, The vibration-rotation spectrum of carbon monoxide, The interaction of rotation and vibrations, Outline of technique and instrumentation, Fourier transform spectroscopy.

**Lectures10**

## SECTION-D

**Raman and Electronic Spectroscopy:**Quantum and classical theories of Raman Effect, Pure rotational Raman spectra for linear and polyatomic molecules, Vibrational Raman spectra, Structure determination from Raman and infra-red spectroscopy, Electronic structure of diatomic molecule, Electronic spectra of diatomic molecules, Born Oppenheimer approximation- The Franck-Condon principle, Dissociation and pre-dissociation energy, The Fortrat diagram, example of spectrum of molecular hydrogen. **Lectures 10**

**Books Suggested:**

1. Introduction to Atomic Spectra: H.E. White, McGraw Hill
2. Fundamentals of Molecular spectroscopy: C.B. Banwell-Tata McGraw Hill, 1986.
3. Spectroscopy Vol. I, II & III: Walker & Straughen
4. Introduction to Molecular Spectroscopy: G.M. Barrow-Tokyo McGraw Hill, 1962.
5. Spectra of Diatomic Molecules: G. Herzberg-New York, 1944.
6. Molecular Spectroscopy: Jeanne L McHale, Prentice Hall, 1999.
7. Molecular Spectroscopy: J.M. Brown, Oxford University Press, 1998.
8. Spectra of Atoms and Molecules: P.F. Bermath-New York, Oxford University Press, 1995.
9. Modern Spectroscopy: J.M. Holias

**SEMESTER - VIII**
**PHYSICS**
**CONDENSED MATTER PHYSICS-I**
**(THEORY)**

**Time: 3 Hrs.** **Max. Marks: 75**
**Credits: 3**
**(3Hrs./week)**
**Course Hrs: 45**

**Instructions for the Paper Setters:**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

**Lattice Specific Heat and Elastic Constants:**
Different theories of lattice specific heat of solids, Einstein model of the lattice Specific heat, Density of modes of vibration, Debye model of Lattice specific heat, Born cut-off procedure, Specific heat of metals. Elastic strain and stress components, Elastic compliance and stiffness constants, Elastic constants of cubic crystals, Elastic waves in cubic crystals.

**Lectures 15**

**SECTION-B**

**Defects and Diffusion in Solids:**
Point defects: Impurities, Vacancies-Schottky and Frankel vacancies, Diffusion, Fick's law, Self diffusion in metals, Color centers and coloration of crystals, F-centres, V-centres, Line defects, Edge and screw dislocations, Burgers vectors, Stress field of dislocations, Grain boundaries, Low angle grain boundaries, dislocation densities, Dislocation multiplication and slips, dislocation and crystal growth.

**Lectures 10**

**SECTION-C**

**Conductivity of metals and ionic crystals:**
Electrical conductivity of metals, Drift velocity and relaxation time, The Boltzmann transport equation, The Sommer field theory of conductivity, Mean free path in metals, Qualitative discussion of the features of the resistivity, Mathiessen's rule. Thermal conductivity of metals, Wiedemann-Franz law. Hydration energy of ions, Activation energy for formation of defects in ionic crystals, Ionic conductivity in pure alkali halides. **Lectures 10**

## SECTION-D

**Dielectrics and Ferro Electrics:**

Macroscopic field, The local field, Lorentz field, The Clausius-Mossotti relations, Different contribution to polarization: dipolar, electronic and ionic polarizabilities, Ferroelectric crystals: Classifications and their general properties, Structure and properties of $BaTiO_3$, The dipole theory of ferroelectricity, objection against dipole theory, Thermodynamics of ferroelectric transitions.

**Lectures 10**

**Books Suggested:**

1. SolidState Physics: A.J. Dekker-Prentice Hall, 1965.
2. An Introduction to SolidState Physics: C. Kittle-Wiley, 1997
3. Elementary Solid State Physics-Omar, Addison Welly, 1975.
4. Principles of Solid State Physics: R.A. Levey-Academic Press, 1968
5. Introduction of Solid State Physics: N. Ashroft and D. Mermin

**SEMESTER - VIII**
**PHYSICS**
**CONDENSED MATTER PHYSICS LAB**
**(PRACTICAL)**

**Time: 2 Hrs.** **Max. Marks: 50**
**Credits:2**
**(4Hrs./week)**

1. To determine Hall coefficient by Hall Effect.
2. To determine the band gap of a semiconductor using p-n junction diode..
3. To determine the magnetic susceptibility of a material using Quink's method.
4. To determine the g-factor using ESR spectrometer.
5. To determine the energy gap and resistivity of the semiconductor using four probe method.
6. To trace hysteresis loop and calculate retentivity, coercivity and saturation magnetization.
7. To determine dielectric constant.
8. To study the series and parallel characteristics of a photovoltaic cell.
9. To study the spectral characteristics of a photovoltaic cell.

**SEMESTER - VIII**

**PHYSICS**

**SPECTROSCOPY LAB**

**(PRACTICAL)**

**Time: 2 Hrs.** **Max. Marks: 50**
**Credits:2**
**(4Hrs./week)**

1. To find the wavelength of monochromatic light using Febry Perot interferometer.
2. To find the wavelength of sodium light using Michelson interferometer.
3. To calibrate the constant deviation spectrometer with white light and to find the wavelength of unknown monochromatic light.
4. To find the grating element of the given grating using He-Ne laser light.
5. To find the wavelength of He-Ne laser using Vernier calipers.
6. To verify the existance of Bohr's energy levels with Frank-Hertz experiment.
7. To determine the charge to mass ratio (e/m) of an electron with normal Zeeman Effect
8. To determine the velocity of ultrasonic waves in a liquid using ultrasonic interferometer

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**SEMESTER-VIII**
**PHYSICS**
**(MINOR COURSE)**
**FABRICATION OF ELECTRONIC DEVICES**

**(THEORY)**

**Time: 3 Hrs.** **M. Marks: 100**
**Credit: 4**
**Course Hrs:60**

**Instructions for the Paper Setters:**Eight questions of equal marks areto be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (notexceeding four). Candidates are required to attempt five questions, selecting at least one questionfrom each Section. The fifth question may be attempted from any Section.

**SECTION-A**

Crystal growth: Czochralski and Bridgman techniques, Float Zone growth, Distributioncoefficients, Zone refining, Wafer preparation and specifications. Epitaxy: Importance of lattice matching in epitaxy, CVD of Si, Thermodynamics of vapour phase growth, defects in epitaxialgrowth, MBE technology.

**Lectures 15**

**SECTION-B**

Diffusion: Fick's diffusion equation in one dimension, Atomistic models of diffusion, analytic solution of Fick' s law for different cases. Diffusivities of common dopants in Si and SiO2. Diffusion enhancements and retardation, Thermal Oxidation: Deal-Grove model of oxidation. Effects of dopants during oxidation, oxidation induced defects, Ion Implantation: channeling and projected range of ions, implantation damage, Rapid Thermal Annealing(RTA).

**Lectures 15**

**SECTION-C**

Metallization applications: Gates and interconnections, Metallization choices, metals, alloys andsilicides, deposition techniques, metallization problems, step coverage, electromigration, Etching: Dry and wet chemical etching, Reactive Plasma Etching, Ion enhanced etching and ion induced etching.

**Lectures 15**

**SECTION-D**

Optical lithography: photoresists, Contact and proximity printers, projection printers, Maskalignment, X-ray and electron beam lithography, Fundamental considerations for IC processing:Building individual layers, Junction and Trench isolation of devices.

**Lectures 15**

**Books Suggested:**

1. The Science and Engineering of Microelectronics Fabrication - SA Campbell - Oxford University Press–1996
2. VLSI Technology - SM Sze - - McGraw Hill International Editions –1988

# FACULTY OF LANGUAGES

SYLLABUS FOR THE

# SUBJECT: PUNJABI COMPULSORY

for the award of the Degree in

**BACHELOR OF ARTS/ BACHELOR OF SCIENCE**

(Offered under 3-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

**Batch: 2024–27**

## GURU NANAK DEV UNIVERSITY AMRITSAR

Bachelor of Arts /Bachelor of Science (Punjabi Compulsory) (CBGS)
(under NEP 2020) *(Batch 2024-27) (Semester I-VI)*
*(Faculty of Languages)*

# Compulsory Subject Punjabi

## First Semester

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | Compulsory Subject Punjabi | |
| 1. | | Punjabi (Compulsory)-1 | 4-0-0 |

## Second Semester

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | Compulsory Subject Punjabi | |
| 1. | - | Punjabi (Compulsory)-2 | 4-0-0 |

## Third Semester

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | Compulsory Subject Punjabi | |
| 1. | - | Punjabi (Compulsory)-3 | 4-0-0 |

## Fourth Semester

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | Compulsory Subject Punjabi | |
| 1. | - | Punjabi (Compulsory)-4 | 4-0-0 |

## Fifth Semester

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | Compulsory Subject Punjabi | |
| 1. | - | Punjabi (Compulsory)-5 | 4-0-0 |

## Sixth Semester

| Sr. No. | Course Code | Course Title | Credits |
|---|---|---|---|
| | | Compulsory Subject Punjabi | |
| 1. | - | Punjabi (Compulsory)-6 | 4-0-0 |

Bachelor of Arts /Bachelor of Science (Punjabi Compulsory) (CBGS)
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*(Faculty of Languages)*

**SEMESTER–I**
**Punjabi (Compulsory)-1**
**ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)–1**

**ਕਰੈਡਿਟ 4–0–0**

**Time: 03 Hours** **Max. Marks: 100**
**(6 ਪੀਰੀਅਡ ਪ੍ਰਤੀ ਹਫ਼ਤਾ)**

**ਅੰਕ–ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ**

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਅੰਕ ਬਰਾਬਰ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ–ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

**ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ–ਪੁਸਤਕਾਂ**

**ਸੈਕਸ਼ਨ - ਏ**

**ਦੋ ਰੰਗ** (ਕਵਿਤਾ ਭਾਗ) (ਸੰਪਾ. ਹਰਜਿੰਦਰ ਸਿੰਘ ਢਿੱਲੋਂ ਅਤੇ ਪ੍ਰੀਤਮ ਸਿੰਘ ਸਰਗੋਧੀਆ), ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
**(ਲੇਖਕ ਦਾ ਜੀਵਨ ਤੇ ਰਚਨਾ /ਪ੍ਰਸੰਗ ਸਹਿਤ ਵਿਆਖਿਆ/ਕਵਿਤਾ ਦਾ ਵਿਸ਼ਾ-ਵਸਤੂ)**

**ਸੈਕਸ਼ਨ - ਬੀ**

**ਪੰਜਾਬ ਦੇ ਮਹਾਨ ਕਲਾਕਾਰ**
(ਸੰਪਾ. ਬਲਵੰਤ ਗਾਰਗੀ), ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
**(ਅੰਮ੍ਰਿਤਾ ਸ਼ੇਰਗਿਲ ਤੋਂ ਭਾਈ ਸਮੁੰਦਰ ਸਿੰਘ ਤਕ)**
**(ਵਿਸ਼ਾ–ਵਸਤੂ/ਸਾਰ/ਨਾਇਕ ਬਿੰਬ)**

**ਸੈਕਸ਼ਨ - ਸੀ**

(ੳ) ਪੈਰ੍ਹਾ ਰਚਨਾ
(ਅ) ਪੈਰ੍ਹਾ ਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ।

**ਸੈਕਸ਼ਨ - ਡੀ**

(ੳ) **ਭਾਸ਼ਾ ਵੰਨਗੀਆਂ** : ਭਾਸ਼ਾ ਦਾ ਟਕਸਾਲੀ ਰੂਪ, ਭਾਸ਼ਾ ਅਤੇ ਉਪ–ਭਾਸ਼ਾ ਵਿਚ ਅੰਤਰ, ਪੰਜਾਬੀ ਉਪਭਾਸ਼ਾਵਾਂ ਦੇ ਪਛਾਣ–ਚਿੰਨ੍ਹ।
(ਅ) **ਪੰਜਾਬੀ ਭਾਸ਼ਾ : ਨਿਕਾਸ ਤੇ ਵਿਕਾਸ**

**ਸਹਾਇਕ ਪੁਸਤਕਾਂ:–**

1. ਬ੍ਰਹਮਜਗਦੀਸ਼ ਸਿੰਘ, **ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਾਵਿ: ਪ੍ਰਮੁੱਖ ਪ੍ਰਵਿਰਤੀਆਂ**, ਵਾਰਿਸ ਸ਼ਾਹ ਫਾਉਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
2. ਰਾਜਿੰਦਰਪਾਲ ਬਰਾੜ, **ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ ਦਾ ਇਤਿਹਾਸ**, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
3. ਜਸਵਿੰਦਰ ਸਿੰਘ, **ਨਵੀਂ ਪੰਜਾਬੀ ਕਵਿਤਾ: ਪਛਾਣ ਚਿੰਨ੍ਹ**, ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।
4. ਧਰਮਪਾਲ ਸਿੰਗਲ, **ਪੰਜਾਬੀ ਜੀਵਨੀ: ਸਰੂਪ ਸਿਧਾਂਤ ਤੇ ਵਿਕਾਸ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
5. ਜੀਤ ਸਿੰਘ ਸੀਤਲ, **ਵਾਰਤਕ ਤੇ ਵਾਰਤਕ ਸ਼ੈਲੀ**, ਪੰਜਾਬ ਸਟੇਟ ਯੂਨੀਵਰਸਿਟੀ ਟੈਕਸਟ ਬੁੱਕ ਬੋਰਡ, ਚੰਡੀਗੜ੍ਹ।
6. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ, **ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਸਰੋਤ ਤੇ ਸਰੂਪ**, ਵਾਰਿਸ ਸ਼ਾਹ ਫਾਉਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
7. ਸੁਖਵਿੰਦਰ ਸਿੰਘ ਸੰਘਾ, **ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ**, ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ, ਜਲੰਧਰ।
8. ਹਰਕੀਰਤ ਸਿੰਘ ਤੇ ਗਿਆਨ ਲਾਲ ਸਿੰਘ, **ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ**, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ, ਚੰਡੀਗੜ੍ਹ।
9. **ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਬੋਧ**, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਅੰਮ੍ਰਿਤਸਰ।
10. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ (ਸੰਪਾ.), **ਵੀਹਵੀਂ ਸਦੀ ਦੀ ਪੰਜਾਬੀ ਵਾਰਤਕ**, ਸਾਹਿਤ ਅਕਾਦਮੀ, ਨਵੀਂ ਦਿੱਲੀ।
11. ਮੋਹਨ ਭੰਡਾਰੀ (ਸੰਪਾ.), **ਕਥਾ ਗਾਰਗੀ ਦੀ**, ਲੋਕਗੀਤ ਪ੍ਰਕਾਸ਼ਨ, ਚੰਡੀਗੜ੍ਹ।

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**SEMESTER–II**
**Punjabi (Compulsory)-2**
**ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)–2**

**ਕਰੈਡਿਟ 4-0-0**

**Time: 03 Hours** **Max. Marks: 100**
**(6 ਪੀਰੀਅਡ ਪ੍ਰਤੀ ਹਫ਼ਤਾ)**

**ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ**

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਅੰਕ ਬਰਾਬਰ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

**ਪਾਠ-ਕ੍ਰਮ ਅਤੇ ਪਾਠ-ਪੁਸਤਕਾਂ**

## ਸੈਕਸ਼ਨ - ਏ

**ਦੋ ਰੰਗ** (ਕਹਾਣੀ ਭਾਗ) (ਸੰਪਾ. ਹਰਜਿੰਦਰ ਸਿੰਘ ਢਿੱਲੋਂ ਅਤੇ ਪ੍ਰੀਤਮ ਸਿੰਘ ਸਰਗੋਧੀਆ), ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
(ਵਿਸ਼ਾ-ਵਸਤੂ/ਸਾਰ/ਲੇਖਕ ਦਾ ਜੀਵਨ ਤੇ ਰਚਨਾ)

## ਸੈਕਸ਼ਨ - ਬੀ

**ਪੰਜਾਬ ਦੇ ਮਹਾਨ ਕਲਾਕਾਰ**
(ਸੰਪਾ. ਬਲਵੰਤ ਗਾਰਗੀ), ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
**(ਸਤੀਸ਼ ਗੁਜਰਾਲ ਤੋਂ ਸੁਰਿੰਦਰ ਕੌਰ ਤਕ)**
**(ਵਿਸ਼ਾ-ਵਸਤੂ/ਸਾਰ/ਨਾਇਕ ਬਿੰਬ)**

## ਸੈਕਸ਼ਨ - ਸੀ

(ੳ) ਸ਼ਬਦ-ਬਣਤਰ ਅਤੇ ਸ਼ਬਦ-ਰਚਨਾ : ਪਰਿਭਾਸ਼ਾ, ਮੁੱਢਲੇ ਸੰਕਲਪ
(ਅ) ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ : ਨਾਂਵ, ਪੜ੍ਹਨਾਂਵ, ਕਿਰਿਆ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ, ਸਬੰਧਕ, ਯੋਜਕ, ਵਿਸਮਕ

## ਸੈਕਸ਼ਨ - ਡੀ

(ੳ) ਦਫ਼ਤਰੀ ਚਿੱਠੀ ਪੱਤਰ
(ਅ) ਅਖਾਣ ਅਤੇ ਮੁਹਾਵਰੇ

**ਸਹਾਇਕ ਪੁਸਤਕਾਂ**

1. ਬ੍ਰਹਮਜਗਦੀਸ਼ ਸਿੰਘ, **ਪੰਜਾਬੀ ਕਹਾਣੀ : ਸਿਧਾਂਤ, ਇਤਿਹਾਸ ਤੇ ਪ੍ਰਵਿਰਤੀਆਂ**, ਵਾਰਿਸ ਸ਼ਾਹ ਫਾਉਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
2. ਬਲਦੇਵ ਸਿੰਘ ਧਾਲੀਵਾਲ, **ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਇਤਿਹਾਸ**, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
3. ਸਵਿੰਦਰ ਸਿੰਘ ਉੱਪਲ, **ਪੰਜਾਬੀ ਕਹਾਣੀਕਾਰ**, ਨੈਸ਼ਨਲ ਬੁੱਕ ਸ਼ਾਪ, ਦਿੱਲੀ।
4. ਸਵਿੰਦਰ ਸਿੰਘ ਉੱਪਲ, **ਪੰਜਾਬੀ ਕਹਾਣੀ : ਸਰੂਪ ਤੇ ਸਿਧਾਂਤ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
5. ਗੁਰਬਖ਼ਸ਼ ਸਿੰਘ ਫ਼ਰੈਂਕ, **ਨਿੱਕੀ ਕਹਾਣੀ ਅਤੇ ਪੰਜਾਬੀ ਨਿੱਕੀ ਕਹਾਣੀ**, ਪੰਜਾਬੀ ਰਾਈਟਰਜ਼ ਕੋਆਪਰੇਟਿਵ ਸੁਸਾਇਟੀ, ਲੁਧਿਆਣਾ।
6. ਧਰਮਪਾਲ ਸਿੰਗਲ, **ਪੰਜਾਬੀ ਜੀਵਨੀ : ਸਰੂਪ ਸਿਧਾਂਤ ਤੇ ਵਿਕਾਸ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ (ਜੀਵਨੀ ਨੰ: 10 ਤੋਂ 18)।
7. ਸੁਖਵਿੰਦਰ ਸਿੰਘ ਸੰਘਾ, **ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ**, ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ, ਜਲੰਧਰ।
8. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ, **ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਸਿਧਾਂਤ ਤੇ ਵਿਹਾਰ**, ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।
9. **ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਬੋਧ**, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਅੰਮ੍ਰਿਤਸਰ।
10. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ (ਸੰਪਾ.), **ਵੀਹਵੀਂ ਸਦੀ ਦੀ ਪੰਜਾਬੀ ਵਾਰਤਕ**, ਸਾਹਿਤ ਅਕਾਦਮੀ, ਨਵੀਂ ਦਿੱਲੀ।
11. ਮੋਹਨ ਭੰਡਾਰੀ (ਸੰਪਾ.), **ਕਥਾ ਗਾਰਗੀ ਦੀ**, ਲੋਕਗੀਤ ਪ੍ਰਕਾਸ਼ਨ, ਚੰਡੀਗੜ੍ਹ।

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## SEMESTER–III
## PUNJABI (COMPULSORY)-3
## ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)–3

**ਕਰੈਡਿਟ 4–0–0**

**Time: 03 Hours** **Max. Marks: 100**

**(6 ਪੀਰੀਅਡ ਪ੍ਰਤੀ ਹਫ਼ਤਾ)**

**ਅੰਕ–ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ**

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਅੰਕ ਬਰਾਬਰ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ–ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

### ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ–ਪੁਸਤਕਾਂ

### ਸੈਕਸ਼ਨ - ਏ

**ਸਭਿਆਚਾਰ ਅਤੇ ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ**
(ਸੰਪਾ. ਡਾ. ਰਣਜੀਤ ਸਿੰਘ ਬਾਜਵਾ, ਵੀਰ ਸਿੰਘ ਰੰਧਾਵਾ)
ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
(ਲੇਖ ਨੰਬਰ 1 ਤੋਂ 8 ਤਕ)
(ਵਿਸ਼ਾ–ਵਸਤੂ/ਸਾਰ)

### ਸੈਕਸ਼ਨ - ਬੀ

**ਆਧੁਨਿਕ ਇਕਾਂਗੀ**
(ਸੰਪਾ. ਰੌਸ਼ਨ ਲਾਲ ਆਹੂਜਾ, ਮਨਜੀਤ ਪਾਲ ਕੌਰ)
ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
**ਵਿਸ਼ਾ ਵਸਤੂ/ਪਾਤਰ ਚਿਤਰਨ/ਰੰਗ–ਮੰਚੀ ਪੱਖ**

### ਸੈਕਸ਼ਨ - ਸੀ

(ੳ) ਸੰਖੇਪ ਰਚਨਾ (ਪ੍ਰੈਸੀ)
(ਅ) ਦਿੱਤੇ ਪੈਰ੍ਹੇ ਵਿਚੋਂ ਅਸ਼ੁੱਧ ਸ਼ਬਦ–ਜੋੜਾਂ ਨੂੰ ਸ਼ੁੱਧ ਕਰਨਾ

### ਸੈਕਸ਼ਨ - ਡੀ

ਮੂਲ ਵਿਆਕਰਨਕ ਇਕਾਈਆਂ : ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਵਰਗੀਕਰਨ
(ਭਾਵੰਸ਼, ਸ਼ਬਦ, ਵਾਕੰਸ਼, ਉਪ–ਵਾਕ ਅਤੇ ਵਾਕ)

**ਸਹਾਇਕ ਪੁਸਤਕਾਂ**

1. ਜੀਤ ਸਿੰਘ ਸੀਤਲ, **ਵਾਰਤਕ ਤੇ ਵਾਰਤਕ ਸ਼ੈਲੀ**, ਪੰਜਾਬ ਸਟੇਟ ਯੂਨੀਵਰਸਿਟੀ ਟੈਕਸਟ ਬੁੱਕ ਬੋਰਡ, ਚੰਡੀਗੜ੍ਹ।
2. ਗੋਬਿੰਦ ਸਿੰਘ ਲਾਂਬਾ, **ਪੰਜਾਬੀ ਵਾਰਤਕ ਤੇ ਵਾਰਤਕਕਾਰ**, ਅਮਰਜੀਤ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਪਟਿਆਲਾ।
3. ਸਤਿੰਦਰ ਸਿੰਘ ਨੂਰ, **ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਵਾਰਤਕ ਦਾ ਇਤਿਹਾਸ**, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
4. ਡਾ. ਜਸਵਿੰਦਰ ਸਿੰਘ, ਡਾ. ਮਾਨ ਸਿੰਘ ਢੀਂਡਸਾ, **ਪੰਜਾਬੀ ਸਾਹਿਤ ਦਾ ਇਤਿਹਾਸ (ਆਧੁਨਿਕ ਕਾਲ)**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
5. ਸਤੀਸ਼ ਕੁਮਾਰ ਵਰਮਾ, **ਪੰਜਾਬੀ ਨਾਟਕ ਦਾ ਇਤਿਹਾਸ**, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
6. ਗੁਰਦਿਆਲ ਸਿੰਘ ਫੁੱਲ, **ਪੰਜਾਬੀ ਇਕਾਂਗੀ : ਸਰੂਪ, ਸਿਧਾਂਤ ਤੇ ਵਿਕਾਸ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
7. ਬ੍ਰਹਮਜਗਦੀਸ਼ ਸਿੰਘ, **ਪੰਜਾਬੀ ਨਾਟਕ ਤੇ ਇਕਾਂਗੀ : ਸਿਧਾਂਤ, ਇਤਿਹਾਸ ਤੇ ਪ੍ਰਵਿਰਤੀਆਂ**, ਵਾਰਿਸ ਸ਼ਾਹ ਫਾਉਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
8. **ਖੋਜ ਪਤ੍ਰਿਕਾ** (ਨਾਟ ਸ਼ੈਲੀਆਂ ਵਿਸ਼ੇਸ਼ ਅੰਕ),
9. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ, **ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਸਿਧਾਂਤ ਤੇ ਵਿਹਾਰ**, ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।
10. ਹਰਕੀਰਤ ਸਿੰਘ ਤੇ ਗਿਆਨ ਲਾਲ ਸਿੰਘ, **ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ**, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ, ਚੰਡੀਗੜ੍ਹ।
11. **ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਬੋਧ**, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਅੰਮ੍ਰਿਤਸਰ।

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## SEMESTER–IV
## PUNJABI (COMPULSORY)-4
## ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)–4

**ਕਰੈਡਿਟ 4–0–0**

**Time: 03 Hours** **Max. Marks: 100**

**(6 ਪੀਰੀਅਡ ਪ੍ਰਤੀ ਹਫ਼ਤਾ)**

**ਅੰਕ–ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ**

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਅੰਕ ਬਰਾਬਰ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

### ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ–ਪੁਸਤਕਾਂ

### ਸੈਕਸ਼ਨ - ਏ

**ਗਲੀਏ ਚਿਕੜੁ ਦੂਰਿ ਘਰੁ** (ਸਵੈ–ਜੀਵਨੀ): ਸ.ਸ.ਵਣਜਾਰਾ ਬੇਦੀ, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਅੰਮ੍ਰਿਤਸਰ
**(ਨਾਇਕ ਬਿੰਬ/ਸਵੈ ਜੀਵਨੀ ਦੇ ਤੱਤ ਤੇ ਪਰਖ/ਵਾਰਤਕ ਸ਼ੈਲੀ)**

### ਸੈਕਸ਼ਨ - ਬੀ

**ਫ਼ਾਸਲੇ** (ਨਾਟਕ): ਜਤਿੰਦਰ ਬਰਾੜ, ਨਾਨਕ ਸਿੰਘ ਪੁਸਤਕਮਾਲਾ, ਅਮ੍ਰਿਤਸਰ
**(ਵਿਸ਼ਾ ਵਸਤੂ /ਸਾਰ/ਨਾਟਕ ਕਲਾ)**

### ਸੈਕਸ਼ਨ - ਸੀ

**(ੳ) ਲੇਖ ਰਚਨਾ** (ਸਮਾਜਕ, ਸਭਿਆਚਾਰਕ, ਇਤਿਹਾਸਕ ਅਤੇ ਵਿਦਿਅਕ ਸਰੋਕਾਰਾਂ ਸੰਬੰਧੀ)
**(ਅ) ਅਖ਼ਬਾਰ ਨੂੰ ਇਸ਼ਤਿਹਾਰ** (ਨਿੱਜੀ, ਦਫ਼ਤਰੀ)

### ਸੈਕਸ਼ਨ - ਡੀ

(ੳ) ਦਿੱਤੇ ਪੈਰ੍ਹੇ ਵਿਚੋਂ ਅਸ਼ੁੱਧ ਸ਼ਬਦ–ਜੋੜਾਂ ਨੂੰ ਸ਼ੁੱਧ ਕਰਨਾ
(ਅ) ਗੁਰਮੁਖੀ ਲਿਪੀ ਦੀਆਂ ਵਿਸ਼ੇਸਤਾਵਾਂ

**ਸਹਾਇਕ ਪੁਸਤਕਾਂ**


1. ਰਾਜਵਿੰਦਰ ਕੌਰ, **ਸਵੈ–ਜੀਵਨੀ : ਸਿਧਾਂਤ ਤੇ ਵਿਹਾਰ**, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
2. ਗੁਰਦਿਆਲ ਸਿੰਘ ਫੁੱਲ, **ਪੰਜਾਬੀ ਨਾਟਕ : ਸਰੂਪ, ਸਿਧਾਂਤ ਤੇ ਵਿਕਾਸ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
3. ਸਤੀਸ਼ ਕੁਮਾਰ ਵਰਮਾ, **ਪੰਜਾਬੀ ਨਾਟ-ਮੰਚ ਦਾ ਨਿਕਾਸ ਤੇ ਵਿਕਾਸ**, ਨੈਸ਼ਨਲ ਬੁੱਕ ਟਰੱਸਟ, ਇੰਡੀਆ।
4. ਕਮਲੇਸ਼ ਉੱਪਲ, **ਨਾਟਕ ਕਲਾ ਸਰੂਪ ਤੇ ਸਿਧਾਂਤ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
5. ਗੁਰਦਿਆਲ ਸਿੰਘ ਫੁੱਲ, **ਪੰਜਾਬੀ ਇਕਾਂਗੀ : ਸਰੂਪ, ਸਿਧਾਂਤ ਤੇ ਵਿਕਾਸ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
6. **ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਬੋਧ**, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਅੰਮ੍ਰਿਤਸਰ।

Bachelor of Arts /Bachelor of Science (Punjabi Compulsory) (CBGS)
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## SEMESTER–V
## PUNJABI (COMPULSORY)-5
## ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)–5

**ਕਰੈਡਿਟ 4–0–0**

**Time: 03 Hours** **Max. Marks: 100**

**(6 ਪੀਰੀਅਡ ਪ੍ਰਤੀ ਹਫ਼ਤਾ)**

**ਅੰਕ–ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ**

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਅੰਕ ਬਰਾਬਰ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

### ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ–ਪੁਸਤਕਾਂ

### ਸੈਕਸ਼ਨ - ਏ

**ਚੋਣਵੀਆਂ ਪੰਜਾਬੀ ਕਹਾਣੀਆਂ**
(ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅਮ੍ਰਿਤਸਰ, 2018)
(ਵਿਸ਼ਾ ਵਸਤੂ/ਸਾਰ/ਕਹਾਣੀ ਕਲਾ)

### ਸੈਕਸ਼ਨ - ਬੀ

**ਪਵਿੱਤਰ ਪਾਪੀ** (ਨਾਵਲ) : ਨਾਨਕ ਸਿੰਘ
ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
(ਲੇਖਕ ਦਾ ਜੀਵਨ ਤੇ ਰਚਨਾ/ਵਿਸ਼ਾ–ਵਸਤੂ/ਪਾਤਰ–ਚਿਤਰਨ)

### ਸੈਕਸ਼ਨ - ਸੀ

**(ੳ)** ਪੈਰ੍ਹਾ ਰਚਨਾ
**(ਅ)** ਸਰਲ ਅੰਗਰੇਜ਼ੀ ਪੈਰ੍ਹੇ ਦਾ ਪੰਜਾਬੀ ਵਿਚ ਅਨੁਵਾਦ

### ਸੈਕਸ਼ਨ - ਡੀ

**ਵਿਆਕਰਨ:**
(ੳ) ਪੰਜਾਬੀ ਧੁਨੀ ਵਿਉਂਤ
(ਅ) ਵਾਕਾਤਮਕ ਜੁਗਤਾਂ : ਮੇਲ ਤੇ ਅਧਿਕਾਰ
(ਏ) ਕਾਰਕ ਤੇ ਕਾਰਕੀ ਸੰਬੰਧ

**ਸਹਾਇਕ ਪੁਸਤਕਾਂ**

1. ਬਲਦੇਵ ਸਿੰਘ ਧਾਲੀਵਾਲ, **ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਇਤਿਹਾਸ**, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
2. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, **ਪੰਜਾਬੀ ਕਹਾਣੀ ਦੀ ਸ਼ਾਹਰਾਹ** (ਭੂਮਿਕਾ), ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
3. ਜੋਗਿੰਦਰ ਸਿੰਘ ਰਾਹੀ, ਰਮਿੰਦਰ ਕੌਰ, **ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਸਫ਼ਰ ਤੇ ਸ਼ਾਸਤ੍ਰ**, ਸਿੰਘ ਬ੍ਰਦਰਜ਼, ਅੰਮ੍ਰਿਤਸਰ (ਭਾਗ ਦੂਜਾ)
4. ਧਰਮਪਾਲ ਸਿੰਗਲ, **ਨਾਨਕ ਸਿੰਘ ਇਕ ਪਰਿਚੈ**, ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
5. ਡਾ. ਕੁਲਵੰਤ ਸਿੰਘ ਕੋਹਲੀ, **ਨਾਨਕ ਸਿੰਘ ਦੇ ਨਾਵਲਾਂ ਦਾ ਆਲੋਚਨਾਤਮਕ ਸਰਵੇਖਣ**, ਪੈਪਸੂ ਬੁੱਕ ਡਿਪੂ, ਪਟਿਆਲਾ।
6. ਡਾ. ਬਿਕਰਮ ਸਿੰਘ ਘੁੰਮਣ, **ਨਾਨਕ ਸਿੰਘ : ਜੀਵਨ ਤੇ ਰਚਨਾ**, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
7. ਮਿੰਨੀ ਸਲਵਾਨ**, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਮੁੱਢਲੇ ਸੰਕਲਪ**, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
8. ਜਗਜੀਤ ਸਿੰਘ, **ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਸ਼੍ਰੇਣੀਆਂ ਤੇ ਇਕਾਈਆਂ**, ਨਿਊ ਬੁੱਕ ਕੰਪਨੀ, ਮਾਈ ਹੀਰਾ ਗੇਟ, ਜਲੰਧਰ।
9. **ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਬੋਧ**, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਅੰਮ੍ਰਿਤਸਰ।

Bachelor of Arts /Bachelor of Science (Punjabi Compulsory) (CBGS)
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**SEMESTER–VI**
**PUNJABI (COMPULSORY)-6**
**ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)–6**

**ਕਰੈਡਿਟ 4–0–0**

**Time: 03 Hours** **Max. Marks: 100**
**(6 ਪੀਰੀਅਡ ਪ੍ਰਤੀ ਹਫ਼ਤਾ)**

**ਅੰਕ–ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ**

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਅੰਕ ਬਰਾਬਰ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ–ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

**ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ–ਪੁਸਤਕਾਂ**

## ਸੈਕਸ਼ਨ - ਏ

**ਕਾਵਿ ਗੌਰਵ** (ਪਹਿਲੇ ਛੇ ਕਵੀ)
(ਸੰਪਾ. ਬਿਕਰਮ ਸਿੰਘ ਘੁੰਮਣ, ਕਰਮਜੀਤ ਕੌਰ), ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅਮ੍ਰਿਤਸਰ,
(ਸ਼ੇਖ ਫਰੀਦ, ਸ਼ਾਹ ਹੁਸੈਨ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ, ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ, ਵਾਰਿਸ ਸ਼ਾਹ, ਸ਼ਾਹ ਮੁਹੰਮਦ)
**(ਪ੍ਰਸੰਗ ਸਹਿਤ ਵਿਆਖਿਆ/ਵਿਸ਼ਾ ਵਸਤੂ/ਸਾਰ)**

## ਸੈਕਸ਼ਨ - ਬੀ

**ਧਰਤੀਆਂ ਦੇ ਗੀਤ** (ਸਫ਼ਰਨਾਮਾ), ਬਰਜਿੰਦਰ ਸਿੰਘ ਹਮਦਰਦ, ਨਾਨਕ ਸਿੰਘ ਪੁਸਤਕਮਾਲਾ, ਅੰਮ੍ਰਿਤਸਰ
**(ਲੇਖਕ** ਦਾ **ਜੀਵਨ ਤੇ ਰਚਨਾ/ ਸਮਾਜ ਸਭਿਆਚਾਰਕ ਪਰਿਪੇਖ/ਸਫ਼ਰਨਾਮੇ ਦੇ ਤੌਰ ਤੇ ਪਰਖ)**

## ਸੈਕਸ਼ਨ - ਸੀ

(ੳ) **ਲੇਖ ਰਚਨਾ** (ਵਿਗਿਆਨ, ਤਕਨਾਲੋਜੀ ਅਤੇ ਚਲੰਤ ਮਸਲਿਆਂ ਸੰਬਧੀ)
(ਅ) ਆਧੁਨਿਕ ਸਾਹਿਤ ਦੇ ਰੂਪ : ਕਵਿਤਾ, ਕਹਾਣੀ, ਨਾਵਲ, ਨਾਟਕ, ਇਕਾਂਗੀ **(ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਤੱਤ)**

## ਸੈਕਸ਼ਨ - ਡੀ

**ਵਿਆਕਰਨ:**
(ੳ) ਵਿਆਕਰਨਕ ਸ਼੍ਰੇਣੀਆਂ : ਲਿੰਗ ਅਤੇ ਵਚਨ
(ਅ) ਨਾਂਵ ਵਾਕੰਸ਼ ਅਤੇ ਕਿਰਿਆ ਵਾਕੰਸ਼ : ਪਰਿਭਾਸ਼ਾ, ਬਣਤਰ ਤੇ ਪ੍ਰਕਾਰ

**ਸਹਾਇਕ ਪੁਸਤਕਾਂ**

1. ਰਤਨ ਸਿੰਘ ਜੱਗੀ, **ਸਾਹਿਤ ਦੇ ਰੂਪ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
2. ਜਗਬੀਰ ਸਿੰਘ, **ਗੁਰਮਤਿ ਕਾਵਿ ਦਾ ਇਤਿਹਾਸ**, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
3. ਗੁਰਦੇਵ ਸਿੰਘ ਸਿੱਧੂ, **ਸੂਫ਼ੀ ਕਾਵਿਧਾਰਾ ਦਾ ਇਤਿਹਾਸ**, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
4. ਕਰਨਜੀਤ ਸਿੰਘ, **ਪੁਰਾਤਨ ਪੰਜਾਬੀ ਵਾਰਤਕ**, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
5. ਡਾ. ਰਛਪਾਲ ਕੌਰ, **ਪੰਜਾਬੀ ਸਫ਼ਰਨਾਮਾ : ਸਰੂਪ ਸਿਧਾਂਤ ਤੇ ਵਿਕਾਸ**, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
6. ਹਰਜਿੰਦਰ ਸਿੰਘ, **ਸਮਕਾਲੀ ਪੰਜਾਬੀ ਸਫ਼ਰਨਾਮਾ : ਵਿਸ਼ਲੇਸ਼ਣ ਤੇ ਮੁਲਾਂਕਣ**, ਲੋਕਗੀਤ ਪ੍ਰਕਾਸ਼ਨ, ਚੰਡੀਗੜ੍ਹ।
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