UNIVERSITY OF DELHI

CNC-II/093/1(40)/EC-1270/2024-25/ 215
Dated: 02.09.2024

NOTIFICATION

Sub: Amendment to Ordinance V

Following addition be made to Appendix-II-A to the Ordinance V (2-A) of the Ordinances of the University;

Add the following:

The Syllabi of the following courses based on Undergraduate Curriculum Framework 2022 implemented from the Academic Session 2022-2023 are notified herewith for the information of all concerned:

1. The syllabi of BA (Hons.) Humanities and Social Sciences offered by Cluster Innovation Centre for Semester-V and Semester-VI based on Undergraduate Curriculum Framework 2022 [ECR- 5-7/ dated 27.07.24]. ***As per Annexure-1.***

2. The syllabus of B.A. Programme (Education) of Semester-V & VI under the Faculty of Education based on Undergraduate Curriculum Framework 2022 [ECR- 5-11/ dated 27.07.24]. ***As per Annexure-2.***

3. The syllabus of BSc. Analytical Chemistry (Kirori Mal College) for Semester-V & VI under Faculty of Science based on Undergraduate Curriculum Framework 2022 [ECR- 5-12/ dated 27.07.24]. ***As per Annexure-3.***

REGISTRAR

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B.A. (Hons.) Humanities and Social Sciences

SEMESTER-V & VI

Cluster Innovation Centre
BA (Hons.) Humanities & Social Sciences
SEMESTER-VI

Based on Undergraduate Curriculum Framework 2022

UNIVERSITY OF DELHI

UNDERGRADUATE PROGRAMMES OF STUDY

STRUCTURE, COURSES & SYLLABI OF SEMESTER – V
B.A. (Honours) Humanities & Social Sciences

Disclaimer: The syllabi are uploaded are as approved by the Academic Council on …… and Executive Council on ….

CLUSTER INNOVATION CENTRE

COURSES OFFERED BY CLUSTER INNOVATION CENTRE

Category II

(UG Courses for Undergraduate Programme of study with Humanities & Social Sciences discipline as one of the Core Disciplines)

DISCIPLINE SPECIFIC ELECTIVE (DSE-03A): Climate Change and Environmental Degradation

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Climate Change and Environmental Degradation (DSE-03A)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

- To enable students to understand and address the risks from climate change and environment degradation.
- To enable students to assess the natural hazards, vulnerabilities and risks associated with climate change.
- To help students determine the public perception on climate change and environment degradation.

Learning Outcomes

- Students will develop adequate knowledge of the complexity and relationship between climate change and environment degradation.
- Students will be able to do quantitative and qualitative assessment of climate change using spatial data.
- Students will be able to design strategies to counter and change public perception on climate change and environment degradation.

OUTLINE OF DSE-03A

Environmental degradation which is a consequence of centuries of unsustainable practices has further been exacerbated by climate change in more recent times. The combined effect of climate change and environmental degradation affects all types of development initiatives that various countries have taken up. This project will thus involve encouraging students to understand the factors responsible for climate change, its relationship with environmental degradation, ways to mitigate the negative consequences of climate change and environmental degradation and also initiate discussions on sustainable efforts through workshops, awareness programs and hands-on learning.

Theoretical Component (01 credit) **15 hours**

Overview of carbon emission, interaction between air pollutants in the atmosphere, introduction to atmospheric science and climatic phenomenon, introduction to water budget systems in the atmosphere, biosphere and lithosphere, climate change and impact to the various communities of plants and animals such as habit shift, drought, migration etc.

Indicative Themes:

- Impact of Human Activity on Environment
- Preserving Ecosystems
- Mitigation and Adaptation

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component may entail learning through practical exercises like:

- Identifying relevant fields/cases/ecosystems/industries, learning to analyse them objectively in its environmental, social and economic context.
- Conducting interviews with experts especially environmentalists
- Conducting observations and group discussions with stakeholders
- Designing public awareness campaigns with regard to impact of human activity on environment and ways to mitigate it
- Participating in and conducting workshops, etc.
- Engagement with interactive tools, visualisations, and data sets related to climate change and environmental research
- Analysing geospatial data related to environmental changes over time, such as deforestation or sea level rise
- Critically analyse reports, policy briefs, and data on global environmental issues and climate change
- or any other practical deemed fit by the teacher in the context of Climate Change and Environmental Degradation

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-03B): Sustainable Energy and Natural Resources

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical / Practice		
Sustainable Energy and Natural Resources (DSE-03B)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

- To address the environmental consequences associated with the exploitation of natural resources.
- To address the different environmental impacts caused by fossil fuels and thermal power plants.
- To make students aware about different ways of energy efficiency use.

Learning Outcomes

- Students will gain a comprehensive understanding of sustainable energy and natural resources.
- Students will be equipped with the knowledge and tools to make informed decisions about sustainable development in their personal and professional lives.

OUTLINE OF DSE-03B

The course will engage with some of the issues around the impact of energy use on climate change, the concept of renewable energy, energy efficiency, natural resource management, sustainable development, and policy and regulation. Students will learn about different renewable energy technologies, including solar, wind, hydroelectric, geothermal, and bioenergy. The course will also explore the importance of energy efficiency in buildings, appliances, and transportation. The concept of sustainable development will be discussed, with a focus on balancing economic development and environmental protection. The course will also cover policy and regulation related to energy and natural resources, as well as the socioeconomic impacts of sustainable development.

Theoretical Component (01 credit) **15 hours**

Introduction to sustainable energy, natural resources and its depletion and different forms of impact caused by anthropogenic activities on natural resources.

Indicative Themes:

- Renewable and non-renewable resources
- Renewable energy
- Affordable and clean energy

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component of this paper may entail learning through practical exercises like:

- Identifying relevant fields/cases/policies, learning to analyse them objectively in its environmental, social and economic context
- Conducting interviews with experts
- Group discussions with stakeholders
- Introduction to open-source platforms like Open Energy Dashboard for monitoring and analysing energy consumption and renewable energy generation data
- Creating infographics, presentations, and visual materials to communicate climate change concepts and data effectively. Design interactive presentations and visual storytelling to convey complex environmental topics related to energy and resources
- Designing public awareness campaigns with regard to the concept of sustainability, energy, wealth generation and development
- Engaging with relevant Sustainable Development Goals (SDGs) and conducting related workshops
- Access energy consumption, production, and renewable energy statistics globally for critical analysis and comparison
- or any other practical deemed fit by the teacher in the context of Sustainable Energy and Natural Resources.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-03C): Sustainable Agriculture and Food Systems

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Sustainable Agriculture and Food Systems (DSE-03C)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

- To introduce students to the elements of sustainable agriculture.
- To enable students to explore the economic, social and environmental dimension of sustainable agriculture and food systems.
- To explore the factors affecting ecological balance and sustainable agriculture systems.

Learning Outcomes

- Students will be able to appreciate and foreground the sustainable agricultural practices in the larger public sphere.
- Students will gain a holistic understanding entailing the economic, social and environmental dimensions of sustainable agriculture and food systems.
- Students will be equipped to make informed decisions about their food choices.

OUTLINE OF DSE-03C

With a rapidly increasing human population, spurt in urbanization, varying food needs, growing wealth, environment degradation affecting food production, knowledge and discussion about sustainable agriculture and sustainable food systems have become imperative. This course will encourage students to examine the principles and practices of sustainable agriculture and food systems. Principles of agroecology, sustainable livestock management, challenges of sustainable and equitable food systems and policy and regulation related to sustainable agriculture and food systems will also be studied under this course. The course will help students lead campaigns towards making the public more aware about sustainable agriculture and food practices.

Theoretical Component (01 credit) **15 hours**

Overview of ecosystem, interaction between biotic and abiotic environment components, energy and nutrient cycles, ecosystem services and biodiversity functioning.

Indicative Themes:

- Environmentally sustainable, socially just, and economically viable agricultural practices
- Access to healthy and sustainable food for all

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component of this paper may entail learning through practical exercises like:

- Identifying relevant fields/cases/policies, learning to analyse them objectively in the environmental, social and economic context focusing on sustainable agriculture initiatives such as organic farming, agroecology, permaculture, etc.
- Conducting interviews with experts, group discussions with stakeholders, designing public awareness campaigns with regard to the concept of sustainable agriculture and food systems in the larger context of economic development and wellbeing.
- Organise field visits to local sustainable farms or arrange practising innovative sustainable techniques. Students observe agricultural practices such as crop rotation, integrated pest management, use of cover crops, and conservation tillage.
- Engaging with farmers to understand challenges and benefits associated with sustainable agriculture.
- Students can create a food system map that identifies key stakeholders such as farmers, distributors, retailers, consumers and food pathways such as production areas, transportation routes.
- Assessing food system dynamics, including production, distribution, consumption, and waste management.
- Critically evaluating sustainability criteria such as biodiversity conservation, soil health, water use efficiency, and carbon footprint in relevant fields or industry.
- Engaging with relevant Sustainable Development Goals (SDGs) and conducting related workshops, etc.
- or any other practical deemed fit by the teacher.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-03D): Circular Economy

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Circular Economy (DSE-03D)	4	1	0	3	Class XII Pass	Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)

Learning Objectives

- To gain a comprehensive understanding of circular economy.
- To understand the importance and practices of reducing waste, waste management, recycling, and reusing.
- To appreciate ethical production and consumption.

Learning Outcomes

- Students will be equipped with the knowledge and tools to make informed decisions about implementing circular economy practices in their personal and professional lives.
- Students will be able to practise ethical production and consumption in their personal and professional lives.

OUTLINE OF DSE-03D

The course engages with concepts such as circular economy, the importance of resource efficiency, the role of business models, the principles of the circular economy, and the challenges and opportunities of implementing circular economy practices. Students will learn about waste management, recycling, and reusing to gain an understanding of the importance of resource efficiency, including the efficient use of energy, water, and materials. The course will explore the role of business models in the circular economy, including product-as-a-service, sharing economy, and closed-loop supply chains. Students will be introduced to the policy and regulatory frameworks, the importance of stakeholder engagement, and the role of innovation and technology.

Theoretical Component (01 credit) **15 hours**

Concept of circular economy, ethical production and consumption, waste management & recycling and sustainable product design

Indicative Themes:

- Environmentally sustainable, socially just, and economically viable production and consumption practices.
- Learning from best practices of waste management, recycling towards efficient use of energy, water and other natural resources.
- Critically analysing the relevant policies and regulation mechanisms.
- Sustainable material and product design.

- Consumer awareness and behaviour change.
- Product life cycle analysis.

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component of this paper may entail learning through practical exercises like:

- Identifying relevant fields/cases/policies, learning to analyse them objectively in its environmental, social and economic context, interviews with experts, group discussions with stakeholders, designing public awareness campaigns with regard to waste management and recycling, ethical production and consumption
- Working on Sustainable Product Designs
- Working with Open-source platform like OpenLCA for conducting life cycle assessments of products or processes to analyse environmental impacts across different life stages (raw material extraction, production, use, disposal)
- Engaging with relevant Sustainable Development Goals (SDGs) and conducting related workshops, etc.,
- or any other practical deemed fit by the teacher in the context of the evolving field of Circular Economy.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-03E): Social Justice and Equity

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Social Justice and Equity (DSE-03E)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

- To introduce students to the key concepts of social justice and equity.
- To examine the intersectionality of social identities.
- To develop strategies for promoting social justice and equity.

Learning Outcomes

- Students will be able to develop a comprehensive understanding of the principles and practices of social justice and equity.
- Students will be able to identify the role of representation and inclusion in social justice and equity.
- Students will be able to apply critical thinking skills to do case studies from different contexts.

OUTLINE OF DSE-03E

This course orients students to the history and theories of social justice including distributive justice and the principles of fairness, equality, and human rights, intersectionality of social identities, importance of representation and inclusion, and the challenges and opportunities of creating a more just and equitable society. Students will learn about the role of media, arts and culture in shaping social norms and values including the role of activism and social movements, and the need for policy and institutional change. Students will also gain an understanding of the socioeconomic and environmental impacts of social justice and equity, including the importance of addressing issues of poverty, inequality, and environmental degradation.

Theoretical Component (01 credit) **15 hours**

Environmental Justice, Intersectionality, Environmental Racism, Just Transition, Eco-feminism and Participatory Democracy.

Indicative Themes:

- Intersection of environmental sustainability and social justice
- Access to basic resources
- Education and awareness: engaging communities in collective action towards a sustainable future
- Gender and Environment

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component of this paper may entail learning through practical exercises like:

- Identifying relevant fields/cases/policies, learning to analyse them objectively in the context of historically disadvantaged groups and its intersectionality with environmental concerns
- Learning the use of tools like ArcGIS for spatial analysis of environmental inequalities and mapping of marginalised communities affected by environmental hazards
- Learning to use community mapping platforms like Google My Maps for collaborative mapping of environmental justice issues
- Conducting interviews and discussions with stakeholders
- Designing public awareness campaigns with regard to the importance of social justice and equity using social media campaign platforms like Twitter, Instagram, or Change.org, for raising awareness, mobilising support, and advocating for environmental justice causes
- Engaging with relevant Sustainable Development Goals (SDGs) and conducting related workshops, etc.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-03F): Sustainable Cities and Communities

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Sustainable Cities and Communities (DSE-03F)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

- To enable students to have a comprehensive understanding of key concepts of sustainable cities.
- To introduce students to the principles and best practices of sustainable cities.
- To examine the role of community in realisation and promotion of sustainable urban development.

Learning Outcomes

- Students will learn about the challenges and opportunities of creating sustainable cities and communities.
- Students will gain an understanding of the principles of sustainable urban planning.
- Students will be able to develop effective strategies in exploring and catalysing the role of community in sustainable urban development.

OUTLINE OF DSE-03F

The course engages with concepts of sustainable urban planning, community engagement, green infrastructure, and urban resilience. Students will also examine the role of community engagement in sustainable urban development, including the importance of stakeholder involvement in decision-making processes. Students will learn about the benefits of green infrastructure, urban resilience etc. Students will be encouraged to analyze case studies of sustainable cities and communities, and explore best practices and innovative solutions for creating sustainable urban environments.

Theoretical Component (01 credit) **15 hours**

Urban sprawl and urbanisation in developing countries, inbound and outbound migration, satellite cities & urbanisation and urban ecology.

Indicative Themes:

- Sustainable urban development that prioritises livability, accessibility, and environmental sustainability
- Urban Dualism

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component of this paper may entail learning through practical exercises like:

- Identifying relevant fields/cases/policies, learning to analyse them objectively in the environmental, social and economic context
- Conducting interviews with experts and policymakers, observations, group discussions with stakeholders, designing public awareness campaigns with regard to the concept of urbanisation, migration, sustainable cities and communities
- Using GIS tools and climate data, students can map vulnerable areas to climate risks such as flooding, heatwaves, or sea-level rise
- Developing sustainability action plans covering areas such as energy efficiency, green infrastructure, waste management, and community engagement based on their field visits and expert interaction and propose strategies to promote sustainable transportation options and reduce reliance on single-occupancy vehicles.
- Analysing data on transportation patterns, accessibility, and emissions.
- Engaging with relevant Sustainable Development Goals (SDGs) and conducting related workshops, etc., or any other practical deemed fit by the teacher in the context of Sustainable Cities and Communities.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

SEMESTER – VI
B.A. (Honours) Humanities & Social Sciences

CLUSTER INNOVATION CENTRE

DISCIPLINE SPECIFIC CORE (DSC)-16:
Social Movements in India

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Social Movements in India (DSC-16)	4	3	1	0	Class XII Pass	NIL

Learning Objectives

The learning objectives of this course are as follows:

- Examine the historical, political, and socio-cultural factors that have shaped social movements in India.
- Develop an awareness of the ethical and moral dimensions of social movements and their implications for social justice and equality.
- Explore the diversity of social movements in India, including their goals, strategies, and impact on society.

Learning Outcomes

On completion of this course, students will be able to:

- Identify and analyse different types of social movements in India.
- Assess the impact of social movements on policy changes, social norms, and institutional transformations in India.
- Engage in interdisciplinary thinking by drawing on insights from sociology, political science, history, and other relevant disciplines.

SYLLABUS OF DSC-16

Unit 1: Conceptualising Social Movements (12 Hours)

Concept of Social Movements
Elements of Social Movements
Social Movements and Social Change
Methods of classification of Social Movements

Unit 2: Social Movements in Ancient and Medieval India (12 Hours)

Socio-religious Movements: Buddhism and Jainism (Equality and Social Justice, Compassion and Ethical Conduct, Non-violence, Asteya, Aparigraha)

Bhakti Movement: Rejection of Social Hierarchies, Inclusivity and Syncretism, Social Reforms

Unit 3: Social Movements in Modern India (12 Hours)

Brahmo Samaj: Emancipation of Women

Arya Samaj: Emphasis on Education

Satya Shodhak Samaj: Social Equality

Prarthana Samaj: Emphasis on Bhakti and Karma Yoga

Ezhava Movement: Political Engagement and Representation

Unit 4: Contemporary Social Movements (09 Hours)

Tribal Movements and Nation Building

Environment Movements: Chipko, Bishnoi, Silent Valley, Appiko

Disability Rights Movement

Gender Minority Groups Rights Movements

Suggested Readings:

- Shah, Ghanshyam, Social movements in India: A Review of the Literature, Sage, 1997
- Dhanagare D.N., Peasant Movements in India 1920-1950, Oxford University Press, 1983
- Zelliot Eleanor, From Untouchable to Dalit: Essays on the Ambedkar Movement, Manohar , 1995
- Crossely, Nick., Making Sense of Social Movements., Open University Press, 2002
- Ray, Raka and Katzenstein, Mary Fainsod. Social Movements in India: Poverty, Power, and Politics. Oxford University Press, 2005.
- Rao, M. Raghavendra. Social Reform Movements in India: A Historical Perspective. Rawat Publications, 2002.
- Roy, Himanshu and Tuteja, K. L. (Eds.). Social Movements in Modern India: A Reader. Oxford University Press, 2018.
- Pathak, R. D., & Mishra, M. (Eds.). (2011). Indigenous Environmental Movements and Activism: Theory and Practice. Rawat Publications.
- Singh, Nandita. (2019). "Adivasi Movements and Environmental Politics in India." In N. Singh & T. H. Teh (Eds.), Environment, Development, and Politics in India: A Reader. Cambridge University Press.
- Lorenzen, David N. (2006). Bhakti Religion in North India: Community Identity and Political Action. State University of New York Press.
- Dr Nagendra. 2009. Bhartiya Sahitya Ka Smekitik Itihas, Delhi University

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE (DSC-17):
Philosophical Debates: Modern and Post-modern

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Philosophical Debates: Modern and Post-modern (DSC-17)	**4**	**3**	**1**	**0**	**Class XII Pass**	**NIL**

Learning Objectives

The learning objectives of this course are as follows -

- The course will focus on the intersections of power, ideology, and representation in various social and historical contexts.
- The course will introduce students to debates with regard to the marginalised groups.
- The students will develop analytical thinking for academic and research writing amongst the students.

Learning Outcomes

Upon completion of this course, students -

- will be able to engage in constructive and informed discussions on issues related to power, ideology and representation.
- will become more aware of the ethical and political implications of critical theory and its application to real-world situations.
- will develop analytical thinking for academic and research writing.

SYLLABUS OF DSC-17

Unit 1: Socialist Philosophy (12 Hours)

- Historical Materialism, Alienation
- Ideology and Hegemony, Organic Intellectuals

Unit II: Gender Debates (9 Hours)

- Feminist Critique of Patriarchy
- Performativity, Gender, Subversion

Unit III: Critical Theory (12 Hours)

- Power and Authorship, Discourse, Intertextuality
- Cultural Capital, Social Reproduction

Unit IV: Postcolonial Turn (12 Hours)

- Ethical Representation in the context of Subaltern: Epistemic Violence, Colonialism, Subalternity, Essentialism, Representation
- Orientalism, Colonialism, Essentialism, Othering, Hegemony, Stereotyping

Essential Readings:

- Lohia, R. (1960) *Marx, Gandhi and Socialism.* Hyderabad, India: Navhindi.

- Said, E.W. (2021) *Orientalism*. London, UK: Penguin.
- Spivak, G.C. *et al.* (2020) *Can the subaltern speak?* London: Afterall Books.
- Butler, J. (2015) *Gender trouble: Feminism and the subversion of identity*. New York: Routledge.
- Foucault, M. (2012) "What is an Author?" London: The Open University.
- Bourdieu, P. (1993) *The field of cultural production*. New York: Columbia University Press.
- Woolf, Virgina (2022) *Room of one's own*. S.l.: Indo European Publishing Co.
- Gramsci, A., Hoare, Q. and Nowell-Smith, G. (2014) *Selections from the prison notebooks of Antonio Gramsci*. New York, NY: International Publishers.

Suggested Readings

- Russell, Bertrand (2020) *History of western philosophy*. S.l.: Routledge.
- Beauvoir, S.de *et al.* (2015) *The second sex*. London: Vintage Books.
- Bhasin, K. (2009) *Understanding gender*. New Delhi: Women Unlimited.
- Held, D. (2010) *Introduction to critical theory: Horkheimer to Habermas*. Cambridge: Polity Press.
- Said, E.W. (2014) *Culture and Imperialism*. London: Vintage Digital.
- Gutting, G. *Foucault: A very short introduction* (2005). Oxford: Oxford University Press

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE (DSC-18):
Human-Digital Interaction

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Human-Digital Interaction (DSC-18)	4	3	1	0	Class XII Pass	NIL

Course Objectives

This course is designed to help students to:

- Acquire a critical understanding of human-technology interface.
- Examine the impact of human-technology interface on individuals and society.

Learning Outcomes

- Students will be able to develop research skills and methods for studying and evaluating human-digital interaction..
- Students will be able to apply the knowledge and skills gained to improve human-digital interaction experiences.
- Students will be able to explore the legal and ethical issues associated with human-technology interaction.

UNIT I: Conceptualising Human-Digital Interaction (9 Hours)

Overview of human-digital interaction

Theoretical Foundations - Information Processing Theory, Activity Theory, Social Presence

Key Concepts - user experience, interface design, accessibility

UNIT II: Emerging Trends (12 Hours)

Debates and Discussions on the following:

Virtual and Augmented Reality

Natural Language Processing

Artificial Intelligence

Internet of Things

Unit III: Socio-Cultural Impact (12 Hours)

Impacts on Relationships, Communication, Identity, Social Norms
Computer-mediated Habitats and Virtual Communities
Culture in Virtual Spaces
Art and Creativity in Cyberspace

UNIT IV: Ethics and Human-Digital Interaction (12 Hours)

Algorithmic Bias
Responsible Design
Accessibility Concerns
Laws and Regulations

Suggested Readings

- Julie A. Jacko, 2012. The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications. Taylor & Francis
- Sharp, H., Preece, J., and Rogers, Y. 2019. Interaction Design: Beyond Human-Computer Interaction. Wiley
- Gellman and Dixon. 2011. Online Privacy: A Reference Book. ABC-CLIO
- Cipolla-Ficarra, F., Ficarra, M.V., et al. 2017. Technology-Enhanced Human Interaction in Modern Society. IGI London

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVE (GE-04A):
Intervention Beyond Mental Illness

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Intervention Beyond Mental Illness (GE-04A)	**4**	**3**	**0**	**1**	**Class XII Pass**	**Student must have studied at least 3-4 papers/ courses in Psychology or Applied Psychology**

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide students with a comprehensive understanding of intervention beyond the concept of mental illness.
- To introduce students to the theory and practice of counselling and psychotherapy.
- To train students on basic skills of effective counselling that will meet the demands of the multi-faceted challenges of a counselling set-up.

Learning Outcomes

Upon completion of this course the students:

- Will gain a comprehensive understanding of the need for holistic intervention in the well-being of individuals.
- Will be able to integrate theory and practice to understand and deal with the diverse challenges of the counselling process.
- Will demonstrate technical skills and competencies to deal with a myriad of problems that get presented in a counselling set up.

SYLLABUS OF GE-04A

Unit 1: Basic Issues in Counselling (9 Hours)
Defining counselling; counsellor as a person; anxieties of young counsellors; ethical issues of practice and concern in counselling; current issues and challenges in counselling.

Unit 2: Theories & Techniques in Counselling (12 Hours)
Psychoanalytic Therapy; Person Centred Therapy; Cognitive-Behaviour Therapy; Postmodern Approaches in Counselling.

Unit 3: Process of Counselling (12 Hours)
Counselling skills; stages of counselling; process of counselling; barriers in the therapeutic process; evaluating effectiveness of intervention.

Unit 4: Integration and Application (12 Hours)
Using clinical case studies, discussions will be centred around integrating various therapeutic techniques in the areas of crises, adjustment difficulties, relationship breakdown, educational needs, behavioural problems, developmental needs, lifestyle issues, mental illness etc. Students will be required to develop an intervention plan for each case discussed.

Practical component (if any) – (30 Hours)

Students will be required to do fieldwork as part of the practical component. In their fieldwork students will be expected to collaborate with organisations/institutions and work on projects centred around the following areas:

a. Counselling and Youth, Gender & Diversity
b. Counselling with survivors of trauma
c. Counselling in relationship issues
d. Counselling and education

Suggested Readings:

- Corey, G. 2013. Theory and Practice of Counselling & Psychotherapy. 9th Edition. Cengage Learning.
- Feltham, C and Dryden, W. 2006. Brief Counselling: A Practical Integrative Approach. 2nd Edition. Open University Press, England.
- Gladding, S. T. and Batra, P. 2018. Counselling: A Comprehensive Profession. 8th Edition. Pearson Education.
- Hough, M. 2021. Counselling Skills and Theory. 5th Edition. Hodder Education, London.
- Nelson-Jones, R. 2015. Basic Counselling Skills: A Helper's Manual. 4th Edition. SAGE Publications Ltd.
- Sue, D. W. and Sue, D. 2015. Counselling the Culturally Diverse: Theory and Practice. 7th Edition. Wiley.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVE (GE-04B):
Heritage Tourism

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the Course
		Lecture	Tutorial	Practical/ Practice			
Heritage Tourism (GE-04B)	**4**	**3**	**1**	**0**	**Class XII Pass**	**Student must have studied at least 3-4 papers/ courses in Tourism or Allied Disciplines**	**Tourism Faculty at CIC**

Learning Objectives

The Learning Objectives of this course are as follows:

- To acquaint students with the significance of heritage tourism in India.
- To encourage students to find innovative ways for the promotion of tourism with special reference to Heritage Tourism.
- To enable the students for sustainable contributions to the tourism industry in India.

Learning Outcomes

Upon completion of this course, students:

- Will be able to appreciate the role of tourism in the preservation of our rich cultural heritage.
- Will be skilled in designing tourism products that will tap the unused and less explored tourism potential of the country.
- Will be skilled in designing innovative strategies that will bridge the gap between the preservation, protection and promotion of our rich cultural heritage.

SYLLABUS OF GE-04B

Unit I: Heritage Tourism Products (12 Hours)

Concept of Heritage Tourism Product
Life Cycle of a Tourism Product
Carrying Capacity of Heritage Destinations
Need for New and Innovative Tourism Products
Challenges in Heritage Tourism Product Designing

Unit II: Heritage Destinations in India (12 Hours)
Natural Heritage Sites
Cultural Heritage Sites
Intangible Cultural Heritage - Art, Dance, Music

Unit III: Heritage Interpretation and Communication (9 Hours)
Heritage Site Interpretation Methods
Visitor Engagement and Education
Marketing and Promotion of Heritage Sites
Digital Technologies and Virtual Heritage Experience

Unit IV: Practising Tourism (12 Hours)
Heritage Walks - Concept and Types
Importance of Heritage Walks
Designing and conducting different types of Heritage Walks

References (English)

- Agrawala, Vasudev Sharan. 1964. *The Heritage of Indian Art*. Publication Division, Ministry of Information & Broadcasting,
- Banerjee, Utpal K. 2006. *Indian Performing Arts: A Mosiac.* Harman Publishing House, New Delhi
- Basham, A.L. 1971. *The Wonder That was India*. Sidgwick & Jackson.
- Harle, J.C. 1986. *The Art and Architecture of the Indian Sub-continent*, Penguin, (Reprint, London, 1990).
- Kotler, Philip. 2002. *Marketing for Hospitality & Tourism.* PHI, New Delhi.
- Liddle, Swapna. 2011. Delhi: 14 Historic Walks. Westland
- Jafa, Navina. 2012. Performing Heritage: Art of Exhibit Walks. Sage India
- Jethwani, S. 2019. Salaam Delhi: Rediscovering 200 monuments in 25 Heritage Walks. Notion Press

(Hindi)

- Agrawala, Vasudev Sharan. 1965. *Bhartiya Kala*, Khand-1, Rajkamal Prakashan, Delhi.
- Basham, A.L. 1993. *Adhbhut Bharat*, (tr. by Venkateshchandra Pandey), Shiva Lal Agarwala & Co., Agra.
- Goyal, Ashish. 2010. *Aitahasik Paryatan*. ALP Books, Delhi.
- Goyal, Ashish. 2010. *Bharat Mein Paryatan Vikas*. ALP Books, Delhi.
- Singh, Surjit. 2012. *Bhartiya Sanskriti Avam Aitahasik Paryatan.* (Indian Culture and Heritage Tourism) Rawat Publication, Delhi.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVE (GE-04C):
Media Studies: Mapping the Field

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the Course
		Lecture	Tutorial	Practical/ Practice			
Media Studies: Mapping the Field (GE-04C)	**4**	**3**	**1**	**0**		**Student must have studied at least 3-4 papers/ courses in Media and Communication studies or Allied Disciplines**	**Media & Communication Studies Faculty at CIC**

Learning Objectives

The Learning Objectives of this course are as follows:

- To learn and appreciate the power of storytelling and its role in daily life
- To develop independence and confidence in methods of information exploration and consumption

Learning Outcomes

Upon completion of this course the students:

- will be trained in content production, technologies and contexts
- will be able to evaluate impact of the media on social values, culture and behaviour

Unit 1: Storytelling Renaissance (10 Hours)

Narratives: Roles and Challenges
Envisioning the form in digital age: Understanding the Transition
Representations: Anthropology of stories
Deconstructing the audience

Unit 2: The Geography of Media Landscape (10 Hours)

Global and Local: Forms and Practices
Vernacular Media: Mapping the issues and landscape

Unit 3: Understanding the Vehicles (12 Hours)

Mass Mediation
Newspapers/ Radio/TV/Film/Photo/Theatre/Media Convergence
Art for Policy Change: Script, Play and Production

Unit 4: Theses on Impact (13 Hours)

The New Information Age: Our Robot Storyteller
War, Conflict, Culture and Society
The New Misinformation Age
Media as Socio-Technological System: Pathway to SDGs

Suggested Readings:

- Benjamin, Walter. "The Work of Art in the Age of Mechanical Reproduction." In Illuminations. Orlando: Harcourt Brace, 1969.
- Selected Photographs of Lewis Hine: https://www.loc.gov/collections/national-child-labor-committee/about-this-collection/
- Lawrence Grossberg. "Wandering Audiences, Nomadic Critics." In Duke University Press. 1988.
- Janice Radway. "Reception Study: Ethnography and the Problems of Dispersed Audiences and Nomadic Subjects." In Duke University Press. 1988.
- Carolyn Marvin, "Dazzling the Multitude: Original Media Spectacles." In Oxford University Press. 1990
- Gilbert B. Rodman, "The Net Effect: The Public's Fear and the Public Sphere." In Columbia University Press. 2003
- Laikwan Pang, "Copying Kill Bill." In Duke University Press. 2005.
- Kipling, Rudyard. "The Man Who Would Be King.", Project Gutenberg. 2005.
- Hall, Stuart, et al. "The Social Production of News." In Media Studies: A Reader. 2nd. ed. Edited by Paul Marris, and Sue Thornham. New York City: NYU Press. 1999.
- McLuhan, Marshall. Understanding Media: The Extensions of Man. Cambridge: MIT Press, 1999.
- Orwell, George. "Nineteen Eighty-Four". Project Gutenberg of Australia. 2001.
- Selected articles of Geoffrey Hinton: https://www.technologyreview.com/2023/05/03/1072589/video-geoffrey-hinton-google-ai-risk-ethics/

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-04A): Innovation and Social Change

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Innovation and Social Change (DSE-04A)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

The learning objectives of this course are as follows:

- Understand the role of innovation in driving social change
- Learn to identify and assess opportunities for social innovation
- Develop skills in designing, implementing, and evaluating social innovation initiatives in the Indian context

Learning Outcomes

Upon completion of this course, students will -

- develop an understanding of the role of innovation in driving social change
- will be able to critically evaluate social innovation initiatives and approaches in the Indian context.
- will be able to design, implement and evaluate social innovation initiatives.
- will be able to work collaboratively with diverse stakeholders in the social innovation process.

OUTLINE OF DSE-04A

This course will provide students a critical understanding of the potential for innovation to drive social change as well as the practical skills and knowledge needed to design, implement and evaluate social innovation initiatives by factoring in the challenges like traditions and belief systems in societies. It will introduce students to the relevance of Design Thinking approach and human-centred design in this context. Besides learning from the latest case studies students will also be exposed to the indigenous knowledge and innovation practices of India.

Theoretical Component (01 credit): 15 hours

Understanding Social Problem; Traditions, Beliefs and Challenges in the context of innovation; Design Thinking Approach and human-centred design; Indigenous systems and Innovative Practices of India; Collaboration and collective action for social change; Innovation, Ethics and Social Responsibility; Case Studies of successful social innovations.

Suggestive Themes:

- Promoting Social Entrepreneurship
- Use of Education and Public Awareness in promoting innovative solutions
- Using traditions and beliefs for social innovation
- Learning from Indigenous systems and Innovative Practices

- Exploring art forms for social innovations

Practical component (if any) - 75% **90 hours**

Depending on the theme chosen by the group of students the practical component of this paper may entail learning through practical exercises like:

- Identifying relevant fields/cases, social startups, indigenous social innovation practices, etc.
- Students may explore, document, and analyse indigenous systems and innovative practices of India, focusing on their cultural, environmental, and socio-economic significance and change. Students may analyse case studies of successful social enterprises. They can examine their business models, strategies for impact measurement, and scalability challenges.
- Using Design Thinking Process as a tool for problem-solving and innovation
- Introduction to ideation tools like Lean Canvas
- Introduction to collaboration tools like Trello or Slack

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-04B):
Technology and Innovation Policies

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Technology and Innovation Policies (DSE-04B)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

The learning objectives of this course are as follows:

- To critically evaluate the current innovation and technology policies
- To assess the role of government and public policy in driving technological innovation
- To examine the technology and innovation policies in the context of sustainability

Learning Outcomes

Upon completion of this course, students will-

- Evaluate of the state of technology and innovation policies in India in comparison the leading economies of the world
- Learn the importance of effective policy interventions in the area of innovation and technology
- Evaluate the impact of intellectual property rights and patent law on innovation outcomes

OUTLINE OF DSE-04B

The course will introduce students to policies in the gamut of Technology and Innovation. It will stress on the role of government in fostering innovation by focusing on the function of public policy on innovation and technological development especially in the India context. The course will examine the relationship between innovation and technology policy and issues such as intellectual property rights, etc. It will engage with the ethical and social implications of technological change. Students will develop an understanding of how different policy approaches can impact technological development, innovation outcomes and society as a whole.

Theoretical Component (01 credit): 15 hours

Technology and Knowledge Diffusion; Triple Helix Model; Technology Transfer; Capacity Building; Knowledge Society; Open Innovation; Technology Governance.

Indicative Themes

- Technology and economic development
- Intellectual property and innovation
- Technology and Society
- Innovation and sustainability
- Digital transformation and future of work

Practical component (if any) - 75% **90 hours**

Depending on the theme chosen by the group of students the practical component of this paper may entail learning through practical exercises like:

- Identifying relevant fields/cases, public policies, sustainable practices, etc.
- Analysing case studies of countries or regions that have experienced significant economic growth due to technological advancements
- Analysing ethical dilemmas posed by new technologies, considering factors like privacy, equity, autonomy, and societal impact
- Studying and conceptualising products that promote sustainability
- Developing an IP strategy for a new technology or product that the students have conceptualised.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-04C):
Social Innovation and Entrepreneurship

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Social Innovation and Entrepreneurship (DSE-04C)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

The learning objectives of this course are as follows-

- To develop an entrepreneurial mindset amongst students
- To ensure that students learn and build skills in collaboration and partnership building.
- To encourage students to learn strategies for scaling social impact and managing growth for social ventures.

Learning Outcomes

On completion of this course, students will be able to -

- identity and seize opportunities for social innovation and entrepreneurship.
- apply the tools and frameworks such as design thinking and human-centred design.
- apply the knowledge and skills to develop social innovation projects including a business plan, pitch and prototype.

OUTLINE OF DSE-04C

This course is geared towards exposing students to entrepreneurial practices in various social sectors in order to encourage them to become entrepreneurs. The course will focus on foregrounding Startups designed towards addressing social problems and advocating larger public goods.

Theoretical Component (01 credit): 15 hours

Understanding Social Innovation and Entrepreneurship; Towards Entrepreneurial mindset, team building and leadership for startups; Product development and Innovation; Business Planning and Strategy for Startups; Entrepreneurial Ethics; Entrepreneurial Ecosystem and networks; Exit strategies and managing risks.

Indicative Themes:

- Ideating and designing a Startup
- Incubating Startups for Social Entrepreneurship

Practical component (if any) - 75% **90 hours**

Depending on the theme chosen by the group of students the practical component may include:

- Simulating a startup scenario where students develop a social business idea from concept to execution.
- Collaborating on tasks such as market research, product development, financial planning, and marketing strategy.
- Engaging with case studies involving ethical dilemmas faced by entrepreneurs, discuss potential consequences, and propose ethical solutions or guidelines for responsible entrepreneurship.
- Organising networking events where students interact with important stakeholders, pitch their startup ideas, seek feedback, and explore potential collaborations or partnerships.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-04D):
Economic Policies and Governance

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Economic Policies and Governance (DSE-04D)	**4**	**1**	**0**	**3**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

- To provide students with a comprehensive understanding of the various economic policies
- To have a comprehensive historic view of economic policies in India.
- To situate national economic policies in the context of global financial institutions and politics.

Learning Outcomes

- Students will be able to analyse and evaluate the effectiveness of various economic policies.
- Students will develop a nuanced understanding of the complexities and challenges of economic policy making.

OUTLINE OF DSE-04D

Being aware of economic policies enables us to understand people, markets, businesses, and financial institutions and therefore better respond to opportunities and threats that impact our daily lives. This course is designed to encourage students to understand the implications of economic policies and their impact on economic and social growth, development and distribution. The course will also help students identify policy measures, which will address the sustainable utilisation of resources. This course will also equip students to critically analyse society through the frame of political economy.

Theoretical Component (01 credit) **15 hours**

Development economics, political economy, mixed economy, macroeconomics, institutional economics

Indicative Themes:

- Monetary policies
- Digital banking
- Agricultural and rural development
- Human Development
- International Trade
- Tourism Policies

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component may include:

- Identifying and navigating authentic sources for economic data.
- Analysing economic data like inflation rate, GDP growth, unemployment and external factors like global economic trends, political events.
- Designing monetary policy actions such as setting interest rates, open market operations and presenting it with rationale, followed by a discussion on the implications for economic stability and growth.
- Proposing innovative features in economic governance leveraging technologies such as AI, blockchain, or mobile banking and articulate their social implications.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-04E):
Environmental Policies and Governance

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Environmental Policies and Governance (DSE-04E)	4	1	0	3	Class XII Pass	Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)

Learning Objectives

The learning objectives of this course are as follows:

- Students will be introduced to the key actors and institutions involved in environmental governance.
- To make students analyse the policy-making process and factors that shape environmental policy decisions.
- To encourage students to evaluate the impact of environmental policies and regulations on the environment and society.

Learning Outcomes

Upon completion of this course, students will -

- have developed the skills required for policy analysis and evaluation in the context of environment and climate change.
- be able to critically analyse the role of non-state actors in environmental governance and natural resource management.
- be able to use policy advocacy as a tool to address environmental issues.

OUTLINE OF DSE-04E

This course provides an in-depth study of the policy tools and strategies designed by the governments and other organisations to address environmental issues. It will also examine the theoretical foundations and practical applications of environmental policies. The course is geared towards raising awareness about the implications of environmental policies on other aspects of a society like, livelihoods, economic inequality and gender disparity. The course will critically examine the environmental policies and governance in India in light of Climate Change, Sustainability and Environmental Justice.

Theoretical Component (01 credit): 15 hours

Environmental ethics, ecological economics, environmental governance, environmental justice, sustainable development, risk assessment and management.

Indicative Themes:

- Natural resource management
- Climate Change ACTS
- Environmental justice
- Biodiversity conservation

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component may include:

- Assessing climate vulnerabilities like extreme weather events, sea-level rise, conduct risk assessments, and propose adaptation measures like infrastructure upgrades, community resilience programmes.
- Developing a management plan considering ecological sustainability, economic viability, and social equity; analysing trade-offs, negotiating agreements, and proposing strategies for resource conservation and equitable distribution.
- Designing mitigation strategies— renewable energy projects, carbon footprint reduction initiatives, etc.
- Conducting an Environmental Impact Assessment of development projects and assess its social and environmental impacts, and aspects of environmental justice.
- Hands-on habitat restoration project in a local natural area. Students conduct site assessments, identify native species, and implement restoration techniques such as invasive species removal, native plantings, and habitat enhancements. They monitor ecological indicators and biodiversity changes over time, documenting progress and challenges faced.
- Using GIS, students will simulate disaster vulnerability and conduct scenario analysis using climate models, land use models and impact model.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-04F):
Social Policies and Governance

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Social Policies and Governance (DSE-04F)	4	1	0	3	Class XII Pass	Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)

Learning Objectives

The learning objectives of this course are as follows:

- To equip students with the knowledge and skills to analyse, evaluate, and contribute to the development of effective and equitable social policies in diverse contexts.
- To enable students to make connections between social policies and other institutions of society.

Learning Outcomes

Upon completion of this course, students will -

- be skilled to contribute to the development of effective social policies.
- be able to appreciate the complex socio-economic-cultural framework within which policies are framed.
- develop a deeper understanding of the complex challenges and dilemmas involved in social policy making and implementation, and the different perspectives and values that inform policy choices.

OUTLINE OF DSE-04F

Social policies reflect the intent and actionable plan of governments to address social issues and challenges, such as poverty, inequality, education, healthcare, housing, employment, and social welfare. These policies are aimed at improving the quality of life of citizens, promoting social justice and equity, and ensuring that everyone has access to basic necessities and services. This course will provide a comprehensive overview of social policies, including their history, design, implementation, and evaluation. It critically examines the political, economic, and social factors that shape the development and implementation of social policies, as well as their impact on different social groups and the broader society.

Theoretical Component (01 credit) **15 hours**

Social justice, welfare state, social exclusion, social capital, participatory democracy, empowerment, public goods, human rights

Indicative Themes:

- Gender & diversity policies
- Cultural policies
- Public policies for the vulnerable groups (children, women, indigenous groups, etc.)
- Social welfare policies
- Education policies
- Public Health Policies

Practical component (if any) - 75 % **90 hours**

Depending on the theme chosen by the group of students the practical component may include:

- Students may identify case studies/policies focusing on social issues like poverty, healthcare, disability, gender, etc. They analyse the case studies through the lens of assigned concepts. They identify social justice implications, evaluate existing policies or interventions, and propose alternative approaches to address underlying social inequalities or injustices. The activities will emphasise on evidence-based analysis and policy recommendations.

- Students may organise workshops where they analyse cases highlighting biases against vulnerable groups, assess diversity gaps, and propose policy recommendations for promoting equality and inclusivity in recruitment, workplace, and decision-making processes. They create action plans with measurable goals and strategies for monitoring progress.

- Students can collaborate with local organisations or communities affected by social issues, organise workshops, focus groups, or participatory forums to gather community perspectives on proposed policy solutions and assess community needs and priorities. Students reflect on the effectiveness of their advocacy strategies, document community feedback, and revise policy recommendations accordingly.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE (DSE-04G):
Methodological Designs for Humanities & Social Sciences Research

Credit Distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Methodological Designs for Humanities & Social Sciences (DSE-04G)	**4**	**3**	**1**	**0**	**Class XII Pass**	**Student must have studied Qualitative and Quantitative Social Inquiry (DSC-03)**

Learning Objectives

The learning objectives of this course are as follows:

- To develop an understanding of the key concepts of research in Humanities and Social Sciences.
- To train students to select and apply appropriate research methods for a given research question.

Learning Outcomes

On completion of this course, students will be able to-

- understand and articulate the role of research methodology in informing and advancing knowledge in Humanities and Social Sciences research.
- select and apply appropriate research methods to answer research questions in Humanities and Social research.

SYLLABUS OF DSE-04G

Unit 1: Concepts and Issues in Humanities and Social Sciences Research (9 Hours)

Defining research; theory and theory construction; philosophical paradigms of research; ethical implications; reviewing literature; issues and challenges in humanities and social sciences research

Unit 2: Quantitative Research Design (12 Hours)

Survey Design (developing a questionnaire, collecting data on an appropriate sample, analysing different statistical methods (using SPSS));

Correlational Design (using an appropriate data collection tool, collect data and analyse using appropriate statistics and interpret the findings (using SPSS))

Unit 3: Qualitative Research Design (12 Hours)

Case Study (approach this design using appropriate sampling technique, interview/ observation to collect data (primary and secondary) and analyse the data using thematic analysis/ narrative analysis/ IPA etc.)

Use of content analysis, textual analysis, discourse analysis and critical discourse analysis for qualitative research design.

Unit 4: Mixed Research Design (12 Hours)

Approach this topic by using both quantitative and qualitative data to answer a research question, integrate and analyse the mixed data.

Suggested Readings:

- Creswell, J. W. and Creswell, J. D. 2018. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 5th Ed. SAGE Publications.
- Flick, U. 2017. An Introduction to Qualitative Research. 5th Ed. SAGE Publications Private Limited.
- Neuman, L. 2014. Social Research Methods: Pearson New International Edition: Qualitative and Quantitative Approaches. 7th Ed. Pearson India Education.
- Wertz, F. J., Charmaz, K., McMullen, L. M., Josselson, R., Anderson, R., McSpadden, E. 2011. Five Ways of Doing Qualitative Analysis: Phenomenological Psychology, Grounded Theory, Discourse Analysis, Narrative Research, and Intuitive Inquiry. 1st Ed. Guilford Press.
- Yin, R. K. 2015. Qualitative Research from Start to Finish. 2nd Ed. Guilford Press.
- Yin, R. K. 2017. Case Study Research and Applications. 6th Ed. SAGE Publications Private Limited.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

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B.A. Programme (Education discipline as one of the Discipline core Courses)

SEMESTER-V & VI

Based on Undergraduate Curriculum Framework 2022

UNIVERSITY OF DELHI

UNDERGRADUATE PROGRAMMESOF STUDY

STRUCTURE, COURSES & SYLLABI OF SEMESTER – V

Disclaimer: The syllabi are uploaded are as approved by the Academic Council on ..... and Executive Council on .....

Manisha

COURSES OFFERED BY DEPARTMENT OF EUCATION

Category II

(B.A Programme Courses for Undergraduate Programme of study with Education discipline as one of the Core Disciplines)

DISCIPLINE SPECIFIC CORE COURSE – 9 (DSC – 9): Teacher and Teacher Education

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ practice		
Teacher and Teacher Education DSC - 9	4	3	1	0	Class XIIth pass	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Discuss the relationship among the concepts on Teaching, Learning, Teacher and Teacher Education
- Develop a Historical perspective on Development of Teacher Education in India
- Describe the Role of Different Agencies in the organisation of Teacher Education in India
- Discuss the education policy documents to understand the status, context of teacher education in India

Learning Outcomes

After completion of the course, student will be able to:

- Explain the relationship among the concepts on Teaching, Learning, Teacher and Teacher Education.
- Compare the Development of Teacher Education in India in a historical context
- Analyse pre-service and in-service teacher education
- Explain the roles of various teacher education agencies
- Analyse various policy documents to infer its role in shaping Teacher Education in India

Manjula

SYLLABUS OF DSC-9

Hours 45

Unit I: Understanding Teacher and Teacher Education (12 hours)

- Changing conceptions of Teaching and Learning; its Implications to teachers and teacher education
- Development of Teacher Education in India: Ancient, Buddhist, Medieval, Modern and Post-Independent period

Unit 2: Teacher Education Programmes and Role of Different Teacher Education Agencies

(15 hours)

- Pre-service Teacher Education at different levels
- In-Service Teacher Education / Continuous Professional Development of Teachers
- NCTE, NCERT, NUEPA and UGC
- SCERT, IASE, CTE, DIET

Unit 3: Teacher Education and Educational Policy Documents (18 hours)

- Education Commissions [University Education Commission (1948); Secondary Education Commission (1952); and National Education Commission (1964-66)]
- National Commission on Teachers (1983)
- Teacher Education Curriculum Frameworks [Teacher Education Curriculum: A Framework (1978); National Curriculum for Teacher Education: A Framework (1988); Curriculum Framework for Quality Teacher Education (1998); and National Curriculum Frameworks for Teacher Education (2009)]
- Educational Policies [National Policy on Education (1968); National Policy on Education (1986); Revised National Policy on Education (1992) and its Programme of Action; and National Education Policy (2020)]

Practicum/ Suggested Projects / Assignments (Any Two)

- Collaborative Group project to analyse the teacher education related contents from Educational Policies and understand the development of teacher education in India and related issues.
- Compare the teacher education curriculum frameworks
- Write a report on changes in teacher education by visiting NCTE and other relevant websites.

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Manisha

Essential/ Recommended Readings

- Darling-Hammond. L. (1995). Changing Conceptions of Teaching and Teacher Development. *Teacher Education Quarterly*, 22(4): 9-26.
- Dixit, U.N. (). *Focal Points in the Development of Teacher Education in India*. In Resource Book on Teacher Education in India. New Delhi: NCERT.
- Mangla, Sheela. (2010). Teacher Education: Trends and Strategies. Delhi: Radha Publications.
- Mohan, Radha. (2019). Teacher Education. Delhi: PHI Learning Private Limited.
- Srivastava, R.C. (1997). Teacher Education in India: Issues and Perspectives. New Delhi: Regency Publications.

Additional Readings

- Ministry of Education, GoI (1962). The Report of the University Education Commission-1948 (First Reprint Edition). Delhi: The Manager Government of India Press.
- Ministry of Education, GoI. (1952-53). Report of the Secondary Education Commission. New Delhi: MoE.
- Ministry of Education, GoI. (1966). Report of the Education Commission (1964-66): Education and National Development. New Delhi: MoE.
- MHRD (1985). Report of the National Commission on Teachers (1983-85). New Delhi:
  Govt. of India.
- NCERT. (1978). Teacher Education Curriculum: A Framework. New Delhi: NCERT.
- NCERT. (1988). National Curriculum for Teacher Education: A Framework. New Delhi: NCERT.
- NCTE. (1998). Curriculum Framework for Quality Teacher Education. New Delhi: NCTE.
- NCTE (2009). National Curriculum Framework for Teacher Education: Towards Preparing Professional and Humane Teacher. New Delhi: NCTE.
- Ministry of Education, GoI. (1968). National Policy on Education, 1968. New Delhi: GoI.
- MHRD, GoI. (1986). National Policy on Education, 1986. New Delhi: GoI.
- MHRD, GoI. (1998). National Policy on Education 1986 (As modified in 1992). New Delhi: GoI.
- MHRD, GoI. (1992). National Policy on Education 1986: Programme of Action 1992. New Delhi: GoI.
- MHRD, GoI. (2020). National Education Policy 2020. New Delhi: GoI.

Audio Visual Material: Across Units

1. To Sir with Love. 1967. Film -- Directed by James Clavell.
2. Stand and Deliver. 1998. Directed by Ramón Menéndez.

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Teaching Learning Process:

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end- semester examination.

Key words

Teacher, Teacher Education, Pre-service Teacher Education, Continuous Professional Development, Educational Policies, National Curriculum Framework on Teacher Education.

Note: Examination Scheme and mode shall be as prescribed by the Examination Branch, University of Delhi from time to time.

Manisha

DISCIPLINE SPECIFIC CORE COURSE – 10 (DSC-10): Schooling in India

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ practice		
Schooling in India DSC 10	**4**	**3**	**1**	**0**	**Class XIIth pass**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- To locate schooling in India in the context of colonialism, nationalism and social reform.
- To create an understanding of school systems, structure, and its policy foundations.
- To develop an understanding of different types of schooling, financing, school management and organization in India.
- To create an understanding of different kinds of school experiences based on caste, class and gender.

Learning Outcomes

After completion of the course student will be able to:

- Discuss characteristics ofindigenous education in preindependence education.
- Explain the growth of mass schooling in India
- Explain the constitutional provisions and relevant policies for expansion of school education.
- Elaborate and analyse the discourses of state, market, welfare, rights in schooling.
- Critically examine the different school systems and realities that compose school experiences.
- Conduct basic interviews and report them systematically.
- Reflect upon and analyse different kinds of school experiences.

SYLLABUS OF DSC-10 **45 Hours**

Unit 1: Schooling in preIndependence India: An Introduction (14 hours)

- Indigenous education in 18th and 19th century Malabar, Bengal, Punjab.
- Schooling and English education: Wood's Dispatch(1854) and William Bentinck Committee Report (1835)
- Schooling and Experiments in Reform in colonial period(Dalit education, Tribal education, Muslim girl's education).
- National movement and school education: Wardha Scheme of Basic Education 1938

Unit 2: Schooling discourses in post-Independence India (16 hours)

- India's emergence as a nation state and Schooling: To read with reference to Secondary Education Commission, Indian Education Commission(1964-66), National Education Policy 1968
- Schooling for human development:Development as freedom, health and nutrition in schools, state level disparities
- Schooling as a Right: Constitutional provisions, Right to Education Act 2009,
- Schooling and the market: Private schooling, Shadow schooling, Equity concerns

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Unit 3: School System and Experiences of schooling (15 hours)

- National System of School education: Policies on school structure, Centre, State and Local body schools
- Types of schooling: common school system, neighborhood schools, stratification in schools
- Schooling Experiences of students and teachers in Public school system, Alternative schools, experimental schools

Practicum

- Projects and assignments on historical and contemporary school practices in India based on essential readings, stories, novels, films, memoirs and diaries.
- Reading and analysis of policy documents on school structure, organization, systems, governance.
- Observation Reports and reflections on specific areas of school: For e.g. Access to schools, School Buildings, Shadow schooling, School schedules and other rituals of schooling.
- Interview of various actors of school, such as Principals, Teachers, School students, non-teaching staff
- Comparative analysis of school experiences of schools in the neighborhood.

Note: The above are suggestive in nature and the teacher may design his/her own assignments and projects as per the specific needs of the class group. The practicum can be done through both individual and group project work.

Essential Readings

Unit 1

Dharampal. (2000). *The Beautiful Tree: Indigenous Indian Education in the Eighteenth Century.*, Mapusa Goa: The Other India Press. (p.p17-23, FraPaolino Da Bartolomeo on Education of Childrenin India, 1796, Extracts From William Adam's State of Education in Bengal 1835-38, G.W. Leitner on Indigenous Education in the Panjab)

Bhattacharya, Tithi. 2005. "Chapter 4: Education and Its Necessary Virtues." In *Sentinels of Culture*, 153–83. New Delhi: OUP.

Zelliot, Eleanor. 2002. "Experiments in Dalit Education: Maharashtra 1850-1947." In *Education and the Disprivileged: Nineteenth and Twentieth Century India,* edited by Sabyasachi Bhattacharya. Hyderabad: Orient Longman.

Bara, Joseph. 2002. "Tribal Education, the Colonial State and Christian Missionaries: Chhotanagpur, 1839-1870." In *Education and the Disprivileged: Nineteenth and Twentieth Century India,* edited by Sabyasachi Bhattacharya. Hyderabad: Orient Longman.

Minault, Gail. 1999. *Secluded Scholars: Women's Education and Muslim Social Reform in Colonial India*. India: Oxford University Press. Chapters 5 and 6

Sykes, Marjorie. 1988. *The Story of NaiTalim : Fifty Years of Education at Sevagram, 1937-1987 : A Record of Reflections*. Sevagram, Wardha: NaiTalimSamiti. Chapters 1-5

Unit 2

Ghosh, Suresh Chandra. 2000. *The History of Education in Modern India, 1757-1998*. New Delhi: Orient Longman. Chapter 18 and 19

De, Anuradha. 2011. *Probe Revisited: A Report on Elementary Education in India*. India: Oxford University Press.

Kumar, Krishna. 2021. "Chapter 4: The Logic of Children's Right to Education." In *Smaller Citizens: Writings on the Making of Indian Citizens*. Orient Blackswan.

Manisha

Majumdar, Manabi, and Sangram Mukherjee. 2015. "Free to Choose or Free to Lose? Debating 'Ability to Pay' for Education." *India International Centre Quarterly* 42 (3/4): 143–56. http://www.jstor.org/stable/26316580

Unit 3

Ministry of Education, GoI. (1968). National Policy on Education, 1968. New Delhi: GoI.
MHRD, GoI. (1986). National Policy on Education, 1986. New Delhi: GoI.
MHRD, GoI. (2020). National Education Policy projects/ assignments. 2020. New Delhi: GoI.
Sarangapani, Padma M. 2018. "Institutional Diversity and Quality." In *The Routledge Handbook of Education in India: Debates, Practices, and Policies*, edited by Krishna Kumar.
Vittachi, Sarojini, NeerajaRaghavan, and Kiran Raj. 2007. *Alternative Schooling in India.* Thousand Oaks, California: Sage Publications.
Yash Pal Committee. (1993). Learning Without Burden: A Report to the Nation. Government of India, Ministry of Human Resource Development.

Additional Readings:

Poromesh, Acharya. 1987. "Education, Politics and Social Structure." In *Education and the Process of Change*, edited by RatnaGhosh and Mathew Zachariah. Sage Publications.
Basu, A. (1985). Review of *The Beautiful Tree: Indigenous Education in the Eighteenth Century; One Teacher, One School*, by Dharampal& J. Dibona. *Comparative Education Review*, *29*(1), 137–140

Sadgopal, Anil. 2010. "Right to Education vs. Right to Education Act." *Social Scientist* 38 (9/12): 17–50.
Sharma, Santosh, ed. 2013. *What Is RTE? Some Ways of Making Education Accessible: A Handbook for Teachers.*
Jha, Jyotsna. 2015. "Education India Private Limited." *India International Centre Quarterly* 42 (3/4): 39–51.
http://www.jstor.org/stable/26316574

Additional Resources

Interview on Right to Education Act with Vinod Raina:
https://edaa.in/site/ek-duniya-ek-awaaz/audio/dr-vinod-raina-on-right-to-education-act
Essay on teaching the Constitution by Krishna Kumar https://www.historyforpeace.pw/post/teaching-the-constitution
RTE guidelines from NCERT
https://ncert.nic.in/dee/pdf/guidelines16.12.2013.pdf

Teaching Learning Process:

The Course is to be taught through lectures, discussions, project work, reading of original school testimonies and policies. Observation and critical analytical skills are to be developed and reflective practices inculcated in the teaching-learning of the course. Interactive pedagogic methods such as classroom discussion, debates, film analysis are to be used. Individual and collaborative projects are to be undertaken and meticulous reporting encouraged.

Assessment Method

The assessment will be formative in nature and will include student participation. Individual and group tasks and assignments will be given. Summative evaluation will be through end semester examination.

Key words

Schooling, Indian education, School Experiences, School system

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

Manisha

DISCIPLINE SPECIFIC ELECTIVE COURSE –I (A) (DSE-1 A: **Social Science Education**

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ practice		
Social Science Education **DSE I (A)**	**4**	**3**	**1**	**0**	Completed 4 core courses in education	**NIL**

Learning Objectives

The learning objectives of this course are as follows:

- To sensitize and apprise the students about the essence and need of social science, along with its interrelationships and interactions with other disciplines.
- To make students understand the philosophical and historical foundation of social science.
- To familiarize the students with the paradigm of the construction of knowledge and research in social science.
- To enable students to develop the expertise and skills to understand and analyze society and social behavior in a context specific manner.

Learning Outcomes

After completion of the course, student will be able to:

- explain key theories and historical developments that have shaped the field of Social Science.
- critically analyze the evolution of social science disciplines and their relevance in contemporary society.
- identify and articulate major political, social, and economic issues affecting modern society.
- demonstrate an understanding of how local actions and events are connected to global processes and outcomes.
- develop the ability to critically reflect on the practice of democracy and constitutional values in their own lives and communities.

Manisha

SYLLABUS OF DSE-1A

45 Hours

Unit I: Meaning, Nature and scope of Social Science (15 hours)

- Meaning, Concept, Nature, and Scope of Social Science
- Aims and Objectives of Social Science
- Distinction between Social Science and Social Studies
- Relations of Social Science with other Subjects: (History, Political Science, Geography, Economics)

Unit 2: Social Science and its Relationships and interaction with other Disciplines (15 hours)

- Social Science and its Interaction with Humanities (Philosophy, Psychology, Fine arts, Languages)
- Social Science and its interaction with Intra Components of Social Science(History, Political Science, Geography, Economics, Sociology and Anthropology etc)
- Social Science and its interaction with science (Physics, chemistry, Biology and Computer Science.

Unit III : Emergence of Social Science in the modern world (15 hours)

- Philosophy of Social Science
- Emergence of Social Science in the modern world and Major Historical phases (Emergence of Social Science under the tutelageof Natural Sciences. Rise of Modern Nation State and its impact on the Social science. Social science in Post-world war Scenario andSocial science in the age of networking society)
- Major paradigm of construction of Knowledge and Research in Social Science (Positivist Paradigm,post- Positivist Paradigm, Political theories and postmodernism.)

Practicum/ Suggested Projects / Assignments (Any Two)

- Visit any agency such as Museums and Historical places etc.
- Interact with the community to understand their social behaviour about specific activities of society.
- Conduct a survey in any social environment to understand the criteria for selecting the stream of study (social- science, science, humanities, and commerce).

Manuals

- Prepare a profile of potential job perspectives on the basis of a particular stream of study (social- science, science, humanities, and commerce).
- Undertake any experiments and prepare a detailed report while using tools and techniques for the construction of knowledge in any discipline that comes under the rubric of social science.

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Essential/ Recommended Readings

- Teltumre, S. (2018).*Republic of Caste in India*. Delhi: Navyana Publication
- K. Webb (1995). *An Introduction to Problems in the Philosophy of Social Sciences*. New York: Pinter, London,
- Arora, P (2014). Exploring the Science of Society. *Journal of Indian Education*. NCERT, New Delhi.
- Arora, P (2014). A Democratic Classroom for Social Science. *Project Report*, University of Delhi, Delhi.
- Batra, P. (Ed 2010). *Social Science Learning in Schools: Perspective and Challenges*.New Delhi: Sage Publications.
- Bining, A.C. & Bining, D.H.(1952).*Teaching of Social Studies in Secondary Schools*. Bombay: Tata McGraw Hill Publishing Co. Ltd.
- Crotty, M., (1998). *The Foundations of Social Research: Meaning and Perspective in the Research Process*. London: Sage Publication.
- Gaurav J. Pathania , et.al. (2023). Caste Identities and Structures of Threats: Stigma, Prejudice, and Social Representation in Indian Universities. *CASTE: A Global Journal on Social Exclusion*, Vol. 4 No. 1 pp. 03 23.
- Hamm, B. (1992).Europe – A Challenge to the Social Sciences. *International Social Science Journal* (vol. 44).
- Haralambos, M. (1980). *Sociology Themes and Perspectives*. New York: O.U.P.
- Kumar, S. (2013).Teaching of Social Science. *Project Report*. University of Delhi, Delhi.
- Kirkpatrick, E. (1997). *Foundation of Political Science: Research, Methods and Scope*. New York: The free press.
- Mayor, F. (1992). The Role of the Social Sciences in a Changing Europe. *International Social Science Journal* (vol. 44).
- Misra, S. & Ranjan, A. (2012).Teaching of Social Sciences: History, Context and Challenges in Vandana Saxena (ed.), *Nurturing the Expert Within*. Pearson, New Delhi.
- Winch, P. (1985).*The Idea of a Social Science and its Relation to Philosophy*. New York: Humanities Press.
- Sony, Y.(2022).*Sprout Story of Species and Geographia*. Bhopal: Eklavya Publication

- Wagner, P. (1999). The Twentieth Century – the Century of the Social Sciences? *World Social Science Report.*
- Wallerstein, I, et al., (1996). Open the Social Sciences: Report of the Gulbenkian Commission on the Restructuring of the Social Sciences. New Delhi: Vistaar Publications,
- Zevin, J., (2000). *Social Studies for the Twenty first Century.* London:Lawrence Erilbaum Associates.

Additional Readings

- Freire, P., (1995). A Dialogue: Culture, Language and Race.*Harvard Educational Review,* Vol.65 No.3.
- Kumar, K. (2016).*Raj SamajaurShiksha.* Delhi:RajKamal Prakashan,
- H.S. Gorden (1991).*The History and Philosophy of Social Science.* London and New York: Routledge.
- Alexander R. (2016).*Philosophy of Science and Social science.*London and New York:
  Routledge.
- Subramanian,S. (1997).*Measurement of Inequality and Poverty.*London: Oxford University Press

Teaching Learning Process:

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through the end- semester examination.

Key words: Social science, Paradigms, Evolution.

DISCIPLINE SPECIFIC ELECTIVE COURSE – 1B (DSE 1B): SCIENCE EDUCATION

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ practice		
Science Education DSE – 1B	4	3	1	0	Completed 4 core courses in education	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Develop an insight of the Nature and History of Science.
- Know and comprehend Indian contribution to the world of Science in both Ancient and Modern times.
- Elaborate and summarize the development of science in the international perspective.
- Develop comprehension of science and scientists in India, including its institutions, research, and development.
- Identify and explore potential learning resources in the area of science including indigenous knowledge and traditional ecological knowledge.
- Analyzethe nature of learning and assessment in the area of science.

Learning outcomes

On completion of this course, learners will be able to:

- Explain the Nature and History of Science and summarize the development of Science in the International Perspective
- Learn and appreciate Indian Contribution to the world of Science in both Ancient and Modern times
- Critically examine potential learning resources in the area of science including indigenous knowledge and traditional ecological knowledge
- Critically evaluate the Nature of learning and assessment in the area of science

SYLLABUS OF DSE 1B

45 Hours

Unit I: Nature and History of Science (15 hours)

- Scientific Inquiry: Tentative and Revisionary Nature of Science
- Place of Science Education in Indian School Curriculum
- Science for Sustainable Development - Role of Indian Cultural Heritage and Indigenous Knowledge Systems
- Contribution of Indian Thoughts and thinkers in the Domain of Scientific Knowledge like Baudhayan Sulbha-Sutra, Aryabhat and Aryabhatika, Varahmihira and his Panchsidhant, Sushurut, Ayurveda, Yoga etc.

- Ancient Indian Classification of Animals, Measurement of Distance and Time
- Development of Science in International Perspective

Unit 2: Practice of Science (15 hours)

- Criteria for selecting/designing Learning Resources in Science
- Improvisations and Science Kits
- Science in Everyday Practices
- Present and Past Institutions of Research & Development of Science and Technology in India including Taxshila and NalandaVishvavidyalaya
- Role of activities like science quiz, science fair, science corner/resource room, science club, excursion and related SUPW in learning science
- Some Eminent Indian Scientists like Sir J. C. Bose, Ramanujan, Meghnad Saha, Sir C.V. Raman, Janaki Ammal

Unit 3: Science Learning:Resources and Assessment(15 hours)

- Potential of Traditional Ecological Knowledge as local learning resource in Different States in India
- Role of Textbooks, reference books, encyclopaedia, newspapers etc. in dissemination of science
- Learning science through multi-media packages, interactive software, websites, Open Education Resources(OER) etc.
- Role and limitations of Science Laboratories
- Assessment in Science, Assessment of laboratory work and project work, Assessment through creative expression-drawing, posters, drama, poetry, etc
- Nature of learning and assessment, analysis and critique of the present pattern of examinations.

Practicum/ Suggested Projects / Assignments (Any Two)

- Observe and document the traditional ecological knowledge available around you
- Engage in self-reflection and document the role of different learning resources in your learning of Science
- Interview five elderly of your community to explore the Traditional Ecological Knowledge available through their life experiences and practices in which they engaged so far
- Watch either 'The Man Who Knew Infinity (2015)' or 'Mission Mangal' (Bollywood Films) and describe how life and experiences of scientists unfolds in them.

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Essential/ Recommended Readings

- Mehrotra, A., Khirwadkar, A., Koul, A., Jha, A. K., Sharma, K., Mohapatra, M., Tyagi, P., Garg, R., Kumar, R., Koireng, R. R., Sindhu, R. S., Sharma, S., Abdullah, S., Aziz, T., & Bhatia, V. B. (2013). *Textbook of Pedagogy of Science (Physical Science) (Part I) ISBN 978-93-5007-224-0.* National Council of Educational Research and Training.
- Mehrotra, A., Khirwadkar, A., Koul, A., Jha, A. K., Sharma, K., Mohapatra, M., Tyagi, P., Garg, R., Kumar, R., Koireng, R. R., Sindhu, R. S., Sharma, S., Abdullah, S., Aziz,

T., & Bhatia, V. B. (2013). *Textbook of Pedagogy of Science (Physical Science) (Part II) ISBN 978-93-5007-225-7*. National Council of Educational Research and Training.
- Mishra, K. (2003). *Sanskrit Vangmay me Vigyan Kaltihas (संस्कृतवांग्मयमेंविज्ञानकाइतिहास*) (1st ed.). National Council of Educational Research and Training.
- Jain, N. K. (1982). *SCIENCE AND SCIENTISTS IN INDIA*. Indian Book Gallery.

Additional Readings

- Sarukkai, S. (2012). What is Science? National Book Trust, Govt. of India.
- Singh, S. (2017). The Educational Heritage of Ancient India. NotionPress.
- Singh, G., & Kumar, R. (2017). Science: Perspective and Nature. In Pedagogy of Science (pp. 7–30). Indira Gandhi National Open University School of Education. http://ignoubbsr.org/BES-141

Audio Visual Material: Across Units

1. 'The Man Who Knew Infinity (2015)' (Bollywood Film)
2. 'Mission Mangal' (Bollywood Film)

Teaching Learning Process:

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end- semester examination.

Key words

Tentative and Revisionary Nature of Science, Contribution of Indian Thoughts and thinkers, Science in International Perspective, Learning Resources in Science, Traditional Ecological Knowledge, Open Education Resources (OER), Assessment in Science

DISCIPLINE SPECIFIC ELECTIVE COURSE – DSE 1 C (DSE 1C) MATHEMATICS EDUCATION

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ practice		
Mathematics Education DSE – 1C	4	3	1	0	Completed 4 core courses in education	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Understanding the nature and conceptual foundations of mathematics;
- Conceptualizing theories of learning mathematics for diverse leaners;
- Developing understanding on the theories and methodologies of teaching and learning mathematics;
- Understanding national and international perspectives in mathematics learning and assessment.

Learning Outcomes

After completion of the course student will be able to:

- discuss the nature of mathematics and its relevance in mathematics curriculum;
- define the aims and objectives of teaching mathematics;
- exemplifying theories of mathematics learning in diverse learning contexts;
- develop assessment plan for different stages of learning;
- identify common errors and misconceptions in mathematics learning;
- explore scope of mathematics across the curriculum;
- familiarize with manipulatives and ICT based tools for mathematics learning;
- acquire an understanding of national and international perspectives in mathematics education with special reference to (NEP 2020 and curriculum frameworks based on it; NAS, ASER, PISA, TIMSS).

SYLLABUS OF DSE 1 C

45 Hours

Unit 1:Nature and conceptual foundations of mathematics (12 hours)

- Introduction to nature of mathematics
- Aims and objectives of teaching mathematics
- Nature and scope of mathematics education
- History of mathematics and its relevance in mathematics curriculum

Unit 2:Theories of learning mathematics for diverse leaners (18 hours)

- Theories of mathematics learning (Piaget, Vygotsky; Bruner. Zoltan Dienes, Van Hailey)
- Conceptual underpinnings: Number sense and numeration; Estimation; Ratio-proportional thinking; algebraic thinking; units of measurement; spatial understanding
- Teaching-learning resources (manipulatives and ICT) based on the theories:
- Diagnosis of errors and remediation
- Assessment plans such as rubric based assessment; graded assignments; class test; diagnostic assessment

Unit 3: Assessment: National and International perspectives in mathematics education (15 hours)

- Need and purpose of assessment
- Assessment plans such as rubric based assessment; graded assignments; class test; diagnostic assessment and remediation
- Mathematics learning and its' assessment as mentioned in NEP 2020 and in latest curriculum framework
- National and international assessment frameworks (NSA, ASER, PISA and TIMSS)

Suggested Practicum

- Observe any classroom for a week to ten days and analyzethe teaching methods
- Develop math teaching – learning resources for any concept and do its field testing
- Develop timeline of developments in mathematics from ancient times to present times.
- Collect data on errors done by students on any concept from athematic or any other concept of mathematics and identify error patterns of students
- Prepare a rubric based assessment for a specific class.
- Critically analyze latest report released by (ASER/PISA/NAS/TIMSS) in terms of mathematics learning and achievement.

Practicum/ Suggested Projects / Assignments (Any Two)

- Do classroom observations and analyze the teaching methods
- Develop math teaching - learning resources and do its field testing
- Develop timeline of developments in mathematics from ancient to latest
- Collect data on errors and identify error patterns
- Prepare a rubric based assessment
- Critically analyze latest report released by (ASER/PISA/NAS/TIMSS)

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Manali

Recommended Readings

Musser, G. L., Peterson, B. E., & Burger, W. F. (2013). *Mathematics for Elementary Teachers: A Contemporary Approach, 10th Edition*. Wiley Global Education.

Rogers, A., Bragg, L., Cooke, A., Fanshawe, M., &Gronow, M. (2021). *Helping Children Learn Mathematics*.

Kamii, C. (1999). *Young Children Reinvent Arithmetic: Implications of Piaget's Theory*. Teachers College Press.

Nunes, T., & Bryant, P. (2021). *Using Mathematics to Understand the World: How Culture Promotes Children's Mathematics*.Routledge.

National Council of Teacher of Mathematics. Principles to Actions: Ensuring Mathematical Success for All. Reston: V.A., 2014.

Courant, H. R. R., Courant, R., Courant, C. I. O. M. S. R., Robbins, H., Stewart, I., & Robbins, P. O. M. H. (1996). *What is Mathematics: An Elementary Approach to Ideas and Methods*. Oxford University Press, USA.

Sriraman, B., Ernest, P., & Greer, B. (2009). *Critical Issues in Mathematics Education*.IAP.

Even, R., & Ball, D. L. (2008). *The Professional Education and Development of Teachers of Mathematics: The 15th ICMI Study*. Springer Science & Business Media.

English, L. D., &Kirshner, D. (2010). *Handbook of International Research in Mathematics Education*.Routledge.

Katz, V. J. (2009). *A History of Mathematics: An Introduction*. Addison-Wesley Longman.

Teaching Learning Process

The course will be taught through participative and interactive pedagogy. It is suggested to use group work, classroom discussions, seminar presentations and critical analysis. Reflective discussions on field work will be encouraged.

Assessment Method

Assessment will be formative in nature based on assignments, practicum, learners' participation in individual and group activities. Semester end exam will be conducted as per the examination schedule released by the Examination Branch, University of Delhi.

Key words

Mathematics, Education, Diversity in Learners

Manisha

DISCIPLINE SPECIFIC ELECTIVE COURSE – 1 D (DSE 1D) LANGUAGE EDUCATION

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ practice		
Language Education DSE –1D	4	3	1	0	Completed 4 core courses in education	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Understand the meaning of language, components and its functions;
- Make learners critically aware of the role language plays in education and explore how language development occurs in children;
- Develop insight into how language is acquired/learnt with respect to first and second language;
- Analyse the language policies and its implementation in Indian classroom;
- Critical analysis of terms such as dialects, mother tongue, first language, and second language, bilingual and multilinguals and explore multilingualism in India;
- Develop language skills to help learners engage in classrooms:
- Understand the process of reading and writing and oral interaction;
- Develop critical understanding about Indian model of language acquisition.

LEARNING OUTCOMES

On completion of this course, learners will be able to:

- Understand the concept, structure and componentsof language;
- Differentiate between language and dialect, first and second language.home and school language, bilingual and multilinguals;
- Develop insight into various theories of language acquisition;
- Understand the process of reading and writing;
- Develop critical understanding about Indian model of language acquisition

SYLLABUS OF DSE -1 D

45 Hours

UNIT 1: General Introduction to Language (Hours 10)

- Language: Its meaning, components and functions
- Dialect, Standard and Non-standard language
- Basic concepts in Phonology, morphology, syntax and semantics

UNIT 2: Language Acquisition and Learning(Hours 15)

- Language and thought
- First and Second language acquisition: Krashen,Chomsky and Vygotsky on language acquisition; relevance of their views for the language teacher
- Contribution of Panini and Indian model of language acquisition (Shravan, Manan, Nidhidhayasan)
- Stages of language development

UNIT 3: Language Processes and the Classroom Context (Hours 8)

- Oral language in the classrooms
- Verbal and non-verbal communication
- Learning to read and comprehend
- Teaching of Listening, Writing

UNIT 4: Language and society (Hours 12)

- Characterizing mother tongue, first language, and second language, bilingual and multi-linguals
- School and home language
- using multilingualism as a resource
- Language policies – NCF 2005, NEP 2020 etc.

SUGGESTED PROJECTS / ASSIGNMENTS (Any Two)

Learners are expected to engage with any two of the following or such similar activities:

- Read the Position Paper on NCF 2005 and NEP 2020 with reference to language education and present your understanding of it.
- Write a detailed approach used in a language classroom to teach the target language to the learners.
- Observe a language class and write a reflective essay on the how writing is taught in the Indian multilingual classroom and suggest strategies to improve it.
- Interview a teacher of a school and assess his/ her understanding about the function of language and its use in daily life.

Note: On the basis of the above, the teacher may design his/her own relevant assignments and projects.

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Readings

Essential/Recommended

- Agnihotri, R. K. (1996). *KaunBhashaKaunBoli*. Sandarbh 13, 37-43
- Agnihotri, R.K. (1999). *Bachchon ki bhashaa seekhne ki kshamata, bhag 1 aur 2 Shakshik Sandarbh*. Bhopal: Eklavya
- Agnihotri, R.K., & Kumar, S. (2001). *Bhasha, boli, aur samaj*. Deshkal Publications.
- Agnihotri, R. K. (2009). Language and dialect. Learning curve, 13.
- Agnihotri, R.K. and Vandhopadhyay, P.K. (ed.) (2000). *Bhasha, bhubhashita or hindi: Ekanth samvaad*. New Delhi: Shilalekh
- Atwell, N. (1987). *In the Middle: Writing, reading, and learning with the adolescents*. Portsmouth: Heineman.
- Khubchandani, C. M. (ed.) *Language in a Plural Society*. IIAS: Shimla, 1988
- Krashen, S. (1982). *Principles and practice in second language acquisition*. Pergamon Press Inc.
- Kumar, G. (2010). *Sanskrit bhasha men dhvani vigayn: Paniniya Shiksha sutra ke sandrabh mein*. Shodha Pragya U.S.V.V. University of Haridwar
- Kumar, G. (2019). *Hindi Bhasha Shikshan*, Pragatishil Prakashan, Delhi
- Kumar, K. (2000). *Childs language and the teacher*. New Delhi: National Book Trust.
- Kunwar, N. (2015). 'Right writing' in Indian classroom: learning tobe artificial. *Language and language teaching*.Vol. 4, No. 1, Issue 7.
- Rai, G. (2021). Teaching of Literature in Multilingual Context: An Approach for Social Justice, ELT Voices, *International Society for Educational Leadership*, Vol 2 (1), ISSN No. 2230-9136.
- Rai, G. (2023). Adopting Multilingualism in the Indian Classroom in the book *Pedagogical Diversity in Education Sector* edited by Dr. Usha Pathak and Dr. Chetna Thapa for University Book House Ltd. Jaipur, (Ist edition), pp 16-29, 978-93-95215-13-8.
- Rai, M. (2015). Writing in Indian schools: the product priority. *Language and language learning*.Vol 4, No 1, Issue 7, 32-36
- Sinha, S. (2012). Reading without meaning: The dilemma of Indian classrooms. *Language and Language Teaching*, 1:1. 22- 26.
- Sinha, S. (2009), Rosenblatt's theory of reading: Exploring literature. *Contemporary Education*
- Swami Dayanand (2010). *Varnochacharan Shiksha*. Ram Lal Kapoor Trust.

Additional Readings

- Agnihotri, R.K. & Khanna, A.L. (eds.) (1994). Second language acquisition. New Delhi: Sage Publications.
- Agnihotri, R.K. (2007). Towards a pedagogical paradigm rooted in multiliguality. International Multilingual Research Journal, Vol. (2) 1-10
- Applying a Vygotskian Model of Learning and Development in B. Spodek (Ed.). Handbook of Research on the Education of Young Children, New York: Macmillan.137-150.
- Bloomfield, L. Language, Holt, Rinehart and Winston: Chicago, 1933: Delhi, 1994, Chap. 13 and 14.

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- Britton, James. Language and Learning. Pelican Books: Harmondsworth. 1972.
- Mason. J. M. and Sinha, S. (1992). Emerging Literacy in the Early Childhood Years.
- NCERT (2005). National Curriculum Framework (NCF). New Delhi: NCERT.
- NCERT (2008). Reading for meaning. Reading Development Cell. NCERT. New Delhi
- National Curriculum Framework for Foundational Stage 2022, NCERT. New Delhi
- Research on the Education of Young Children, New York: Macmillan.137-150.
- Rosenblatt, Louise, M. What Facts Does This Poem Teach You? Language Arts, 57 (4). April, 1980.
- Sapir, E. Language, Harcourt Bruce: New York, 1949. Chapter 4
- Tompkins, Gail. E, Teaching Writing: Balancing Process and Product, 2nd Edition. McMillan Pub. Co: UK., 1993
- Wilkinson, Andrew, Foundation of Language, Talking and Reading in Young Children, Oxford
- Yule, G. (2006). The study of language. Delhi: Cambridge University Press.

TEACHING LEARNING PROCESS

The course will be taught through interactive pedagogic methods, such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

ASSESSMENT METHOD

The assessment will be formative in nature and will include student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end- semester examination.

Key words – Language acquisition, Indian model of language, Multilingualism

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

Category III

B.A. Programme Courses for Undergraduate Programme of study with Education discipline as one of the Core Disciplines as non-Major or Minor discipline)

DISCIPLINE SPECIFIC CORE COURSE – 9 (DSC – 9): Teacher and Teacher Education

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ practice		
Teacher and Teacher Education DSC - 9	4	3	1	0	Class XIIth pass	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Discuss the relationship among the concepts on Teaching, Learning, Teacher and Teacher Education
- Develop a Historical perspective on Development of Teacher Education in India
- Describe the Role of Different Agencies in the organisation of Teacher Education in India
- Discuss the education policy documents to understand the status, context of teacher education in India

Learning Outcomes

After completion of the course, student will be able to:

- Explain the relationship among the concepts on Teaching, Learning, Teacher and Teacher Education.
- Compare the Development of Teacher Education in India in a historical context
- Analyse pre-service and in-service teacher education
- Explain the roles of various teacher education agencies
- Analyse various policy documents to infer its role in shaping Teacher Education in India

SYLLABUS OF DSC-9

Hours 45

Unit I: Understanding Teacher and Teacher Education (12 hours)

- Changing conceptions of Teaching and Learning; its Implications to teachers and teacher education
- Development of Teacher Education in India: Ancient, Buddhist, Medieval, Modern and Post-Independent period

Unit 2: Teacher Education Programmes and Role of Different Teacher Education Agencies

(15 hours)

- Pre-service Teacher Education at different levels
- In-Service Teacher Education / Continuous Professional Development of Teachers
- NCTE, NCERT, NUEPA and UGC
- SCERT, IASE, CTE, DIET

Unit 3: Teacher Education and Educational Policy Documents (18 hours)

- Education Commissions [University Education Commission (1948); Secondary Education Commission (1952); and National Education Commission (1964-66)]
- National Commission on Teachers (1983)
- Teacher Education Curriculum Frameworks [Teacher Education Curriculum: A Framework (1978); National Curriculum for Teacher Education: A Framework (1988); Curriculum Framework for Quality Teacher Education (1998); and National Curriculum Frameworks for Teacher Education (2009)]
- Educational Policies [National Policy on Education (1968); National Policy on Education (1986); Revised National Policy on Education (1992) and its Programme of Action; and National Education Policy (2020)]

Practicum/ Suggested Projects / Assignments (Any Two)

- Collaborative Group project to analyse the teacher education related contents from Educational Policies and understand the development of teacher education in India and related issues.
- Compare the teacher education curriculum frameworks

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- Write a report on changes in teacher education by visiting NCTE and other relevant websites.

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Essential/ Recommended Readings

- Darling-Hammond, L. (1995). Changing Conceptions of Teaching and Teacher Development. *Teacher Education Quarterly*, 22(4): 9-26.
- Dixit, U.N. (). *Focal Points in the Development of Teacher Education in India*. In Resource Book on Teacher Education in India. New Delhi: NCERT.
- Mangla, Sheela. (2010). Teacher Education: Trends and Strategies. Delhi: Radha Publications.
- Mohan, Radha. (2019). Teacher Education. Delhi: PHI Learning Private Limited.
- Srivastava, R.C. (1997). Teacher Education in India: Issues and Perspectives. New Delhi: Regency Publications.

Additional Readings

- Ministry of Education, GoI (1962). The Report of the University Education Commission-1948 (First Reprint Edition). Delhi: The Manager Government of India Press.
- Ministry of Education, GoI. (1952-53). Report of the Secondary Education Commission. New Delhi: MoE.
- Ministry of Education. GoI. (1966). Report of the Education Commission (1964-66): Education and National Development. New Delhi: MoE.
- MHRD (1985). Report of the National Commission on Teachers (1983-85). New Delhi:
  Govt. of India.
- NCERT. (1978). Teacher Education Curriculum: A Framework. New Delhi: NCERT.
- NCERT. (1988). National Curriculum for Teacher Education: A Framework. New Delhi: NCERT.
- NCTE. (1998). Curriculum Framework for Quality Teacher Education. New Delhi: NCTE.
- NCTE (2009). National Curriculum Framework for Teacher Education: Towards Preparing Professional and Humane Teacher. New Delhi: NCTE.
- Ministry of Education, GoI. (1968). National Policy on Education, 1968. New Delhi: GoI.
- MHRD, GoI. (1986). National Policy on Education, 1986. New Delhi: GoI.
- MHRD, GoI. (1998). National Policy on Education 1986 (As modified in 1992). New Delhi: GoI.
- MHRD, GoI. (1992). National Policy on Education 1986: Programme of Action 1992. New Delhi: GoI.
- MHRD, GoI. (2020). National Education Policy 2020. New Delhi: GoI.

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UNDERGRADUATE PROGRAMMESOF STUDY

STRUCTURE, COURSES&SYLLABI OF SEMESTER -VI

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COURSES OFFERED BY DEPARTMENT OF EUCATION

Category II

(B.A Programme Courses for Undergraduate Programme of study with Education discipline as one of the Core Disciplines)

DISCIPLINE SPECIFIC CORE COURSE – 11 (DSC-11): Research I-Introduction to Educational Research

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Research I-Introduction to Educational Research DSC-11	4	3	1	-	• Class XIIth Pass	• No Pre-requisite

Learning Objectives

The Learning Objectives of this course are as follows:

- Understand the idea of research and its conceptual foundations.
- Conceptualize the relevance of research design in diverse social context.
- Critically understand the process of research and different research methods.

Learning Outcomes

After completion of the course, student will be able to:

- Acquire critical thinking skills and professional capacities regarding research.
- Understand different inquiry methods and approaches to explore diverse realties.
- Design and administer a research in systematic way.
- Organize complex research experiences in written account.

Syllabus DSC-11 **45 Hours**

Unit 1: Understanding Conceptual Foundations of Research (12 Hours)

- Introduction to the idea of research
- Generic research skills such as critical and analytical thinking and problem solving to various contexts
- Contextualizing research in divers contexts
- Situating ethics and integrity in researchers' life

Unit 2: Fundamentals of Designing a Research (23 Hours)

- Understanding research design
- Developing abilities to conceptualize research design
- Understanding the process of locating research problem
- Importance of literature review in research
- Research question, Objectives and Hypothesis
- Understanding sampling and tools
- Understanding data analysis and organizing research experience

Unit 3: investigating Different Realties: Types and Nature of Different Research Methods (10 Hours)

- Introduction to qualitative research and its methods
- Introduction to quantitative research and its methods
- Introduction to mixed method research and its methods

Practicum/ Suggested Projects / Assignments (Any Two)

- Research based projects and assignments.
- Critical analysis of literature on any issues/theme.
- Data collection Tasks based on interview and observation skills.
- Identification tasks of different independent and dependent variables.
- Design and administer a mini research in university or otherwise regarding any issue .

Note: On the basis of the above, the teacher may design his/her own relevant assignments and projects.

Essential/Recommended Readings

- Aikin, M.C.(Ed.).(1992). *Encyclopedia of educational research*(6th ed.). New York: Macmillan

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- Booth, W. C., Colomb, G. G., & Williams, J. M. (2008). *Craft of Research*. London: The University of Chicago Press.
- Creswell, J. W.(2018). *Research design: Qualitative, quantitative and mixed methods approaches.* 5th Ed. Thousand Oaks, CA: Sage.
- Flick, U. (2015). *Introducing Research Methodology: A Beginner's Guide to Doing a Research Project.* Thousand Oaks, CA: Sage
- Kumar, S. (2019). *Action Research and Qualitative Research: Evidence Based Practices in Education*. India: Kanishka Publication. 978-81-8457-862-1
- Kumar, S. (2018). Framework to Theorization: A Ray of Hope in Qualitative Research, *HIGHBROW Bi-annual Multidsciplinary Journal of Research*, SatyaSai College for Women, Bhopal
- Koul, L. (2007). *ShaikshikAnusandhan Ki Karyapranali*. Vikas Publishing
- Koul, L. (2020). *Methodology of Educational Research*. India: Vikas publishing
- Merriam, B. S. &Tisdell, J. E. (2015). *Qualitative Research: A Guide to Design and Implementation*. San Francisco: John Wiley & Sons. 978-1119003618

Teaching Learning Process:

The Course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis. Collaborative learning tasks, enhancing reading comprehension of core writings in the area and developing innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will include student participation. Individual and group tasks and assignments will be given. Summative evaluation will be through end semester examination.

Key words

Education, Research, Designing Research

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

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DISCIPLINE SPECIFIC CORE COURSE – 12 (DSC-12): RESEARCH 2- RESEARCH METHODS IN EDUCATION

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Research 2- Research Methods in Education DSC-12	4	3	1	-	• Class XIIth Pass	• No Pre-requisite

Learning Objectives

The Learning Objectives of this course are as follows:

- Enhance the conceptual understanding and application of research
- Developing analytical and reflective skills for conducting any research
- Conceptualising different aspects and steps involved in research
- Conducting research in diverse social realities

Learning Outcomes

After completion of the course student will be able to:

- Explore different ways/ approaches to understand the social realities, issues and opportunities
- To decide the nature of research relevant for their study
- To design and administer research in the context of their respective discipline
- Deliberate on the ethical issues related to research
- Critically evaluate any research in the light of various relevant parameters of credibility
- Equipped with the skills and competencies required for academic research writing

Syllabus DSC-12 **45 Hours**

Unit 1: Research in Education **(15 Hours)**

- Nature of discipline and research
- Methodological approaches/ Methods of Educational Research: Historical, Descriptive, Case Study, Action, Ethnographic, Experimental,
- Research: Ethics, Rigour (Credibility, Transferability, Dependability) and quality
- Role of researcher: Subjective vs Objective

Unit 2: Guidelines for Conducting Research **(15 Hours)**

- Quantitative Research and Statistical Analysis: Data and its representation; Descriptive Statistical Measures; Measures of Central Tendency, Variability and Relationship; Limitation of Statistical tools.
- Qualitative Research and Interpretation: Advantages and Limitations; Ethical responsibility and validation process;

Unit 3: Designing and conducting research **(15 Hours)**

- Identifying the research problem and formulating research questions
- Locating in a Paradigm
- Process of writing review of literature
- Sample Selection- Probability and Non-probability
- Types of research tools and rationale for selecting it
- Approaches for analysis
- Writing a Research Report

Practicum/ Suggested Projects / Assignments (Any Two)

- Identifying a dissertation and describe the design of its research
- Critically analyse any research paper/article
- Select a topic of your choice, conduct a mini action / survey research and write a report
- Organise a viva session among groups on the basis of conducted action research

Note: On the basis of the above given suggestions , teachers can design their own appropriate assignments and projects.

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Essential/Recommended Readings

- Blaikie, N., & Priest, J. (2017). *Social research: Paradigms in action*. John Wiley & Sons.
- Check, J., &Schutt, R. K. (2011). *Research methods in education*. SAGE Publications.
- Cohen, L., Manion, L., & Morrison, K. (2017). *Research methods in education*. Routledge.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE.
- Killam, L. (2013). *Research terminology simplified: Paradigms, axiology, ontology, epistemology and methodology*. Laura Killam.
- Koepsell, D. (2017). *Scientific integrity and research ethics: An approach from the ethos of science*. Springer.
- Mellinger, C. D., & Hanson, T. A. (2016). *Quantitative research methods in translation and interpreting studies*. Routledge.
- Myers, J. L., Well, A., &Lorch, R. F. (2010). *Research design and statistical analysis*. Routledge.
- O'Dwyer, L. M., &Bernauer, J. A. (2013). *Quantitative research for the qualitative researcher*. SAGE Publications.
- Saldana, J. (2011). *Fundamentals of qualitative research*. Oxford University Press.
- Willis, J. W., Jost, M., &Nilakanta, R. (2007). *Foundations of qualitative research: Interpretive and critical approaches*. SAGE.
- Yin, R. K. (2017). *Case study research and applications: Design and methods*. SAGE Publications.

Teaching Learning Process:

The Course will be facilitated through different pedagogical techniques and methods such as interactive sessions, experimentation, critical analysis of already conducted researches, discussion, focus group discussions, debates, reading extensively related to research and developing and conducting creative projects and dissertations. Critical, reflective and analytical thinking, reading and writing skills will be encouraged.

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Assessment Method

Formative assessment will be student centred in nature based on their participation and engagement. Individual and group assignments/ project will be given with a focus on their competencies. Year-end exam will also be conducted at the end of the semester as a summative evaluation.

Key words

Education, Research Design, Sample, Data, Research Paradigm

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

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DISCIPLINE SPECIFIC ELECTIVE COURSE – 2A (DSE-2A) EARLY CHILDHOOD EDUCATION

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
EARLY CHILDHOOD EDUCATION DSE -2A	4	3	1	-	Completed 4 Core Courses in Education	• No Pre-requisite

Learning Objectives

The Learning Objectives of this course are as follows:

- To build a holistic understanding about Early Childhood Education (ECE), its need and importance
- To develop a comprehensive understanding of the key developmental aspects, issues and concerns related to early childhood.
- To trace the trajectory of the policies, schemes, programmes and initiatives pertaining to Early Childhood Education in India.
- To familiarise the principles of early learning, ECE curriculum and pedagogy, and assessment and evaluation in early childhood.
- To build perspective on the role of teachers, parents, family and community in the development of children in early years.

Learning Outcomes

After completion of the course student will be able to:

- Understand the need, significance and goals of Early Childhood Education

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- Comprehend the key concerns in development of children across different domains in early childhood
- Examine and review Early Childhood Education policies, frameworks, schemes and programmes, and issues and concerns in India
- Draw linkages between the local and global socio-political-historical constructs around early childhood
- Develop an understanding of the principles of early learning, ECE curriculum and pedagogy, assessment and evaluation of children's learning and progress in early childhood
- Recognize the role of teacher, parents, family and community in holistic development of children.

Syllabus DSE-2A 45 Hours

Unit I: Understanding early childhood from a developmental and psycho-social perspective (12 hours)

- Meaning of growth and development, principles of development, basic issues and debates in child development (such as nature/nurture, continuity/discontinuity, active/passive and universal/contextual)
- Developmental characteristics and needs of children across different domains (physical, cognitive, language and socio-emotional)with reference to:
    - Prenatal stage
    - Birth to three years
    - Three to six years
    - Six to eight years
- Implications for parenting and early schooling

Unit 2: EARLY CHILDHOOD EDUCATION IN INDIA (18 hours)

- Early Childhood Education: Nature, significance and goals

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- Early Childhood Education policies, frameworks, schemes and programmes in India (with special reference to NPE (1986), POA (1992), NCF (2005), National ECCE Policy (2013), NEP (2020))
- Locating ECE in the Indian and global context: needs and rights of Children, UNCRC, MDGs, SDGs
- Critical issues in ECE: access, quality, equity, teacher preparation, diversity and inclusion

Unit 3: Curriculum and Pedagogy for Early Childhood Years (15 hours)

- Guiding principles of early learning and ECE curriculum: developmentally appropriate curriculum, role of physical and social environment, importance of play and activity-based learning, storytelling, craft, art drama, music and dance.
- Foundational literacy and numeracy and use of culturally appropriate teaching-learning materials.
- Assessment and evaluation in ECE: early identification and stimulation, short term and long-term plans, assessment methods, maintaining records
- Qualities and role of an ECE teacher
- Involving parents, family and community in ECE

Practicum/ Suggested Projects / Assignments (Any Two)

Students are expected to engage with any two of the following or such similar activities:

- Visit an Early Childhood Care and Education Centre/Preschool in your neighbourhood. Observe and document in detail the setting, overall learning environment, staffing, teaching-learning pedagogy equipment, assessment methods, play and learning materials available, and other facilities available.
- Design a developmentally appropriate weekly plan for engaging children in early childhood keeping the principles of early learning and curriculum planning in mind.
- Conduct a survey/interview with parents of children in early childhood about their expectations from preschool education, their involvement in the learning process of their children, teacher-

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parent/family/community collaboration, parenting practices and role of culture in early bringing up.

- Prepare a plan for setting up an early childhood education centre/preschool facility. Focus on various considerations such as licensing requirements and professional standards, budget, design of the indoor and outdoor spaces, suitable equipment and learning materials, staff recruitment, graded curriculum and schedule of activities, plan for involvement of parents and community and so forth.
- Make a collection of lullabies, poems, songs, games, activities from local culture that are used by parents and teachers to promote learning and well-being in early childhood.

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Essential/ Recommended Readings

- Berk, L.E. (2022). *Infants and children: Prenatal through middle childhood.* New Delhi: Sage.
- Gupta, A. (2006). *Early childhood education: Post Colonial theory and practices in India-Balancing Vygotsky and Vedas*. New York: Palgrave Macmillan.
- Kaul, V., &Bhattacharjea, S. (2020). Early childhood education and school readiness in India: Quality and diversity. Singapore: Springer.
- Kaul, V. (2012). *Early childhood care and education in India: Mid-decade assessment*. New Delhi: NUEPA.
- National Council of Educational Research and Training. (2003). *A study of process and effectiveness of linkages between ECCE and Primary Education in the Context of SSA*. New Delhi: NCERT.
- National Council of Educational Research and Training. (2008). *Early Childhood Education: An Introduction.* New Delhi: NCERT. Retrieved from https://ncert.nic.in/dee/pdf/Earlychildhood.pdf
- Ranganathan, N. (2000). The primary school child. New Delhi: Orient Longman.
- Rao, N., Ranganathan, N., Kaur, R., &Mukhopadhayay, R. (2021). Fostering equitable access to quality preschool education in India: Challenges and opportunities.

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InternationalJournal of Child Care and Education Policy, 15(9). https://ijccep.springeropen.com/articles/10.1186/s40723-021-00086-6

- Santrock, J.W. (2021). (15th Ed.). Child Development: An introduction. New York: McGraw-Hill Education.
- Sharma, A., Sen, R.S., &Gulati, R. (2008). Early Childhood Development Policy and Programming in India. *International Journal of Early Childhood-Policy Change*, 40 (2), 65-84.
- Singh, A. (Ed.), (2015). *Foundations of Human Development: Lifespan Approach*. Orient Blackswan.
- Swaminathan, M. (1998). Ed. *The first five years: A critical perspective on Early Childhood Care and Education in India*. New Delhi: Sage.
- Tuli, M. (2012). Beliefs on parenting and childhood in India. *Journal of Comparative Family Studies*, 43(1), 81-91.

Policies and Documents

- Government of India (2009). *The right of children to free and compulsory education act, 2009*. The Gazette of India: Extraordinary. (Part II, Sec 1. August). https://www.education.gov.in/sites/upload_files/mhrd/files/upload_document/rte.pdf
- Government of India (2013). *National early childhood care and education (ECCE) policy*. Ministry of Women and Child Development. https://wcd.nic.in/sites/default/files/National%20Early%20Childhood%20Care%20and%20Education-Resolution.pdf
- Government of India (2013). *National early childhood care and education (ECCE) curriculum Framework*. Ministry of Women and Child Development. https://wcd.nic.in/sites/default/files/national_ecce_curr_framework_final_03022014%20%282%29.pdf
- Government of India (2013). *Quality standards for early childhood care and education (ECCE)*. Ministry of Women and Child Development.
- Government of India (2020). *National education policy 2020*. Ministry of Human Resource Development. New Delhi: Government of India. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- Government of India (n.d.). *Regulatory guidelines for private play schools*. National

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Commission for Protection of Child Rights, Government of India. https://ncpcr.gov.in/showfile.php?lang=1&level=1&&sublinkid=933&lid=1271

- Government of India. (1986). *National policy on education 1986*. Ministry of Human Resource development.
- Government of India. (1992). *Programme of action*. Ministry of Human Resource development. http://14.139.60.153/bitstream/123456789/372/1/Policy-Programme%20of%20Action%201992%20Final%20.pdf
- National Council of Educational Research and Training. (2005). *National Curriculum Framework -2005*. New Delhi: NCERT.
- National Council of Educational Research and Training. (2006). *Position Paper on Early childhood education*. New Delhi: NCERT.

Additional Readings

- Badheka, G., &Pathak, C. (2009). *Diwaswapna*. New Delhi: National Book Trust.
- Dreze, J. (2006). Universalisation with quality: ICDS in a rights perspective. *Economic and political weekly*, 3666-3671.
- Holt, J (1974). *Escape from Childhood*. Boston: E. P. Dutton. (Chapter 1, 2 and 7)
- Hurlock, E.B. (2017). (6th Ed.). *Child growth and development*. New Delhi: Tata McGraw-Hill Education.
- Kaul, V. (2002). Early childhood care and education. In R. Govinda (Ed.), *India Education Report: A profile of Basic Education* (pp. 23-34). NIEPA: Oxford University Press.
- Kaur, R. (2022). *Constructions of childhood in India. Exploring the personal and socio-cultural contours*. UK: Routledge.
- Kumar, K. (1998). *The child's language and the teacher: A handbook*. New Delhi: National Book Trust.
- Melhuish, E., &Petrogiannis, K. (2006). *Early childhood care and education: International Perspective* (pp. 133-149). Oxon: Routledge.
- Sen, R.S. (2016). Literacy in Pre-primary and Class 1: Processes of Teaching and learning in a trilingual environment. In N. Rao (ed.), *Disciplinary dialogues on social change: Gender, Early childhood and theatre* (pp 93-130). New Delhi: Academic Foundation.

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Audio Visual Material: Across Units (If any)

1. Stanley kaDabba. 2011. Amole Gupte
2. TaareZameen Par. 2007. Directed by Aamir Khan.
3. I am Kalam. 2010. Directed by NilaMadhab Panda.
4. Bum Bum Bole. 2010. Directed by Priyadarshan.

Teaching Learning Process:

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end-semester examination.

Key words

Early Childhood Education, Children, Early Childhood Care and Education, Policy

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

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DISCIPLINE SPECIFIC ELECTIVE COURSE – 2B (DSE-2B) PRIMARY EDUCATION IN INDIA

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
PRIMARY EDUCATION IN INDIA DSE -2B	4	3	1	-	Completed 4 Core Courses in Education	• No Pre-requisite

Learning Objectives

The Learning Objectives of this course are as follows:

- Discuss the relationship among the different levels of education in India and the status of primary education in it.
- Understand the development of primary education in India and the need for Universalisation of primary Education
- To describe the constitutional provisions, educational policies, and curriculum frameworks in understanding the context and status of primary education in India.

Learning Outcomes

After completion of the course, student will be able to:

- Critically reflect on the various policy documents towards the historical development of primary education in India.
- Analyse the guiding principles in the universalisation of primary education and the challenges to SarvaShikshaAbhiyaan (SSA) scheme.
- Explain the quality concerns in the context of teaching and learning at the primary level of education in India.

Syllabus DSE-2B **45 Hours**

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Unit 1 Development of Primary Education in India **(18 Hours)**

- Primary Education in India's Educational structure; Schools in India: types and affiliation; The Constitutional provisions; The Right to Free and Compulsory Education Act 2009
- Recommendations of Educational Policies: National Policy on Education (1968); National Policy on Education (1986) and its Programme of Action (1992); and National Education Policy (2020).
- Role of centre government for guiding policy, national initiatives, and responsibilities of state governments- Ministry of Education (NCERT), Ministry of social justice and empowerment (RCI), State Department of education (SCERTs), District level (DIETs, BRC, CRC)
- Decentralization of authority- Role of Panchayati Raj Institutions, Urban local bodies, School management Committees
- International Agencies: UNICEF, UNESCO, WHO

Unit 2: Programmes in Primary Education and their Implementation (14 Hours)

- National Curriculum Frameworks for school education- 1975, 1986, 2000, 2005.
- Centrally and state sponsored schemes and projects: Assumptions, implementation, and impact on enrolment and quality in primary education.
- Centrally sponsored schemes- IEDC (Integrated Education for Disable Children, 1974), Operation Black board, MLL (Minimum Levels of Learning), DPEP (District Primary Education Programme), KGBV (Kasturba Gandhi BalikaVidyalaya), SSA (SarvaShikshaAbhiyaan), Mid-day meal scheme
- State Projects – LokJumbhish, Nali Kali, ShikshaKarmi

Unit 3: Curriculum, Pedagogy, Assessment and Inclusion in Primary Education

(13 Hours)

- Principles of curriculum development at primary level: relevance, contextual, integration
- Pedagogy at Primary level: flexibility, child centred, joyful
- Assessment at Primary level: CCE, school based assessment
- Inclusion: Need, concept, Challenges of bringing all children to same school
- Professional Development of Teachers at primary level

Practicum/ Suggested Projects / Assignments (Any Two)

Students are expected to engage with any two of the following or such similar activities:

- Collaborative group project to compare various curriculum frameworks with reference to primary education

- Visit to different types of primary school, observe and document in detail the setting, overall learning environment, teaching-learning pedagogies, assessment strategies, facilities available in school.
- Design a weekly plan for teaching –learning of primary school children for any concept keeping the principles of curriculum in mind.
- Conduct a survey/interview with primary school teachers about their role and responsibilities in the school, expectation of students and their parents, and their job satisfaction.

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Essential/ Recommended Readings

- Ghosh, S. C. (2007). History of education in India. Delhi: Rawat Publications.
- Narulla & Naik (2000). A Student's History of Education in India. New Delhi: Macmillan India Ltd. Also available in Hindi
- PROBE (1999) Public report on basic education in India. New Delhi: Oxford University Press.

Policies and Documents

- Government of India (2009). *The right of children to free and compulsory education act, 2009*. The Gazette of India: Extraordinary. (Part II, Sec 1. August). https://www.education.gov.in/sites/upload_files/mhrd/files/upload_document/rte.pdf
- Government of India (2020). *National education policy 2020*. Ministry of Human Resource Development. New Delhi: Government of India. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- Government of India (1992). *Programme of action*. Ministry of Human Resource development.http://14.139.60.153/bitstream/123456789/372/1/Policy-programme%20of%20Action%201992%20Final%20.pdf
- MHRD, GoI. (1986). National Policy on Education, 1986. New Delhi: GoI.
- MHRD, GoI. (1992). National Policy on Education 1986: Programme of Action 1992. New Delhi: GoI.
- MHRD, GoI. (2020). National Education Policy projects/ assignments. 2020. New Delhi: GoI.
- Ministry of Education, GoI. (1966). Report of the Education Commission (1964-66): Education and National Development. New Delhi: MoE.
- Ministry of Education, Government of India (1968). National Policy on Education, 1968. New Delhi: GoI.
- National Council of Educational Research and Training. (2005). *National Curriculum Framework -2005*. New Delhi: NCERT.
- National Council of Educational Research and Training. (2006). *Position Paper on Early childhood education*. New Delhi: NCERT.

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Audio-Visual Material:

- Stanley kaDabba. 2011. Amole Gupte
- TaareZameen Par. 2007. Directed by Aamir Khan.
- I am Kalam. 2010. Directed by NilaMadhab Panda.

Teaching Learning Process:

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end-semester examination. Examination Scheme and mode shall be as prescribed by the Examination Branch, University of Delhi from time to time.

Key words

Primary Education, Pre-service, Continuous Professional Development, Educational Policies, National Curriculum Framework.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

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DISCIPLINE SPECIFIC ELECTIVE COURSE – 2C (DSE-2C) SECONDARY EDUCATION IN INDIA

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Secondary Education in India DSE -2C	4	3	1	-	Completed 4 Core Courses in Education	• No Pre-requisite

Learning Objectives

The Learning Objectives of this course are as follows:

- Discuss the relationship among the different levels of education in India and the status of secondary education in it.
- Understand the development of secondary education and the organisation of Universalisation of Secondary Education (RMSA).
- To describe the constitutional provisions and educational policies in understanding the context and status of secondary education in India.

Learning Outcomes

After completion of the course, student will be able to:

- Critically reflect on the various policy documents towards the historical development of secondary education in India.
- Analyse the guiding principles in the Universalisation of Secondary Education (RMSA) and the challenges to RMSA scheme.
- Explain the quality concerns in the context of teaching and learning at the secondary level of education in India.

Syllabus DSE-2C **45 Hours**

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Unit I:Development of Secondary Education in India **(18 Hours)**

- Secondary Education in India's Educational structure; Schools in India: types and affiliation; The Constitutional provisions
- Recommendations of Major Commissions and Committee Reports in shaping the secondary education - Mudaliar Commission (1953), Kothari Commission (1964-66), NEP (1986) and revised PoA (1992), NEP (2020)
- Educational Policies- National Policy on Education (1968); National Policy on Education (1986); Revised National Policy on Education (1992) and its Programme of Action; and National Education Policy (2020).

Unit 2: Curricular Frameworks and Universalisaton of Secondary Education. (14 Hours)

- National Curriculum Frameworks for school education- 1975, 1986, 2000, 2005.
- Guiding principles of RashtriyaMadhyamikShikshaAayog (RMSA) - universal access, equality, quality and equity
- Curricular and structural aspects; major challenges.

Unit 3: Continuous Professional Development **(13 Hours)**

- Continuous Professional Development of Secondary level teachers
- Innovation in secondary education; Indicators of quality, Learner Outcomes
- NCERT, SCERT, NCTE, CBSE, NIOS

Practicum/ Suggested Projects / Assignments (Any Two)

- Collaborative Group project to analyse the secondary education related content from educational policies and understand the development of teacher education in India and related issues.
- Compare the teacher education curriculum frameworks
- Critical report on changes in school education since the implementation of RMSA.
- Visit to different types of secondary schools and preparation of school profile.
- **Note:** On the basis of the above, the teacher may design his/her own relevant

Essential/ Recommended Readings

- Ghosh, S. C. (2007). *History of education in India*. Delhi: Rawat Publications.
- Ministry of Education, GoI. (1952-53). *Report of the Secondary Education Commission*. New Delhi: MoE.
- Ministry of Education, GoI. (1968). *National Policy on Education, 1968*. New Delhi: GoI.
- MHRD, GoI. (1986). *National Policy on Education, 1986*. New Delhi: GoI.
- MHRD, GoI. (2020). *National Education Policy projects/ assignments. 2020*. New Delhi: GoI.
- Narulla & Naik (2000). *A Student's History of Education in India*. New Delhi: Macmillan India Ltd. Also available in Hindi

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Additional Readings

- Ministry of Education, GoI. (1966). *Report of the Education Commission (1964-66): Education and National Development.* New Delhi: MoE.
- MHRD, GoI. (1998). *National Policy on Education 1986 (As modified in 1992).* New Delhi: GoI.
- MHRD, GoI. (1992). *National Policy on Education 1986: Programme of Action 1992.* New Delhi: GoI.
- PROBE (1999). *Public Report on Basic Education in India.* New Delhi: Oxford University Press.

Audio Visual Material: Across Units

1. To Sir with Love. 1967. Film – Directed by James Clavell.
2. Stand and Deliver. 1998. Directed by Ramón Menéndez.

Teaching Learning Process:

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end-semester examination.

Key words

Secondary Education, Pre-service, Continuous Professional Development, Educational Policies, National Curriculum Framework.

Note: Examination Scheme and mode shall be as prescribed by the Examination Branch, University of Delhi from time to time.

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DISCIPLINE SPECIFIC ELECTIVE COURSE – 2D (DSE-2D) HIGHER EDUCATION IN INDIA

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Higher Education in India DSE -2D	4	3	1	-	Completed 4 Core Courses in Education	• No Pre-requisite

Learning Objectives

The Learning Objectives of this course are as follows:

- Discuss the relationship among the different levels of education in India and the status of higher education in it.
- Understand the development and various strands of higher education in India.
- To describe the constitutional provisions and educational policies in understanding the context and status of higher education in India.

Learning Outcomes

After completion of the course, student will be able to:

- Critically reflect on the various policy documents towards the historical development of higher education in India.
- Analyse the different strands and the challenges in higher education.
- Explain the quality concerns in the context of teaching and learning at the higher level of education in India.

Syllabus DSE-2C **45 Hours**

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Unit I:Development of Higher Education in India **(18 Hours)**

- Higher Education in India's Educational Structure; Higher Education Institutions in India: Aims, Types and Affiliation; The Constitutional provisions Higher Education: Historical Perspective and societal linkages Globalisation in Higher education
- Recommendations of Major Commissions and Committee Reports in Shaping the Higher Education – Radhakrishnan Commission (1948), Kothari Commission (1964-66), NEP (1986) and Revised PoA (1992),
- Educational Policies- National Policy on Education (1968); National Policy on Education (1986); Revised National Policy on Education (1992) and its Programme of Action; and National Education Policy (2020).

Unit 2: Curricular and Structural Aspects of Higher Education (14 Hours)

- Universal Access, Quality and Equity in Higher Education;
- UGC, NCTE, AICTE, NAAC, HECI
- The Economics of Higher Education: Access and Competition; Globalisation in Higher Education

Unit 3: Continuous Professional Development **(13 Hours)**

- Continuous Professional Development of Higher Education Teachers
- Innovation in Higher Education; Learner Outcomes; Trends in Research
- Student Affairs, Leadership - Major Challenges

Practicum/ Suggested Projects / Assignments (Any Two)

- Collaborative Group project to analyse the higher education related content from educational policies and understand the development of higher education in India and related issues.
- Illustrate upon the structure and organisation of higher education in India.
- Critical report on changes in higher education since India's independence.
- Visit any three types of higher education institutes and prepare a comparative flow chart on different aspects of student affairs.
- Construct a profile of an Indian college student.

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Essential/ Recommended Readings

- Deshpande,H.V.(2020).*Higher Education in India: New Perceptions and Perspectives*. Chennai: Notion Press.
- Ghosh, S. C. (2007). *History of Education in India*. Delhi: Rawat Publications.

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- Ministry of Education, GoI. (1968). *National Policy on Education, 1968*. New Delhi: GoI.
- MHRD, GoI. (1986). *National Policy on Education, 1986*. New Delhi: GoI.
- MHRD, GoI. (2020). *National Education Policy projects/ assignments. 2020*. New Delhi: GoI.
- Narulla & Naik (2000). *A Student's History of Education in India*. New Delhi: Macmillan India Ltd. Also available in Hindi
- Tilak,J.B.G.(2013).*Higher Education in India-In search of equality, quality and quantity.* New Delhi: Orient Blackswan.

Additional Readings

- Ministry of Education, GoI. (1966). *Report of the Education Commission (1964-66)*: Education and National Development. New Delhi: MoE.
- MHRD, GoI. (1998). *National Policy on Education 1986 (As modified in 1992)*. New Delhi: GoI.
- MHRD, GoI. (1992). *National Policy on Education 1986: Programme of Action 1992*. New Delhi: GoI.

Audio Visual Material: Across Units

3. To Sir with Love. 1967. Film – Directed by James Clavell.
4. Three Idiots. 2009. Directed by RajkumarHirani.

Teaching Learning Process:

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end-semester examination.

Key words

Higher Education, Continuous Professional Development, Educational Policies.

Note:Examination Scheme and mode shall be as prescribed by the Examination Branch, University of Delhi from time to time.

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GENERIC ELECTIVE COURSE – GE (GE-2) EDUCATION IN MULTICULTRUAL SOCIETY

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
EDUCATION IN MULTICULTRUAL SOCIETY GE -2	4	3	1	-		• No Pre-requisite

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand multiculturalism and its relevance for educational settings.
- To identify and analyze the cultural diversity within educational contexts, including language, religion, socioeconomic status, and gender.
- To understand the theoretical foundations and historical development of multicultural education.
- To evaluate the impact of cultural biases and stereotypes on teaching and learning.
- To examine the challenges and possibilities of multicultural education in specific regional or national contexts.

Learning Outcomes

After completion of the course students will be able to:

- Demonstrate an understanding of the concept of multiculturalism, including its theoretical foundations, historical development, and relevance in contemporary educational contexts.
- Analyse with awareness and sensitivity different cultures and show an appreciation for cultural differences and inclusion of diverse individuals and communities in educational settings.
- Evaluate biases and stereotypes that could become barriers in educational settings.

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- Examine equity and social justice issues and recognize the relationship between multicultural education and social justice, especially how educational practices can promote equity, inclusivity, and equal opportunities for learners from diverse backgrounds.

Unit 1: Understanding Multiculturalism and Education in India (12 hours)

- Cultural, language and ethnic diversities in India, Multiculturalism: Significance, historical background, theoretical approaches to multiculturalism
- Cultural identities and schooling experiences in India: Cultural awareness, Stereotypes and biases
- Constitutional provisions for promoting inclusive experiences in multicultural society

Unit 2: Multicultural Classroom (18 hours)

- Multicultural curriculum: Examining National Curriculum Frameworks
- Culturally responsive pedagogy and inclusive classrooms
- Integrating diverse perspectives and knowledge systems
- Diverse learners and needs of marginalized students
- Examinations, Assessments and Multiculturalism: Issues and Challenges

Unit 3: Multicultural Education and Social Justice (15 hours)

- Multicultural Education and Social Justice: Inter-relationships
- Equity and Power Imbalances in education: Concerns and Strategies
- State and Non state roles

Practicum

- Preparing case studies on diverse cultural experiences that they bring to school
- Analysis of policy documents on social justice and inferring multi-cultural connections
- Getting to know a student from a culturally different background and writing a report on universal experiences and diverse ways of realizing them.

Note: The above are suggestive in nature and the teacher may design his/her own assignments and projects as per the specific needs of the class group. The practicum can be done through both individual and group project work.

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Essential Readings

Banks, J. A., & McGee Banks, C. A. (2019). *Multicultural Education: Issues and Perspectives*. John Wiley & Sons

Gollnick, D. M., & Chinn, P. C. (2021). *Multicultural Education in a Pluralistic Society* (11th ed.). Hoboken, NJ: Pearson Education.

Stembridge, A. (2019). *Culturally Responsive Education in the Classroom: An Equity Framework for Pedagogy*. New York: Routledge.

Delpit, L., &Kilgour Dowdy, J. (Eds.). (2008). *The Skin That We Speak: Thoughts on Language and Culture in the Classroom*. New York, NY: New Press.

Ministry of Law and Justice (2015). *The Constitution of India* New Delhi: Legislative Department, Ministry of Law and Justice, Government of India

Mohanty, A. K. (2019). *The Multilingual Reality: Living with Languages*. Bristol, UK: Multilingual Matters.

Additional Resources

https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

https://www.education.gov.in/sites/upload_files/mhrd/files/NCF-School-Education-Pre-Draft.pdf

https://www.ncert.nic.in/pdf/focus-group/cst_final.pdf

https://www.ncert.nic.in/pdf/focus-group/special_ed_final1.pdf

https://www.ncert.nic.in/pdf/focus-group/position_paper_on_sc_st.pdf

https://www.ncert.nic.in/pdf/focus-group/heritage_craft.pdf

Teaching Learning Process:

The Course is to be taught through lectures, discussions, project work, reading of original school testimonies and policies. Observation and critical analytical skills are to be developed and reflective practices inculcated in the teaching-learning of the course. Interactive pedagogic methods such as classroom discussion, debates, film analysis are to be used. Individual and collaborative projects are to be undertaken and meticulous reporting encouraged.

Assessment Method

The assessment will be formative in nature and will include student participation. Individual and group tasks and assignments will be given. Summative evaluation will be through end semester examination.

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Key words

Multiculturalism, Social Justice Cultural Responsive Education, School Experiences

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

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COURSES OFFERED BY DEPARTMENT OF EUCATION

Category III

B.A. Programme Courses for Undergraduate Programme of study with Education discipline as one of the Core Disciplines as Non-major or Minor discipline

DISCIPLINE SPECIFIC CORE COURSE – 11 (DSC-11): Research I-Introduction to Educational Research

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Research I-Introduction to Educational Research DSC-11	4	3	1	-	• Class XIIth Pass	• No Pre-requisite

Learning Objectives

The Learning Objectives of this course are as follows:

- Understand the idea of research and its conceptual foundations.
- Conceptualize the relevance of research design in diverse social context.
- Critically understand the process of research and different research methods.

Learning Outcomes

After completion of the course, student will be able to:

- Acquire critical thinking skills and professional capacities regarding research.
- Understand different inquiry methods and approaches to explore diverse realties.

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University of Delhi, Delhi-110007

- Design and administer a research in systematic way.
- Organize complex research experiences in written account.

Syllabus DSC-11

45 Hours

Unit 1: Understanding Conceptual Foundations of Research (12 Hours)

- Introduction to the idea of research
- Generic research skills such as critical and analytical thinking and problem solving to various contexts
- Contextualizing research in divers contexts
- Situating ethics and integrity in researchers' life

Unit 2: Fundamentals of Designing a Research (23 Hours)

- Understanding research design
- Developing abilities to conceptualize research design
- Understanding the process of locating research problem
- Importance of literature review in research
- Research question, Objectives and Hypothesis
- Understanding sampling and tools
- Understanding data analysis and organizing research experience

Unit 3: investigating Different Realties: Types and Nature of Different Research Methods (10 Hours)

- Introduction to qualitative research and its methods
- Introduction to quantitative research and its methods
- Introduction to mixed method research and its methods

Practicum/ Suggested Projects / Assignments (Any Two)

- Research based projects and assignments.
- Critical analysis of literature on any issues/theme.
- Data collection Tasks based on interview and observation skills.
- Identification tasks of different independent and dependent variables.
- Design and administer a mini research in university or otherwise regarding any issue .

Note: On the basis of the above, the teacher may design his/her own relevant assignments and projects.

Essential/Recommended Readings

Aikin, M.C.(Ed.).(1992). *Encyclopedia of educational research* (6th ed.). New York: Macmillan

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Booth, W. C., Colomb, G. G., & Williams, J. M. (2008).*Craft of Research.* London: The University of Chicago Press.

Creswell, J. W.(2018). *Research design: Qualitative, quantitative and mixed methods approaches.* 5th Ed. Thousand Oaks, CA: Sage.

Flick, U. (2015).*Introducing Research Methodology: A Beginner's Guide to Doing a Research Project.* Thousand Oaks, CA: Sage

Kumar, S. (2019).*Action Research and Qualitative Research: Evidence Based Practices in Education.* India: Kanishka Publication. 978-81-8457-862-1

Kumar, S. (2018). Framework to Theorization: A Ray of Hope in Qualitative Research, *HIGHBROW Bi-annual Multidsciplinary Journal of Research*, SatyaSai College for Women, Bhopal

Koul, L. (2007). *ShaikshikAnusandhan Ki Karyapranali.* Vikas Publishing

Koul, L. (2020). *Methodology of Educational Research.* India: Vikas publishing

Merriam, B. S. &Tisdell, J. E. (2015).*Qualitative Research: A Guide to Design and Implementation.* San Francisco: John Wiley & Sons. 978-1119003618

Teaching Learning Process:

The Course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis. Collaborative learning tasks, enhancing reading comprehension of core writings in the area and developing innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will include student participation. Individual and group tasks and assignments will be given. Summative evaluation will be through end semester examination.

Key words

Education, Research, Designing Research

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

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B.Sc. Analytical Chemistry

SEMESTER-V & VI

BSc. (Analytical Chemistry)
(Analytical and Chemistry Component)

Kirori Mal College

SEMESTER V

DISCIPLINE SPECIFIC CORE COURSE CHEM-DSC -13: Analytical Chemistry- V: Instrumental Methods Of Analysis-I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Instrumental Methods of Analysis-I DSC-13: Analytical Chemistry-IV	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

This course is to make students understand the following concepts:

• Spectroscopic methods of analysis
• Principles of UV and Visible spectrophotometry and its applications
• Various components of UV and Visible spectrophotometry
• Single and double beam instruments
• IR spectroscopy and its applications

Learning Outcomes:

By the end of this course, students will be able to learn:

- Different types of spectroscopic methods of analysis.
- The instrumentation and the applications of the UV- Visible and IR spectrometry.

Syllabus of DSC-13

THEORY COMPONENT-

Unit 1: Basic Concepts of Spectroscopy (04 Hours)

An introduction to spectroscopic methods of analysis: Electromagnetic radiation, frequency, wavelength, Planck's equation, Electromagnetic spectrum, mathematical description of wave, superposition of waves, optical interferences, interaction of radiation with the matter, emission of radiation, absorption of radiation, scattering, line broadening.

Unit 2: UV- Visible Spectrophotometry: (12 Hours)

A. Lambert-Beer's law

B. Principles, Electronic transitions, Instrumentation, Single/double beam instrument

C. Industrial/Research Applications: Effect of solvent and conjugation on λ_{max}, Effect of cis-trans geometrical isomerism (e.g. stilbene, cinnamic acid, maleic and fumaric acid), calculation λ_{max} of different compounds (homo- and heteroannular dienes, unsaturated carbonyl compounds) (Woodward-Fieser Rule and Schott's Rule) and calculation of stoichiometric ratios of metal-ligand complex using Job's method.

Unit 3: IR Spectrophotometry: (10 Hours)

A. Principle, Modes of vibrations, Bands (Fundamental, overtones, etc)

B. Instrumentation: FT-IR, sample handling, special cautions during scanning.

C. Applications: Identification of the functional groups (mention the use of fingerprint region and functional group region) and simple organic molecules, Factors affecting the absorption frequency.

Unit 4: Raman spectroscopy: (04 Hours)

Introduction, basic principle, instrumentation, the difference between Raman and IR, Applications of Raman spectroscopy.

PRACTICAL COMPONENT (60 Hours)

1. Comparison of UV spectra of $K_2Cr_2O_7$ in aqueous and acidified medium (UV range 180-250 nm).
2. Determination of the pK_a of an indicator (methyl orange) using a spectrophotometer.
3. To find the stability constant and reaction stoichiometry of the complex formed between iron and 1,10-phenanthroline.

4. Identification of the structure of organic compounds using IR- spectroscopy (IR spectra should be provided).
5. Partial reduction of m-dinitrobenze to m-nitro aniline and its characterization using IR spectroscopy.
6. Synthesis of benzoic acid from benzamide and its characterization using IR spectrum.
7. Isolation of DNA from onion and its characterization using UV spectroscopy.
8. Extraction of carotene and xanthophyl from plants and recording its IR spectra.
9. Discuss the IR spectra of alcohols, carbonyl compounds, carboxylic acids and esters. (*Provide IR spectra*).
10. Oxidation of benzaldehyde to benzoic acid and compare the IR spectra of product with starting material.
11. Visit to Central Instrument Facility Centre- Delhi University and prepare a report.

References

- Kemp, W. (1991), Organic Spectroscopy, Palgrave Macmillan.
- Pavia, D.L., et al. (2015) Introduction to Spectroscopy, Cengage Learning India Private Limited.
- Banwell, C.N. (2006), Fundamentals of Molecular Spectroscopy,Tata McGraw-Hill Education.
- Kalsi, P.S. (2002) Spectroscopy of Organic Compounds, New Age International Publishers.
- Smith, B.C. (1998), Infrared Spectral Interpretations: A Systematic Approach, CRC Press.
- Plummer, D.T.(2001), Introduction to Practical Biochemistry, McGraw-Hill.
- B D Khosla, et al. (2018) Senior Practical Physical Chemistry, R Chand & Co.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE CHEM-DSC -14: Chemistry- V: Coordination Chemistry and Organometallics

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Coordination Chemistry and Organometallics DSC-14: Chemistry- V	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

- The course introduces the students to basics of coordination chemistry and organometallics which are of immense importance to biological systems, qualitative and quantitative analysis, catalysis, medicines, paints and pigments etc.
- Nomenclature, isomerism, bonding in coordination compounds has been dealt with in sufficient detail along with special emphasis on important coordination compounds in the biological system.
- In organometallic chemistry, the students are introduced to classification of organometallic compounds, the concept of hapticity and the 18-electron rule governing the stability of a wide variety of organometallic species with special emphasis on metal carbonyls.

Learning Outcomes:

By the end of this course, students will be able to:

- Understand terms: ligand, denticity of ligands, chelate, coordination number.
- Systematically name coordination compounds.
- Discuss the various types of isomerism possible in Octahedral and Tetrahedral coordination compounds.
- Use Valence Bond Theory to predict the structure and magnetic behaviour of metal complexes and understand the terms inner and outer orbital complexes.
- Explain the meaning of the terms Δo., Δt, pairing energy, CFSE, high spin and low spin and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy.
- Explain magnetic properties and colour of complexes on basis of Crystal Field Theory
- Apply 18-electron rule to rationalize the stability of metal carbonyls and related species.
- Learn how IR data can be used to understand extent of back bonding in metal carbonyls

Syllabus of DSC-14

THEORY COMPONENT

Unit 1: Introduction to Coordination compounds (06 Hours)

Brief discussion with examples of types of ligands, denticity and concept of chelate. IUPAC system of nomenclature of coordination compounds (mononuclear and binuclear) involving simple monodentate and bidentate ligands. Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Unit 2: Bonding in Coordination compounds (14 Hours)

Valence Bond Theory (VBT): Salient features of theory, concept of inner and outer orbital complexes, Drawbacks of VBT.

Crystal Field Theory: Splitting of d orbitals in octahedral symmetry. Crystal field effects for weak and strong fields, Crystal field stabilization energy (CFSE), concept of pairing energy, Factors affecting the magnitude of Δ, Spectrochemical series, Splitting of d orbitals in

tetrahedral symmetry, Comparison of CFSE for octahedral and tetrahedral fields, tetragonal distortion of octahedral geometry, Jahn-Teller distortion.

UNIT 3: Organometallic chemistry (10 Hours)

Definition and classification with appropriate examples based on nature of metal-carbon bond (ionic, sigma, pi and multicentre bonds), Structure and bonding of methyl lithium and Zeise's salt, Structure and bonding of ferrocene, mononuclear and polynuclear carbonyls of 3d metals, 18-electron rule as applied to carbonyls, π-acceptor behaviour of carbon monoxide (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

PRACTICAL COMPONENT (60 Hours)

1. Estimation of Mg^{2+} by direct complexometric titrations using EDTA.
2. Estimation of Zn^{2+} by direct complexometric titrations using EDTA.
3. Estimation of Ca^{2+} by direct complexometric titrations using EDTA.
4. Preparation of the following inorganic compounds and their characterization using appropriate analytical techniques:
   (i) Tetraamminecopper(II) sulphate
   (ii) Potassium trioxalatoferrate(III) trihydrate
   (iii) Chrome alum
   (iv) Cuprous chloride
   (v) Manganese(III)phosphate ($MnPO_4.H_2O$)
   (vi) Potash alum
   (vii) Acetylacetonate complex of Cu^{2+} and Fe^{3+}
   (viii) Tetraamminecarbonatocobalt(III)nitrate

References:

Theory:

- Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry-Principles of Structure and Reactivity, Pearson Education
- Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), Inorganic Chemistry 2nd Ed., Oxford University Press.
- Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company.
- Cotton, F.A.; Wilkinson, G.; Gaus, P.L. Basic Inorganic Chemistry, 3rd Edition, Wiley India.
- Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), Concepts and Models of Inorganic Chemistry, John Wiley & Sons.
- Greenwood, N.N.; Earnshaw, A. (1997), Chemistry of the Elements, 2nd Edition, Elsevier.

Practical:

- Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989),Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.
- Marr, G.; Rockett, B.W. (1972), Practical Inorganic Chemistry, Van Nostrand Reinhold.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

SEMESTER VI

DISCIPLINE SPECIFIC CORE COURSE CHEM-DSC -16: Analytical Chemistry- VI: Instrumental Methods of Analysis-II

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Instrumental Methods of Analysis-II DSC-16: Analytical Chemistry- VI	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**Must have studied Instrumental Methods of Analysis-I**

Learning Objectives:

The Objective of this course is to make students aware of the following concepts:

•Atomic spectroscopy
• NMR spectroscopy and its applications
• ESR spectroscopy

Learning Outcomes:

By the end of this course, students will be able to learn:

- What are the different types of spectroscopic methods of analysis that can be used to analyze the samples.
- The instrumentation and the applications of the NMR and ESR spectroscopy.

Syllabus of DSC-16

THEORY COMPONENT-

Unit 1: Atomic Spectroscopy **(06 Hours)**

A. Basic principle and Bohr theory of hydrogen atom
B. Types
C. Atomizer
D. Atomic absorption and photoelectron spectroscopy
E. Applications of absorption and photoelectron spectroscopy

Unit 2: ^{1}H NMR Spectroscopy **(18 Hours)**

A. Principle
B. Instrumentation and sample handling
C. Spin-spin and spin-lattice relaxation
D. Chemical shift
E. Solvents, Internal and external reference compounds
F. Factors affecting chemical shift (Electronegativity, diamagnetic anisotropy, *etc*.)
G. Spin-spin coupling
H. Coupling constants and its applications in characterization of organic molecules including *cis*- and *trans*-isomers
I. Discussion on Chemical shift equivalent nuclei and Magnetic equivalent nuclei with suitable examples
J. Deuterium exchange, Effect of restricted rotation (*e.g.* DMF) and low temperature NMR.
K. Identification of simple organic compounds including tautomer's using ^{1}H NMR spectral data.

Unit 3: ESR spectroscopy: **(06 Hours)**

Basic principles, Relaxation and line width, zero-field splitting and Kramer's degeneracy, g-factor and factor affecting g-factor, Hyperfine coupling constants splitting in triplet spectra, ESR of simple radicals.

PRACTICAL COMPONENT **(60 Hours)**

1. Determination of sodium in ORS using atomic absorption spectroscopy.
2. Determination of copper in drinking water using atomic absorption spectroscopy.
3. Multi-step organic synthesis and characterization of compounds using ^{1}H NMR spectral data (^{1}H NMR spectra of the compounds will be provided to students)
   (**a**) Aniline to *p*-bromoacetanilde
   (**b**) Nitration of bromobenzene
   (**c**) Substitution (S_N2) reaction of 1-iodobutane and 2-naphthol
   (**d**) Synthesis of chalcones, coumarins and xanthenes
4. Separation and identification of organic mixtures containing up to ***two components*** (Use functional group test only).
5. ESR spectra of simple radicals should be discussed in detail with students.

References:

- Skoog, D.A. et al (2018) Principles of Instrumental Analysis, Cengage Learning India Private Limited.
- Kemp, W. (1991), Organic Spectroscopy, Palgrave Macmillan.
- Pavia, D.L., et al. (2015) Introduction to Spectroscopy, Cengage Learning India Private Limited.
- Silverstein, R.M. (2014) Spectrometric Identification of Organic Compounds. John Wiley & Sons.
- Kalsi, P.S. (2002) Spectroscopy of Organic Compounds, New Age International Publishers.
- Chang, R. (1971) Basic Principles of Spectroscopy, McGraw-Hill, New York.
- Ahluwalia, V.K.; Dhingra, S. (2000), Comprehensive Practical Organic Chemistry: Qualitative Analysis, Universities Press.
- Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.
- Mann F.G, and Saunders, B.C. (2009) Practical Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), Singapore.
- Vogel A.I. (2010) Elementary Practical Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), Singapore.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE CHEM-DSC -17: Chemistry- VI: Quantum Chemistry and Spectroscopy

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Quantum Chemistry and Spectroscopy DSC-17: Chemistry- VI	**04**	**02**	**-**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The objective of this course is

- To introduce the students to the concepts and methodology of quantum mechanics,
- Its applications to spectroscopy
- To establish the relation between structure determination and spectra.

Learning Outcomes:

By the end of this course, students will be able to:

- Understand basic principles of quantum mechanics: operators, eigen values, averages, probability distributions.

- Understand and use basic concepts of microwave, IR and UV-VIS spectroscopy for interpretation of spectra.
- Explain Lambert-Beer's law, quantum efficiency and photochemical processes.

Syllabus of DSC-17

THEORY COMPONENT

Unit 1: Quantum Chemistry (15 Hours)

Postulates of quantum mechanics, quantum mechanical operators.

Free particle. Particle in a 1-D box (complete solution), quantization, normalization of wave functions, concept of zero-point energy.

Schrodinger equation and its application to free particle and particle in a 1D box

Qualitative treatment of H and H like atoms. Setting up of Schrodinger equation for many electron atoms.

Rotational Motion: Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels.

Vibrational Motion: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels.

Unit 2: Spectroscopy (15 Hours)

Spectroscopy and its importance in chemistry. Wave-particle duality. Link between spectroscopy and quantum chemistry. Electromagnetic radiation and its interaction with matter.

Laws of photochemistry including Lambert-Beer’s law. Jablonski diagram, Fluorescence and phosphorescence.

Types of spectroscopy. Difference between atomic and molecular spectra. Born- Oppenheimer approximation: Separation of molecular energies into translational, rotational, vibrational and electronic components.

Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational spectroscopy.

IR Spectroscopy: Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Vibrations of polyatomic molecules. Group frequencies. Effect of hydrogen bonding (inter- and intramolecular) and substitution on vibrational frequencies.

Electronic Spectroscopy: Electronic excited states. Free electron model and its application to electronic spectra of polyenes. Colour and constitution, chromophores, auxochromes, bathochromic and hypsochromic shifts.

PRACTICAL COMPONENT **(60 Hours)**

1. Study the 200-500 nm absorbance spectra of $KMnO_4$ and K_2Cr2O_7 (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$ (*Use solutions of different pH*)
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.
4. Verify Lambert-Beer's law and determine the concentration of $K_2Cr_2O_7$ in a solution of unknown concentration.
5. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
6. Study the kinetics of iodination of propanone in acidic medium.
7. Determine the dissociation constant of an indicator (phenolphthalein).
8. Study the kinetics of interaction of phenolphthalein with sodium hydroxide.
9. Study the kinetics of interaction of crystal violet with sodium hydroxide.

References:

Theory

- Banwell, C.N.; McCash, E.M.(2006), Fundamentals of Molecular Spectroscopy, Tata McGraw- Hill.
- Kapoor, K.L.(2015),A Textbook of Physical Chemistry, McGraw Hill Education, ,Vol 4, 5th Edition, McGraw Hill Education.
- McQuarrie, D.A.(2016),Quantum Chemistry, Viva Books.
- Chandra, A. K.(2001),Introductory Quantum Chemistry, Tata McGraw-Hill.

Practical:

- Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R. Chand & Co, New Delhi.
- Kapoor, K.L. (2019),A Textbook of Physical Chemistry, Vol.7, 1st Edition, McGraw Hill Education.

- Garland, C. W.; Nibler, J. W.; Shoemaker, D. P.(2003),Experiments in Physical Chemistry, 8th Edition, McGraw-Hill, New York.

Additional Resources:

- Castellan, G. W .(2004),Physical Chemistry, Narosa.
- Petrucci, R. H.(1989),General Chemistry: Principles and Applications, Macmillan Publishing

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

11.2. DISCIPLINE SPECIFIC ELECTIVES (DSE)

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Analytical Chemistry- I: Analytical Biochemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Analytical Biochemistry DSE: Analytical Chemistry-I	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The Objective of the course is

- To learn about proteins, enzymes, nucleic acids and lipids, using suitable examples, drug receptor interaction.
- Structure Activity Relation (SAR) studies along genetic code and concept of heredity.

Learning Outcomes:

By the end of this course, students will be able to:

- Learn about structures of carbohydrates and Proteins
- Learn about the molecules, macromolecules, polymers and their formations
- Learn about the metabolism of a few biomolecules.
- Know basic principles of drug-receptor interaction and structure activity relationship (SAR).
- Know biochemistry of diseases.

Syllabus of DSE-AC1

THEORY COMPONENT

Unit 1: Carbohydrates and Proteins: (16 Hours)

Basic understanding of the structures and properties of carbohydrates, biological importance of Carbohydrates.
Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, Haworth projections and conformational structures; Structure elucidation of glucose and fructose (Fischer's proof), Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;
Disaccharides – Structure elucidation of maltose, lactose and sucrose.
Polysaccharides – Elementary treatment of starch, cellulose and glycogen.
Amino Acids, Peptides and Proteins:
α-Amino Acids - Classification and characterization, Zwitterions, pKa values, isoelectric point and electrophoresis;
Proteins: Classification, Primary, secondary and tertiary structures of proteins, test for proteins, isolation, characterization, biological importance; denaturation of proteins.

Enzymes: Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as an example), factors affecting enzyme action, coenzymes and cofactors (ATP, NAD, FAD), specificity of enzyme action (including stereospecificity).

Unit 2: Lipids (06 Hours)
Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Liposomes and their biological functions and underlying applications. Lipoproteins. Properties, functions and biochemical functions of steroid hormones and peptide hormones.

Unit 3: Clinical Biochemistry: (08 Hours)
A diagnostic approach by blood/ urine analysis. **Blood:** Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anemia: Causes and symptoms.
Urine: Collection and preservation of samples. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

PRACTICAL COMPONENT (60 Hours)

1. Carbohydrate- qualitative and quantitative both.
2. Proteins-qualitative tests
4. Determination of the iodine number of oil.

5. Determination of the saponification value of an oil.
6. Determination of acid value of fats and oils.
7. Determination of cholesterol using Liebermann- Burchard reaction.
8. Estimation of DNA by diphenylamine reaction
9. Isolation and characterization of DNA from Onion/cauliflower.
10.Determination of amount of protein using Lowry's method/ Biuret method.
11. To study the activity of α-amylase.
12. To study the effect of temperature and pH on the activity of α-amylase.

References:

- Devlin, T. M. (2010), Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons.
- Berg, J.M., Tymoczko, J.L.; Stryer, L. (2010), Loose-leaf Version for Biochemistry, W.H.Freeman.
- Lehninger, A.L., Nelson, D.L.;Cox, M. (2004), Principle of Biochemistry, W.H.Freeman.
- Morrison, R. N.; Boyd, R. N. (2016) Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. (2015) Organic Chemistry (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Additional References:

- Swahney, S.K.; Singh, R. (2001), Introductory Practical Biochemistry, Narosa Publishing House.
- Cooper, T.G. (2011),The Tools of Biochemistry, Wiley India Pvt Ltd.
- Wilson, K.; Walker, J. (2000), Principles and Techniques of Practical Biochemistry, Cambridge University Press.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Analytical Chemistry- II: Polymers

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Polymers DSE: Analytical Chemistry-II	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The objective of the course is:

- To study and develop understanding of molecules and macromolecules.
- To study about molecular weight determination and the solution properties of polymers.

Learning Outcomes:
By the end of this course, students will be able to:

- Learn about the molecules, macromolecules and polymers
- Learn about properties of polymer solutions.
- Learn about the differentiation between molecule and polymer.
- Learn about the properties of polymers and their industrial applications.

Syllabus of DSE-AC2

THEORY COMPONENT

Unit 1: Introduction to Polymers (04 Hours)
Introduction of polymeric materials, classification of polymers, Various structures of copolymers such as linear branched and cross-linked polymers and their types, Molecular forces and chemical bonding in polymers

Unit 2: Polymerization (04 Hours)
Criteria for synthetic polymer formation, Types of polymerizations, Relationships between functionality, extent of reaction and degree of polymerization.

Unit 3: Molecular Weight of Polymers (10 Hours)
Nature and structure of polymers: structure-property relationships, molecular weight of polymers (M_n, M_w), molecular weight distribution, polydispersity, and determination of molecular weight by viscosity, end group analysis, cryoscopy, ebulliometry, osmometry, light scattering & ultracentrifugation method

Unit 4: Solution Properties of Polymers (12 Hours)

Criteria for polymer solubility, Polymer solution − solubility parameter, properties of dilute solutions and their criteria, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change. Flory- Huggins theory.

Glass Transition Behaviour of Polymers
Glass transition temperature (T_g), factors affecting the glass transition temperature, WLF equation.

PRACTICAL COMPONENT (60 Hours)

1. Free radical solution polymerization of

   (i) Styrene (St) (ii)Methyl Methacrylate (MMA) (iii) MethylAcrylate (MA).

2. IR , ^{1}H NMR studies of polymers (PSt, PMMA, PMA, PEG, PVOH)

3. Thermal studies of polymers (PSt, PMMA, PMA, PEG, PVOH)

4. To check the solubility of the given polymeric sample in different solvents.

5. Preparation of nylon-6,6

6. Determination of the viscosity-average molecular weight of poly(vinyl alcohol).

7. Determination of the fraction of head-to-head monomer linkages in of poly(vinyl alcohol)

9. Determination of molecular weight by end group analysis.

10. Chemical identification of polymers- (i) Unsaturation (ii) Testing of functional groups (associated with polymers).

11. Determination of hydroxyl number of a polymer using colorimetric method.

12. i) Preparation of urea-formaldehyde resin

ii) Separation of monomers from polymers by solvation-technique.

References:

- Harry R. Allcock, Frederick W. Lampe and James E. Mark ((2003) Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall
- Fred W. Billmeyer (1984) Textbook of Polymer Science, 3rd ed. Wiley-Interscience,
- L. H. Sperling (2005) Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
- Malcolm P. Stevens (2005) Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press.
- Gowarikar V.R., (2010) Polymer Science, New Age International Publishers Ltd.
- Ghosh P., (2010) Polymer Science and Technology: Plastics, Rubbers, Blends and Composites, Tata McGraw Hill.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Analytical Chemistry- III: Food Chemistry, Nutrition and Additives

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Food Chemistry, Nutrition and Additives DSE: Analytical Chemistry-III	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The introductory course on food chemistry, nutrition and additives is designed:

- To develop a basic understanding of the sources, importance, stability.
- To study about transformations of food components during handling and processing.

Learning Outcomes:

By the end of this course, students will be able to:

- Build a strong understanding of fundamentals of food chemistry.
- Understand how alterations /transformations during processing and handling affect the quality and stability of food
- Learn about the nature and importance of additives in food chemistry

Syllabus of DSE-AC3

THEORY COMPONENT

Unit 1: Introduction **(03 Hours)**

Introduction of food chemistry; An overview of the following: alterations during handling or processing (texture, flavour and colour), chemical and biochemical reactions leading to alteration in food quality (browning, oxidation, hydrolysis, protein denaturation), cause and effect relationship pertaining to food handling; Factors governing stability of food (chemical and environmental factors) and role of food chemists.

Unit 2: Water: **(09 Hours)**

Definition of water in food, Structure of water and ice, Types of water, Sorption phenomenon, Water activity and packaging, Water activity and shelf-life.

Carbohydrates: Introduction, Sources, Functions, Deficiencies, Structure and importance of Polysaccharides in food chemistry (Agar and Agarose, Pectin, Hemicellulose, Cyclodextrins, Gums, Alginate, Starches, Modified starches), Non Enzymic Browning and its prevention, Caramelisation, Formation of acrylamide in food, Role of carbohydrates as sweeteners in food.

Unit 3: Vitamins and Minerals. **(06 Hours)**

Vitamins: Introduction, Sources, Classification: Water Soluble and Water insoluble Vitamins, Essential Vitamins, Physiological function, deficiencies, Causes of variation and loss in foods, Vitamin like compounds, Effect of food processing. Minerals: Introduction, Sources, Classification: Major minerals and trace elements, Physiological function, Deficiencies, Factors affecting mineral content of food, Fortification and enrichment of foods with minerals, Effect of food processing

Unit 4: Food additives: **(12 Hours)**

Additives: Introduction, Importance, Classification, Antioxidants, Emulsifiers, Stabilizers, Gelling agents, Gums, Thickeners, Sweeteners, Acidulants, Preservatives, Humectants, Food toxins.

Colouring Agents and Pigments: Introduction, Natural food colourants: Anthocyanins, Carotenoids, Chlorophyll, Caramel, Betalains; Examples of Pigments in common food; Nature-identical colourants: β -Carotene, Canthaxanthin and Riboflavin. Artificial colouring agents; Artificial/synthetic colourants: Azo dyes (e.g. amaranth dye, tatrazine, citrous red, Allura red); Quinoline (e.g. quinoline yellow); Phthalein (e.g. erythrosine); Triarylmethanes and indigoid (e.g. indigo carmine), FD&C Dyes and Lakes; Properties of certified dyes, Colours exempt from certification.

Food Flavours: Sensation of taste and odour, Chemical Dimension of basic types of taste (Salty, Sweet, Bitter, Sour, Umami taste), other sensations like astringency, coolness, pungency/pungency); Non-Nutritive Sweeteners (aspartame, saccharin, sucralose, Cyclamate) and Nutritive Sweeteners, Molecular mechanism of flavour perception, Biogenesis of fruits and vegetable flavours, Taste Inhibition, Modification and Enhancement, Common Vegetable and Spice Flavours.

PRACTICAL COMPONENT (60 Hours)

1. Determination of Moisture in different Food Products by hot air oven-drying method.
2. Paper chromatography of synthetic food dyes (*ascending and circular both*).
3. Quantitative determination of Food dyes in Powdered drink mixes by Spectrophotometric method.
4. Colorimetric determination of Iron in vitamin / dietary tablets.
5. Determination of rancidity of edible oils by Kriess Test.
6. Estimation of Vitamin C in a given solution/ Lemon Juice/ Chilies by 2, 6-dichlorophenol Indophenol Method.
7. Isolation of Casein from milk.
8. Qualitative test for Amino acids and proteins (Biuret Test, Xanthoproteic Test, Ninhydrin Test, Millon's Test, Nitroprusside Test, etc).
9. Determination of total fat by acid hydrolysis method.

References:

Theory:

- DeMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), Principles of Food Chemistry, 4th Edition, Springer.
- Msagati, T.A.M. (2013), Chemistry of Food Additives and Preservatives, WileyBlackwell.
- Fennema, O.R. (2017), Food Chemistry, 5th Edition, CRC Press.
- Attokaran, M. (2017), Natural Food Flavors and Colorants, 2nd Ed., Wiley-Blackwell.
- Potter, N.N., Hotchkiss, J.H, (1995) Food Science, 5 th Ed., Chapman & Hall.
- Brannen, D., Davidsin, P.M., Salminen, T. Thorngate III, J.H. (2002), Food Additives, 2 nd Edition, CRC Press.
- Coultate, T. (2016), Food: The Chemistry of its Components, 6th Edn., Royal Society of Chemistry. 8. Belitz, H. D.; Grosch, W. (2009), Food Chemistry, Springer.

Practicals:

1. Ranganna, S. (2017). Handbook of analysis and quality control for fruits and vegetable products, 2nd Edn., McGraw Hill Education.
2. Sawhney, S.K., Singh, R. (2001), Introductory Practical Biochemistry, Narosa Publishing House.

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DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Analytical Chemistry- IV: Industrial Chemicals and Environment

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Industrial Chemicals and Environment DSE: Analytical Chemistry-IV	**04**	**02**	**-**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The objective of this course is

- To teach students about various processes being used in industry
- To learn basis properties of gases and their industrial production, uses, storage and hazards. Manufacturing, applications, analysis and hazards of the Inorganic Chemicals,
- Preparation of Ultra-Pure metals for semiconducting technology, Air and Water pollution, control measures for Air and Water Pollutants,
- Catalyst and Biocatalyst,
- Energy and Environment.

Learning Outcomes:

By the end of this course, students will be able to:

- The different toxic gases and their toxicity hazards
- Safe design systems for large scale production of industrial gases.
- Manufacturing processes, handling and storage of inorganic chemicals.
- Hazardous effects of the inorganic chemicals on human beings and vegetation.
- The requirement of ultra-pure metals for the semiconducting technologies
- Composition of air, various air pollutants, effects and control measures of air pollutants.
- Different sources of water, water quality parameters, impacts of water pollution, water treatment.

Syllabus of DSE-AC4

THEORY COMPONENT

Unit 1: Chemical Technology (08 Hours)

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Introduction to clean technology.

Unit 2: Industrial Gases and Inorganic Chemicals (10 Hours)

(a) Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, helium, hydrogen, acetylene, chlorine, fluorine, sulphur dioxide and phosgene.
(b) Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate. Preparation of metals (ferrous and nonferrous) and ultra-pure metals for semiconductor technology.

Unit 3. Environment (12 Hours)

(a) Air Pollution: Pollutants and their sources, pollution by SO_2, CO_2, CO, NOx, H_2S and other foul-smelling gases. Green House effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.
(b) Water pollution and Water Quality Standards: Pollutants and their sources, Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluent from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, *etc.* Industrial waste management, incineration of waste. Water

treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.
(c) Energy & Environment: Sources of energy: Coal, petrol and natural gas. Nuclear fusion / fission, solar, hydrogen, geothermal, tidal and hydel.

PRACTICAL COMPONENT (60 Hours)

1. Percentage of available chlorine in bleaching powder.
2. Measurement of chloride, sulphate and salinity of water samples by simple titration method. ($AgNO_3$ and potassium chromate)
3. Estimation of total alkalinity of water samples (CO_3^{-2}, HCO_3^-) using double titration method.
4. Measurement of dissolved CO_2 in water.
5. Determination of hexavalent Chromium Cr(VI) concentration in tannery wastes/waste water sample using UV-Vis spectrophotometry technique.
6. Study of some of the common bio-indicators of pollution.
7. Estimation of SPM in air samples.
8. Preparation of borax/ boric acid.
9. Detection of constituents of Ammonium Sulphate fertilizer (Ammonium and Sulphate ions) by qualitative analysis and determine its free acidity.
10. Detection of constituents of CAN fertilizer (Calcium, Ammonium and Nitrate ions) fertilizer and estimation of Calcium content.
11. Detection of constituents of Superphosphate fertilizer (Calcium and Phosphate ions) and estimation of phosphoric acid content.
12. Detection of constituents of Dolomite (Calcium, Magnesium and carbonate ions) and determination of composition of Dolomite (Complexometric titration).

References:

Theory

- Manahan, S. E. (2017), Environmental Chemistry, CRC Press.
- Buchel, K. H.; Moretto, H. H.; Woditsch, P. (2003), Industrial Inorganic Chemistry, Wiley-VCH.
- De, A. K. (2012), Environmental Chemistry, New Age International Pvt., Ltd.
- Khopkar, S. M. (2010), Environmental Pollution Analysis, New Age International Publisher.
- Stocchi E. (1990) Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- Felder, R. M.; Rousseau, R. W. (2008) Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.

- Kent, J. A. (2007) Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

Practicals

- Vowles, P. D.; Connell, D. W. (1980), Experiments in Environmental Chemistry: A Laboratory Manual, Vol. 4, Pergamon Series in Environmental Science.
- Gopalan, R.; Anand, A.; Sugumar R. W. (2008), A Laboratory Manual for Environmental Chemistry, I. K. International.
- Svehla, G. (1996), Vogel's Qualitative Inorganic Analysis, Prentice Hall.
- Banewicz, J. J.; Kenner, C.T. Determination of Calcium and Magnesium in Limestones and Dolomites, Anal. Chem., 1952, 24 (7), 1186–1187.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Analytical Chemistry- V: Python Programming for Analytical Chemists

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Python Programming for Analytical Chemists DSE: Analytical Chemistry-V	**04**	**03**	**0**	**01**	**Class 12th with Physics, Chemistry, Mathematics**	

Learning Objectives

This course aims

- To teach students the fundamental building blocks and syntax of coding in Python
- To apply python programming to solve simple Chemistry problems by thinking algorithmically and coding structurally.

Learning Outcomes:

By studying this course, the students will be able to:

• Understand the importance of python programming in chemistry and its applications in the field of AI and ML

• Perform simple computations in python after learning the basic syntax, loop structure, string data manipulation etc.
• Solve chemistry problems such as finding pK_a of a weak acid, solving Schrodinger's equation etc.
• Plot experimental data and perform regression analysis

Syllabus of DSE-AC5

THEORY COMPONENT

Unit 1: Introduction to Python (04 Hours)
Python coding environment setup, Python as an interpreted language, Brief history of Python, Uses of Python (including artificial intelligence and machine learning), Applications of Python in Chemistry

Unit 2: Coding in Python (16 Hours)
(i) Basic syntax including constants and variables, Operators, Data Types, Declaring and using Numeric data types: int, float, string etc. (ii) Program Flow Control Conditional blocks: if, else and else if, simple FOR loops, FOR loop using ranges, string, list and dictionaries. Use of while loops, Loop manipulation using pass, continue, break and else. (iii) Complex data types: String, List, Arrays, Tuples and Dictionary, String operations and manipulation methods, List operations including slicing, in-built Python Functions. (iv) Python packages - usage of numpy and scipy for mathematical computations.

Unit 3: Plotting graphs (10 Hours)
Matplotlib for Plotting - Simple plots, formatting of plots, multiple plots, histograms, bar graphs, distributions, curve fitting – linear regression.

Unit IV: Numerical Methods in Chemistry (15 Hours)
Solution of quadratic equation, polynomial equations (formula, iteration, Newton – Raphson methods and binary bisection) with examples of polynomial equations used in chemistry; Numerical differentiation – finite difference method (backward, central and forward), Numerical integration - Trapezoidal and Simpson's rule to calculate area under the curves for chemistry problems, e.g., entropy calculations, Simultaneous equations, Statistical analysis-mean, variance, standard deviation, error, Curve fitting – linear regression, Solving Schrödinger's equation using Python packages.

PRACTICAL COMPONENT (30 Hours)

1. Writing simple programs using scipy and numpy
a. syntax, data types
b. loop structure, conditional loops
c. To learn string data manipulation
d. Array and lists
e. Sorting, matrix manipulations

2. Plotting graphs using matplotlib a. Planck's distribution law
b. Maxwell-Boltzmann distribution curves as a function of temperature and mass
c. Radial distribution curves for hydrogenic orbitals

d. Gas law Isotherms – Ideal and Real

e. Data from phase equilibria studies

f. Wavefunctions and Probabilities as multiplots

g. Kinetics data with linear fitting

3. Numerical Methods in Chemistry

a. Solving equations involved in chemical equilibria such as pH of a weak acid at a given concentration, cubic equation obtained from solving van der Waals equation of real gases using Iteration, Newton-Raphson, and Binary Bisection Method

b. Numerical Differentiation – finding equivalence point given pH metric and potentiometric titrations data by finding the first and the second derivative using the finite difference method

c. Numerical Integration – Trapezoidal and Simpson's 1/3 rule to calculate enthalpy and entropy of an ideal gas

d. Statistical Analysis – Calculating Mean, Variance, Standard Deviation

e. Solving Schrodinger's Equation

References:

1. Dr. M. Kanagasabapathy(2023), Python for Chemistry: An introduction to Python algorithms, Simulations, and Programing for Chemistry (English Edition), BPB Publications

2. Robert Johansson (2021), Numerical Python: Scientific Computing and Data Science Applications with NumPy, SciPy and Matplotlib, 2nd Edition, Apress

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DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Chemistry- I: Green Chemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Green Chemistry DSE: Chemistry-I	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

This course is designed

- To become more and more environmentally conscious and work towards sustainable practices.
- To practice chemistry in the safest way possible is key towards safe working conditions in the laboratories as well as the chemical industry
- To extend the same to society in a sustainable future for the planet.

Learning Outcomes:

By the end of this course, students will be able to:

- Understand the twelve principles of green chemistry and also build the basic understanding of toxicity, hazard and risk related to chemical substances.
- Calculate atom economy, E-factor and relate them in all organic synthesis
- Appreciate the use of catalyst over stoichiometric reagents
- Learn to use green solvents, renewable feedstock and renewable energy sources for carrying out safer chemistry
- Appreciate the use of green chemistry in problem solving skills and critical thinking to innovate and find solutions to environmental problems.
- Learn to design safer processes, chemicals and products through understanding of inherently safer design (ISD)
- Appreciate the success stories and real-world cases as motivation for them to practice green chemistry

Syllabus of DSC-C1

THEORY COMPONENT

Unit 1: Introduction (08 Hours)

Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry.

• Need of green chemistry

• Importance of green chemistry in- daily life, Industries and solving human health problems (four examples each).

• A brief study of Green Chemistry Challenge Awards (Introduction, award categories and study about five last recent awards).

Unit 2: Twelve Principles of Green Chemistry (12 Hours)

The twelve principles of the Green Chemistry with their explanation, Special emphasis on the following:

• Prevention of waste / byproducts, pollution prevention hierarchy.

• Green metrics to assess greenness of a reaction: environmental impact factor, atom economy and calculation of atom economy.

• Green solvents-supercritical fluids, water as a solvent for organic reactions, ionic liquids, solvent less reactions, solvents obtained from renewable sources.

• Catalysis and green chemistry- comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.

• Green energy and sustainability.

• Real-time analysis for pollution prevention.

• Prevention of chemical accidents, designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation

Unit 3: (10 Hours)

The following Real-world Cases in green chemistry should be discussed: Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments. Designing of environmentally safe marine antifoulant. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.

PRACTICAL COMPONENT (60 Hours)

Characterization by melting point, UV-Visible spectroscopy, IR spectroscopy and any other specific method should be done (wherever applicable).

1. Preparation and characterization of nanoparticles of gold using tea leaves/silver nanoparticles using plant extracts.
2. Preparation of biodiesel from waste cooking oil and characterization (TLC, pH, solubility, combustion test, density, viscosity, gel formation at low temperature and IR can be provided).
3. Benzoin condensation using thiamine hydrochloride as a catalyst instead of cyanide.
4. Extraction of D-limonene from orange peel using liquid CO_2 prepared from dry ice.
5. Mechanochemical solvent free, solid-solid synthesis of azomethine using *p*-toluidine and *o*-vanillin/*p*-vanillin.
6 Microwave-assisted Knoevenagel reaction using anisaldehyde, ethylcyanoacetate and ammonium formate.
7. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.
8. Photochemical conversion of dimethyl maleate to dimethyl fumarate (*cis-trans* isomerisation)
9. Benzil- Benzilic acid rearrangement: Preparation of benzilic acid in solid state under solvent-free condition.

References:

Theory:

1. Anastas, P.T., Warner, J.C. (2014), Green Chemistry, Theory and Practice, Oxford University Press.
2. Lancaster, M. (2016), Green Chemistry: An Introductory Text, 3rd Edition, RSC Publishing.

3. Cann, M. C., Connely, M.E. (2000), Real-World cases in Green Chemistry, American Chemical Society, Washington.
4. Matlack, A.S. (2010), Introduction to Green Chemistry, 2nd Edition, Boca Raton: CRC Press/Taylor & Francis Group publisher.
5. Alhuwalia, V.K., Kidwai, M.R. (2005), New Trends in Green chemistry, Anamalaya Publishers.
6. Sidhwani, I.T, Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.

Practical:

1. Kirchoff, M.; Ryan, M.A. (2002), Greener approaches to undergraduate chemistry experiment, American Chemical Society, Washington DC.
2. Sharma, R.K.; Sidhwani, I.T.; Chaudhari, M.K. (2013), Green Chemistry Experiments: A monograph, I.K. International Publishing House Pvt Ltd. New Delhi.
3. Pavia, D.L.; Lamponam, G.H.; Kriz, G.S.W. B. (2012), Introduction to organic Laboratory Technique- A Microscale approach, 4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.
4. Sidhwani I.T. (2015), Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. DU Journal of Undergraduate Research and Innovation, 1(1),131-151. ISSN: 2395-2334.
5. Sidhwani, I.T; Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.
6. Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, Department of Science and Technology, Government of India.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Chemistry- II: Conductance, Electrochemistry and Chemical Kinetics

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Conductance, Electrochemistry and Chemical Kinetics DSE: Chemistry-II	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

This course is aimed at

- To learn about electrolytic and galvanic cells,
- To measure conductance and learn its applications,
- To measure emf and its applications.
- To learn about the reaction rate, order, activation energy and theories of reaction rates.

Learning Outcomes:
By the end of this course, students will be able to:

- Explain the factors that affect conductance, migration of ions and application of conductance measurement.
- Understand the importance of Nernst equation, measurement of emf, calculations of thermodynamic properties and other parameters from the emf measurements.
- Understand rate law and rate of reaction, theories of reaction rates and catalysts; both chemical and enzymatic.

Syllabus of DSE-C2

THEORY COMPONENT

Unit 1: Conductance (08 Hours)

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes, Kohlrausch Law of independent migration of ions, Ionic velocity, mobility and their determination, transference number and its relation to ionic mobility, Conductometric titrations (only acid-base).

Unit 2: Electrochemistry (12 Hours)

Concept of reversible and irreversible cells, standard electrode potential, concept of EMF of a cell, measurement of EMF of a cell, Nernst equation and its importance, types of electrodes, electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells, liquid junction potential and salt bridge, pH determination using hydrogen electrode and quinhydrone electrode, Potentiometric titrations-qualitative treatment (acid-base and oxidation-reduction only).

Unit 3: Chemical Kinetics and Catalysis (10 Hours)

The concept of reaction rates, effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants), half–life of a reaction, general methods for determination of order of a reaction, Concept of activation energy and its calculation from Arrhenius equation. Theories of reaction rates: Collision theory and activated complex theory of bi-molecular reactions. Comparison of the two theories (qualitative treatment only) Catalysis: Types of catalyst, specificity and

selectivity, mechanisms of catalyzed reactions at solid surfaces. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

PRACTICAL COMPONENT (60 Hours)

Conductance

1. Determination of molar conductance, degree of dissociation and dissociation constant of a weak acid.
2. Perform the following conductometric titrations: **a**) Strong acid *vs* strong base **b**) Weak acid *vs* strong base. **c**) Mixture of strong acid and weak acid *vs.* strong base.

Potentiometry

3. Perform the potentiometric titrations of
   a) Strong acid vs strong base
   b) Weak acid vs strong base.
   c) Potassium dichromate vs. Mohr's salt Chemical Kinetics
4. Study the kinetics of acid hydrolysis of methyl acetate with hydrochloric acid.
5. Study the kinetics of Iodide-persulphate reaction by Initial rate method or integrated rate law method.
6. Effect of substrate concentration on acid phosphatase activity and determination of its K_m, V_{max} and K_i (with respect to inorganic phosphate).

References:

Theory:

- Castellan, G. W .(2004),P hysical Chemistry, Narosa.
- Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol.1, 6th Edition, McGraw Hill Education.
- Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol.5, 3rd Edition, McGraw Hill Education.
- Puri, B.R., Sharma, L.R. and Pathania M.S. (2020), Principles of Physical Chemistry, Vishal Publishing Co.

Practical:

- Khosla, B.D.; Garg, V.C.; Gulati, A.(2015), Senior Practical Physical Chemistry, R. Chand & Co.
- Kapoor, K.L. (2019), A Textbook of Physical Chemistry, Vol 7, 1st Edition, McGraw Hill Education.
- Batra, S.K., Kapoor, V and Gulati, S. (2017) 1 st Edition, Experiments in Physical Chemistry, Book Age series.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Chemistry- III: Novel Inorganic Solids

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Novel Inorganic Solids DSE: Chemistry-III	**04**	**03**	**0**	**01**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

This course will

- To know about Novel inorganic solids and their applications in both industrial and research arenas.
- To utilize them as catalysts, as a nano reactor to host reactants for synthesis and for the controlled release of biomolecules.

Learning Outcomes:

By the end of this course, students will be able to:

- Understand the mechanism of solid-state synthesis.
- Explain about the different characterization techniques and their principles.
- Understand the concept of nanomaterials, their synthesis and properties.
- Explain the mechanism of growth of self-assembled nanostructures.
- Understand the real-world importance of bioinorganic nanomaterials.
- Explain the importance of composites and their applications.
- Understand the importance and real-life application of solid materials

Syllabus of DSE-C3

THEORY COMPONENT

Unit 1: Synthesis of Inorganic solids (05 Hours)

Conventional heat and beat method, Co-precipitation method, Sol-gel method, Hydrothermal method, Chemical vapor deposition (CVD), Ion-exchange and Intercalation method.

Unit 2: Characterization techniques of inorganic solids (10 Hours)

Powder X-ray Diffraction, UV-visible spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Fourier-Transform Infrared (FTIR) spectroscopy, Brunauer–Emmett–Teller (BET) surface area analyser, Dynamic Light Scattering (DLS).

Unit 3: Solid Electrolytes (10 Hours)

Cationic, anionic and mixed solid electrolytes and their applications. Inorganic pigments – coloured, white and black pigments. One-dimensional metals, molecular magnets, inorganic liquid crystals.

Unit 4: Nanomaterials (10 Hours)

Overview of nanostructures and nanomaterials, classification, preparation and optical properties of gold and silver metallic nanoparticles, concept of surface plasmon resonance, carbon nanotubes, inorganic nanowires, Bioinorganic nanomaterials, DNA and its nanomaterials, natural and artificial nanomaterials, self-assembled nanostructures, control of nanoarchitecture, one dimensional control.

Unit 4: Composite Materials (10 Hours)

Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, bio-nanocomposites, environmental effects on composites, applications of composites.

PRACTICAL COMPONENT (30 Hours)

1. Synthesis of silver nanoparticles by chemical methods / green approach and characterization using UV-visible spectrophotometer.
2. Synthesis of metal sulphide nanoparticles (MnS, CdS, ZnS & CuS) and their characterization using UV-visible spectrophotometer.
3. Intercalation of hydrogen in tungsten trioxide and its conductivity measurement using conductometer.
4. Synthesis of inorganic pigments ($PbCrO_4$, $ZnCrO_4$, Prussian Blue, Malachite).
5. Synthesis of pure ZnO and Cu doped ZnO nanoparticles.
6. Preparation of zeolite A and removal of Mg and Ca ions from water samples quantitatively using zeolite.

References:

Theory:

- West, A. R. (2014), Solid State Chemistry and Its Application, Wiley.
- Smart, L. E.; Moore, E. A., (2012), Solid State Chemistry: An Introduction CRC Press Taylor & Francis.
- Rao, C. N. R.; Gopalakrishnan, J. (1997), New Direction in Solid State Chemistry, Cambridge University Press.
- Poole Jr.; Charles P.; Owens, Frank J. (2003), Introduction to Nanotechnology, John Wiley and Sons.

Practicals:

- Orbaek, W.; McHale, M.M.; Barron, A. R.; Synthesis and Characterization of Silver Nanoparticles for An Undergraduate Laboratory, J. Chem. Educ. 92, 2015, 339−344.
- Cheng, K.H.; Jacobson, A.J.; Whittingham, M.S. (1981), Hexagonal Tungsten Trioxide and Its Intercalation Chemistry, Solid State Ionics, 5, 1981, 355-358.
- Ghorbani H.R.; Mehr, F.P; Pazoki, H; Rahmani, B.M.; Synthesis of ZnO Nanoparticles by Precipitation Method, Orient J Chem 2015, 31(2).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Chemistry- IV: Phase Equilibria and Solutions

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Phase Equilibria and Solutions DSE: Chemistry - IV	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The course is designed

- To understand phase, co- existence of phases, phase diagram, CST
- To know about distribution law and its applications.

Learning Outcomes:
By the end of this course, students will be able to:

- Understand phase equilibrium, criteria, CST, Gibbs-Duhem-Margules equation.
- Apply the concepts of phase and its applications in purification etc.
- Learn about distribution law and its importance in solvent extraction.

Syllabus of DSE-C4
THEORY COMPONENT

Unit 1: Phase Equilibria **(15 Hours)**

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria,
Phase diagram for one component systems (H_2O, CO_2 and S), with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points. Phase diagram of three component system, Triangular plots, water-chloroform-acetic acid system.
Application of phase in explaining phenomenon in everyday life.

Unit 2: Solution **(15 Hours)**

Concentration term, lowering of vapour pressure, Raoult's law. Thermodynamic basis of the colligative properties - lowering of vapour pressure, elevation of Boiling Point, Depression of Freezing point and Osmotic pressure and derivation of expressions for these using chemical potential. Concept of activity and activity coefficients. Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, lever rule, partial miscibility of liquids, CST (both upper and lower) and effect of impurities on CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

PRACTICAL COMPONENT **(60 Hours)**

Phase Equilibrium
1. Determination of critical solution temperature and composition at CST of the phenol water system
2. To study the effect of impurities of sodium chloride and succinic acid on the CST of phenol-water system.
3. Construction of the phase diagram using cooling curves:
   (i) simple eutectic
   (ii) congruently melting systems.
4. Distribution of I_2/acetic/ benzoic acid between water and chloroform/CCl_4 or cyclohexane.
5. Study of equilibrium of any one of the following reactions by distribution method:
(i) I_2 (aq) + I^- (aq) ⇌ I_3^-(aq)
(ii) Cu^{2+} (aq) + nNH_3⇌ $[Cu(NH_3)_n]^{2+}$

References:

Theory:

- Atkins, P.W.; Paula, J.de. (2014), Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press.
- Ball, D. W. (2017), Physical Chemistry, 2 nd Edition, Cengage Learning, India.

- Castellan, G. W. (2004), Physical Chemistry, 4 th Edition, Narosa.
- Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 1, 6 th Edition, McGraw Hill Education.
- Kapoor, K.L. (2020) A Textbook of Physical Chemistry, Vol 3, 5th Edition, McGraw Hill Education.

Practical:

- Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R. Chand & amp; Co, New Delhi.
- Kapoor, K.L. (2019), A Textbook of Physical Chemistry, Vol.7, 1 st Edition, McGraw Hill Education.
- Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), Experiments in Physical Chemistry, 8 th Edition, McGraw-Hill, New York

Additional Resources:

- Moore, W.J. (1972), Physical Chemistry, 5th Edition, Longmans Green & Co. Ltd.
- Glasstone, S. (1948), Textbook of Physical Chemistry, D. Van Nostrand company, New York.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Chemistry- V: Main Group Chemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Main Group Chemistry DSE: Chemistry -V	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The objective of this paper is

- To provide basic understanding of the fundamental principles of metallurgy through study of the different methods of extraction and refining of metals.

- To illustrates the diversity and fascination of inorganic chemistry through the study of structure, properties and utilities of s- and p-block elements and their compounds

Learning Outcomes:

By the end of this course, students will be able to:

- Understand the basis of occurrence of metals in nature and the methods that can be applied on minerals to extract the metals from them.
- Explain the importance of free energy of formation of oxides with the choice of reducing agent for extracting the metals.
- Understand and explain the importance of refining of metals and the choice of a refining procedure.
- Explain the group trends observed for different properties of s and p block elements
- Explain the structures and the bonding basis of compounds of s- and p- block elements
- Explain the uniqueness observed in alkali metals and some other main group elements
- Understand and explain the polymerization of inorganic ions to generate inorganic polymers and the difference between organic and inorganic polymers.

Syllabus of DSE-C5

THEORY COMPONENT

Unit 1: General Principles of Metallurgy (06 Hours)

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: Electrolytic process, Van Arkel-De Boer process, Zone refining.

Unit 2: General Properties (05 Hours)

General group trends of s- and p-block elements with special reference to melting and boiling points, flame colour, metallic character and complex formation tendency, diagonal relationship and anomalous behaviour of first member of each group, Alkali metal solutions in liquid ammonia

Unit 3: Structure, Bonding, Properties and Applications (15 Hours)

Structure, bonding, properties (Acidic/Basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, thermal stability) and applications of the following:

Crown Ethers and cryptates of Alkali metals

Hydrides: hydrides of Group 13 (only diborane), Group 14, Group 15 (EH_3 where E = N, P, As, Sb, Bi), Group 16 and Group 17.

Oxides: Oxides of nitrogen, phosphorus and sulphur, Oxoacids: oxoacids of phosphorus, sulphur and chlorine, Halides of phosphorus

Unit 4: Inorganic Polymers **(04 Hours)**

Preparation, properties, structure and uses of the following:

Borazine, Silicates and Silicones

PRACTICAL COMPONENT **(60 Hours)**

Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations including interfering radicals and water insoluble. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: CO_3^{2-}, NO_2^- , S^{2-}, SO_3^{2-} , SO_4^{2-} , $S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^- , Br^- , I^- ,

NO_3^- , BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+} (*At least 10 combinations of mixture to be prepared*).

References:

Theory:

- Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
- Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry-Principles of Structure and Reactivity, Pearson Education.
- Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), Concepts and Models of Inorganic Chemistry, John Wiley & Sons.
- Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.
- Housecraft, E. H.; Sharpe, A.G. (2018), Inorganic Chemistry, 5th Edition, Pearson.
- F.A. Cotton & G. Wilkinson (1999), Advanced Inorganic Chemistry, 6th Edition, John Wiley & Sons.

Practicals:

- Vogel, A.I. (1972), Qualitative Inorganic Analysis, Longman.
- Svehla, G. (1996), Vogel's Qualitative Inorganic Analysis, Prentice Hall.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE: Chemistry- VI: Active Methylene Compounds, Polynuclear Hydrocarbons and Heterocyclic

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Active Methylene Compounds, Polynuclear Hydrocarbons and Heterocyclic Compounds DSE: Chemistry -VI	**04**	**02**	**0**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The purpose of this course is

- to introduce the chemistry and applications of polynuclear hydrocarbons,
- To know about active methylene and heterocyclic compounds.

Learning Outcomes:

By the end of the course, the students will be able to:

- Understand the fundamentals of functional group chemistry, polynuclear hydrocarbons and heterocyclic compounds through the study of methods of preparation, properties and chemical reactions with underlying mechanism.
- Become familiar with their particular properties, chemical reactions, criterion of aromaticity with reference to polynuclear hydrocarbons and heterocyclic compounds, trends in basicity of amines and heterocyclic compounds and their behaviour at different pH.
- Understand the Synthetic applications of these compounds including their medicinal applications through their reaction chemistry.

Unit 1: Active methylene compounds **(08 Hours)**

Preparation and reactions, Claisen ester condensation, Keto-enol tautomerism. Reactions: Synthetic uses of ethylacetoacetate and malonic esters (preparation of non-heteromolecules having up to 6 carbons).

Unit 2: Polynuclear Aromatic compounds: **(09 Hours)**

Introduction, Classification, Structure, Nomenclature and uses. Aromaticity of polynuclear hydrocarbons, structure elucidation of Naphthalene and general methods of preparation of naphthalene, phenanthrene and anthracene (including Haworth method, Friedel Craft acylation, Diels Alder reaction and Pschorr Synthesis).
Relative reactivity of naphthalene, phenanthrene and anthracene in comparison to benzene.
Properties: Physical properties, discussion on the following reaction (with mechanism) for Naphthalene, Anthracene and Phenanthrene: Addition reactions, Oxidation, Electrophilic substitution- Friedel Craft reaction, Chloromethylation, Halogenation, Formylation, Nitration and sulphonation. Reduction reaction and Diels Alder reaction.

UNIT-3: Heterocyclic Compounds **(13 Hours)**

Introduction, importance, classification and nomenclature of heterocyclic compounds (containing only one hetero atom). General discussion on the following aspects of heterocyclic compounds: Structure, aromaticity in 5-membered and 6-membered rings containing one heteroatom; Basicity and relative reactivity towards electrophilic substitution reactions (amongst five membered and six membered rings)

General methods of synthesis for: Furan, Pyrrole (Paal-Knorr synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Properties: Physical properties, discussion on the following reaction (with mechanism) for Furan, Pyrrole, thiophene, Pyridine- Electrophilic substitution- Nitration, sulphonation, halogenation, Formylation, acylation, mercuration and carboxylation. Oxidation, Reduction, Addition, Reactions showing acidic /basic character. Reaction with diazonium salts, Ring opening, Ring expansion and Nucleophilic substitution reaction wherever applicable should be discussed

PRACTICAL COMPONENT **(60 Hours)**

1. Nitration of simple compounds like Chlorobenzene/Bromobenzene.
2. Benzoylation of p-toluidine (or any other compound).
3. Oxidation of toluene to benzoic acid.
4. Detection of Nitrogen/sulphur/halogens in the given organic compound.
5. Systematic identification of bifunctional compounds (Salicylic Acid, Cinnamic acid and nitro phenols) and preparation of their derivatives.
6. Systematic identification of Aromatic hydrocarbons and aryl halides.
7. Multistep synthesis: (a) Cyclohexanone to caprolactam (b) Aniline to p-bromo aniline

References:

- Morrison, R. T.; Boyd, R. N. (2010) Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
- Finar, I. L.(2002) Organic Chemistry (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016),Organic Chemistry, 12th Edition, Wiley.

- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P. (2013),Organic Chemistry, Oxford University Press.
- Gilchrist, T.L. (1997),Heterocyclic Chemistry, Pearson Education.
- Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Chemistry of six to eight membered N, O, S, P and Se heterocycles), Elsevier publication.
- Ahluwalia, V.K.; Dhingra, S. (2000), Comprehensive Practical Organic Chemistry: Qualitative Analysis, Universities Press.
- Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989),Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.
- Mann F.G, and Saunders, B.C. (2009) Practical Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), Singapore.
- Vogel A.I. (2012) Elementary Practical Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), Singapore.

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DISCIPLINE SPECIFIC ELECTIVE COURSE: DSE-RM: Research Methodology for Chemists

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Research Methodology for Chemists DSE-RM	**04**	**03**	**0**	**01**	**Class 12th with Physics, Chemistry, Mathematics**	**NIL**

Learning Objectives

The course is designed

- To make the students aware of fundamental but mandatory ethical practices in chemistry.
- To make the students aware of data analysis.
- To make the students aware of literature survey in different modes.
- To make the students aware of safety handling and safe storage of chemicals.
- This paper will help student to learn to avoid plagiarism. To learn different e-resources.

Learning Outcomes:
By the end of the course, the students will be able to:

- Ethical practices in chemistry
- Data analysis
- Literature survey in different modes
- Three R (recovery, recycling and reuse of laboratory chemicals).
- e-resources.
- Plagiarism, consequences

Syllabus of DSE-RM
THEORY COMPONENT

Unit 1: Literature Survey (20 Hours)

Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.
Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki- Databases, ChemSpider, Science Direct, SciFinder, Scopus.
Information Technology and Library Resources: The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information. publications of scientific work. Writing ethics. Avoiding plagiarism.

Unit 2: Chemical Safety and Ethical Handling of Chemicals (12 Hours)

Safe working procedure and protective environment, protective apparel, emergency, procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.

Unit 3: Data Analysis (13 Hours)

The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments. Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiple linear regression analysis.

PRACTICAL COMPONENT (30 Hours)

1. Collection of journal articles on a particular topic using Google Scholar and creating a database.
2. Collection of journal articles on a particular topic using Science Direct and creating a database.
3. Collection of journal articles on a particular topic using Scopus and creating a database.
4. Collection of chemical structure using ChemSpider and creating a database.
5. Collection of chemical structure using SciFinder and creating a database.
6. Curve fitting using freely available softwares/apps (any one)
7. Making of power point presentation
8. Experimental learning of safe storage hazardous chemicals
9. Experimental learning of handling of hazardous chemicals

References:

- Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011) Practical skills in chemistry. 2nd Ed. Prentice-Hall, Harlow.
- Hibbert, D. B. & Gooding, J. J. (2006) Data analysis for chemistry. Oxford University Press.
- Topping, J. (1984) Errors of observation and their treatment. Fourth Ed., Chapman Hall, London.
- Harris, D. C. Quantitative chemical analysis. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, how to use Excel in analytical chemistry and in general scientific data analysis. Cambridge Univ. Press (2001) 487 pages.
- Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992.
- OSU safety manual 1.01.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.