

References

Given the nature of the course, readings will be updated every year.

1. Centre for Budget and Governance Accountability. Recent reports.
2. Chakraborty, P. (2015). Intergovernmental fiscal transfers in India: Emerging trends and realities. In P. Patnaik (ed.): *Macroeconomics*. Oxford University Press.
3. Ministry of Finance. Economic and social classification of the budget.
4. Ministry of Finance. Economic survey (latest).
5. Ministry of Finance. Finance commission report (latest).
6. Ministry of Finance. Union budget.
7. Reddy, Y. (2015). Continuity, change and the way forward: The fourteenth finance commission. *Economic and Political Weekly*, 50(21), 27-36.

Teaching Learning Process

Lectures and tutorials

Assessment Methods

Internal assessment and final examination as per CBCS rules

Keywords

Economic survey, union budget, government policy

Research Methodology (PS41)

Skill Enhancement Elective Courses (SEC) Credit: 4

Course Objective

This course is designed to provide students skills for collecting and analysing data to answer real world problems. It will cover modes of data collection, data cleaning and data representation.

Course Learning Outcomes

The student will develop an understanding of how commonly available data is collected and analyzed. This would help in the interpretation of secondary data and in the management of small primary surveys.

Unit 1

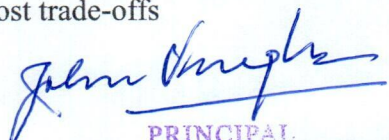
Data Types and sources: Qualitative and quantitative data, measurement and scales; overview of some secondary data sources

Unit 2

Questionnaire design: Measurement and scales, ordering of questions, coding responses

Unit 3

Sampling techniques: Simple random sampling, stratification, sequential sampling; Size and cost trade-offs


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Unit 4

Processing of survey data: Data cleaning, checking for consistency

Unit 5

Analysing data: Generating sample statistics and representing them in an easily comprehensible manner

Unit 6

Ethics and Scientific Integrity: Respecting respondent privacy, ethical standards of conduct

References

1. Cochran, W. (2008). *Sampling techniques*, 3rd ed. Wiley.
2. Groves, R., Fowler, F., Couper, M., Lepkowski, J., Singer, E., Tourangeau, R. (2009). *Survey Methodology*. Wiley.
3. Kumar, R. (2014). *Research methodology: A step by step guide for beginners*, 4th ed. Sage Publications.

Teaching Learning Process

Combination of labs and lectures

Assessment Methods

Assessment will be based on lab tests and projects.

Keywords

Data, sampling, surveys, data analysis, ethics

Data Analysis (PS51)

Skill Enhancement Elective Courses (SEC) Credit: 4

Course Objective

The students will be instructed on the use of spreadsheet and statistical software to analyse data. Software used for the course will vary based on what is available. Open access software such as R will be encouraged.

Course Learning Outcomes

Students will learn to input, visually represent and analyse data.

Unit 1

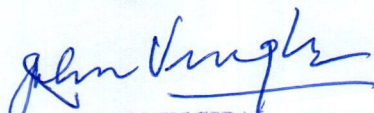
Introduction to available software and how it deals with data

Unit 2

Data cleaning: checking for outliers, cleaning variable names, consistency checks

Unit 3

Data visualisation: scatter plots, line graphs, box plots and other graphical formats


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Skill Enhancement Courses

Understanding Economic Survey and Union Budget (PS31)

Skill Enhancement Elective Courses (SEC) Credit: 4

Course Objective

The course seeks to familiarise students with basic concepts related to the Economic Survey and Union Budget. It aims to equip students with sufficient knowledge and skills to analyse these documents.

Course Learning Outcomes

Students will have the capability to understand government policies and will be informed participants in economic decision-making.

Unit 1

Concepts:

- Fiscal policy, areas of government spending in India;
- Capital and revenue expenditure; plan and non-plan expenditures;
- Deficits (fiscal, primary, revenue), impact of fiscal deficits on the economy;
- Capital receipts, revenue receipts; tax and non-tax revenue; direct and indirect taxes; need for rationalization of tax structure; Goods and Services Tax (GST);
- Actual, revised and budget estimates;
- Zero-base budgeting;
- Gender budgeting;
- Fiscal devolution and centre-state financial relations

Unit 2

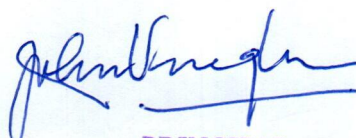
The economic survey

- Analysis of current and past policy emphasis

Unit 3

The union budget

- Need for the budget; understanding the process of budget making in India;
- Analysis of fiscal and revenue deficits;
- Analysis of sources of revenue and expected growth in revenue; tax simplification, improvement in administration, expansion of tax net and other measures to improve revenue receipts;
- Analysis of expenditure pattern and expected growth in expenditure; thrust areas of budget; sectors that have received higher/lower shares of expenditure, the reasons and consequences thereof; steps proposed to ensure effective spending


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2. Chakraborty, P. (2015). Intergovernmental fiscal transfers in India: Emerging trends and realities. In P. Patnaik (ed.): *Macroeconomics*. Oxford University Press.
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Teaching Learning Process

Lectures and tutorials

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Skill Enhancement Elective Courses (SEC) Credit: 4

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Unit 1

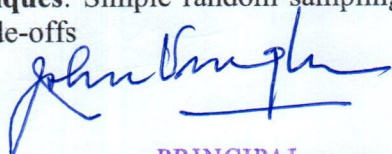
Data Types and sources: Qualitative and quantitative data, measurement and scales; overview of some secondary data sources

Unit 2

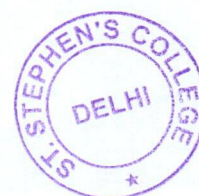
Questionnaire design: Measurement and scales, ordering of questions, coding responses

Unit 3

Sampling techniques: Simple random sampling, stratification, sequential sampling; Size and cost trade-offs



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SEC I

Heritage and Tourism

Course Objectives:

The objective of this course is to enable the students to understand the social, historic, scientific, aesthetic and economic values that are inherent in a cultural heritage. The template is set with practices of visual representation in colonial India and the institutionalizing of colonial archaeology. In the last quarter of the 19th century, Indian artefacts get museumized with the coming of exhibitions, fairs, collections, setting up of museums and botanical gardens. This making of Indian heritage through the rhetoric of spectacle in the colonial period forms part of the first unit. Moving to the contemporary times, to make the course more conducive to employment opportunities, present day practices of marketing heritage are explored in the next unit. Religious tourism, commercialization of nature tourism, nostalgia tourism and the lived experience of heritage walks as cultural representations are studied here. While there are obvious advantages of Tourism as being economically viable, the last unit deals with the impact of overkill tourism practices. Case studies of three different socio-ecological spaces, as also issues of conservation of heritage sites, making a case for sustainable tourism, are studied in the last unit. The objective of the course, strengthened with project work and field trips, is to equip the students to appreciate the nature of industries associated with heritage and tourism.

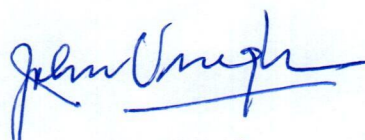
Learning Outcomes:

Upon successful completion of course students will have knowledge and skills to:

- Enhance his/her ability to discern the nature of the cultural heritage of the nation.
- Contextualise his/her country's history of heritage representation, to effectively comprehend the present.
- Draw inference from different aspects of tourism, its varieties and be sensitive to the impact of overkill tourism in different geographical areas with specific local sensibilities, thus making a case for sustainable tourism.
- Equip himself/ herself with theoretical knowledge of heritage and tourism.

Course Content:

Unit I: Constitution of heritage in colonial India


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Institutionalization and commodification of Indian art and architecture: collections, exhibitions, museums and monumentalization — case study of the Great Exhibition, London; Kew Gardens, London; Indian Museum, Kolkata; Tranquebar; guide books and travel literature.

Unit II: Tourism: marketing heritage

- a. Religious Tourism: Case studies of Kashi, Sarnath, Ajmer Sharif, Amritsar, Born Jesus Cathedral of old Goa
- b. Memory and tourism: Raj nostalgia, Indian diaspora's search for roots
- c. Ecotourism: commercialising nature
- d. Exhibiting culture: handicrafts, heritage walks and tours, palaces, heritage festivals

Unit III: Sustainable Tourism

- a. Interface with local sensibilities: case study of Agra, Simla, Goa
- b. Conservation of Heritage: Humayun's Tomb, Ajanta Caves

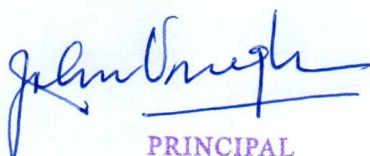
Unit IV: Field trips/Project work: Some suggestions:

- a. Field Trips to Mathura Museum, National Museum, National Gallery of Modern Art, Rail Museum, Sulabh International Museum of Toilets, National Craft Museum, galleries, exhibitions
- b. Heritage walks/trails to monuments and sites
- c. Visit to light and sound shows and live performances at monuments, sites
- d. Documenting the impact of tourism on heritage sites and local communities
- e. Making a report on the ongoing conservation projects of various sites by the ASI, Aga Khan Trust for Culture, INTACH and other community and private organizations
- f. Food tourism etc.

ESSENTIAL READINGS AND UNIT-WISE TEACHING OUTCOMES:

Unit I: This Unit explains institutionalization and commodification of Indian art and architecture during colonial period. In what ways collections, exhibitions, Museums etc. were institutionalised during British India to Constitute Heritage. (**Teaching Time:** 5 Weeks Approx.)

- Breckenridge, Carol A. (1989). "The Aesthetics and Politics of Colonial Collecting: India at World fairs". *Comparative Studies in Society and History* vol. 31 no.2, pp. 195-216.
- Brockway, Lucile H. (1979). "Science and Colonial Expansion: The Role of the British Royal Botanic Gardens". *American Ethnologist* vol. 6 no.3, pp. 449-65.

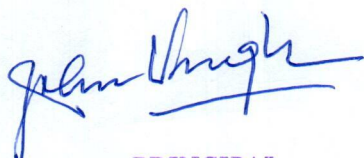

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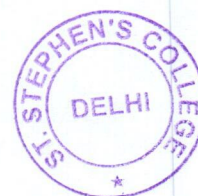
- Guha-Thakurta, Tapati, (2004). "The Museum in the Colony: Collecting, Conserving, Classifying." in *Monuments, Objects, Histories. Institutions of Art in Colonial and Postcolonial India*. Ranikhet: Permanent Black, pp. 43-82.
- Fihl, Esther. (2017). "Collections at the National Museum of Denmark." in Esther Fihl (ed.). *Intercultural Heritage and Historical Identities. Cultural Exchange on the Coromandel Coast of India*. Copenhagen: The National Museum of Denmark, pp. 17-32.
- Mackenzie, John M. (2005). "Empires of Travel: British Guidebooks and Cultural Imperialism in the 19th and 20th centuries." in John K. Walton, (ed.). *Histories of Tourism: Representation, Identity and Conflict*. Buffalo, Toronto: Channel View Publications, pp. 19-38.

Unit II: This unit will examine marketing of heritage as a tourism product. It will examine case study of religious tourism, ecotourism and cultural practices. (**Teaching Time:** 8 Weeks Approx.)

- Bandyopadhyay, Rumki and Kushagra Rajendra. (2018). "Religious Tourism: The Beginning of a New Era with Special Reference to India." in Shin Yesuda, Razaq Raj and Kevin Griffin (eds.). *Religious Tourism in Asia. Tradition and Change through Case Studies and Narratives*. Boston: CABI Publishing, pp. 67-76 (Chapter 8).
- Majumdar, Nandini. (2014). *Banaras: Walks through India's Sacred City*. New Delhi: Roli Books.
- Kejriwal, Om Prakash (Ed.). (2010). *Kashi Nagari Ek: Roop Anek*. New Delhi: Publication Division, Govt. of India.
- Sanyal, Usha. (2007). "Tourists, Pilgrims and Saints: The Shrine of Mu'in al-Din Chishti of Ajmer." in Carol Henderson and Maxine Weisgrau (Eds.). *Raj Rhapsodies. Tourism, Heritage and the Seduction of History*. Hampshire: Ashgate, pp. 183-202; (Ashgate e-book.)
- Kalra, Vikram. (2005). *Amritsar. The City of Spirituality and Valour*. New Delhi: INTACH.
- Rajagopalan, S. (1975). *Old Goa*. New Delhi: Archaeological Survey of India.
- Bandyopadhyay, Ranjan. (2012). "'Raj Revival' Tourism: Consuming Imperial/Colonial Nostalgia". *Annals of Tourism Research* vol. 39 no.3, pp. 1718-1722.
- Seshadri, Swathi. (2012). "Missing the Woods for the Trees?" *Economic and Political Weekly* vol. 47 no.36, pp. 12-14.
- Karanth K. Ullas and Krithi K. Karanth. (2012). 'A Tiger in the Drawing Room: Can Luxury Tourism Benefit Wildlife?' *Economic and Political Weekly* vol. 47 no.38, pp. 38-43.



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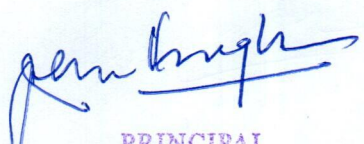
Unit III: This unit deals with questions of guest-host relationships and its" impact on tourism potential. It also examines important concerns of conservation concerning heritage sites -- natural as well as manmade. **(Teaching Time: 6 Weeks Approx.)**

- Chakravarty, Surajit and Clara Irazabal. (2011). "Golden Geese or White Elephants? The Paradoxes of World Heritage Sites and Community-based Tourism Development in Agra, India." *Community Development. Journal of the Community Development Society* vol. 42 no.3, pp. 359-76.
- Batra, Adarsh. (2002). "A Case Study of Major Issues and Sustainable Solutions to Mountain Tourism in the Capital of Himachal Pradesh, Eternal India." *Annfo/in: An International Journal of Tourism and Hospitality Research* vol. 3 no.2, pp. 213-20.
- Pal, Anil and B. K. Pal. (2016) "Tourism and its impact on Socio-Economic Life of Simla District, Himachal Pradesh." *Essence. International Journal for Environmental Rehabilitation and Conservation*. Vol.VII no.2, pp. 1-16.
- Anon, (1994). "Simla losing its Charm." *ndin Green File*.
- Noronha, Frederick. (1997). "Goa: Fighting the Bane of Tourism". *Economic and Political Weekly* vol. 32 no.51, pp. 3253-56.
- Routledge, Paul. (2000). "Consuming Goa: Tourist Site as Dispensable Space". *Economic and Political Weekly* vol. 35 no.30, pp. 2647-56.
- For Humayun's Tomb conservation by the Agha Khan Trust for Culture: https://www.akdn.org/sites/akdn/files/media/publications/2013_09_-_aktc_india_-_humayun_tomb_conservation.pdf
- For Ajanta conservation: https://www.jica.go.jp/english/our_work/evaluation/oda_loan/post/2007/pdfproject28_full.pdf
<http://ajantacaves.com/Howtoeach/Conservation/>
<https://frontline.thehindu.com/static/html/fi1523/15230650.htm>

Suggested Readings

- Bandyopadhyay, Ranjan. (2018). "Longing for the British Raj: Imperial/colonial nostalgia and tourism." *Hospitality & Society* vol. 8 no.3, pp. 253-71.
- Jafa, Navina. (2012). *Performing Heritage: Art of Exhibit Walks*. New Delhi: Sage Publications (See "Introduction", pp. xxi-xxix.).
- Pubby, Vipin. (1988). *Simla Then and Now*. New Delhi: Indus Publishing Co.
- Thapar, Romila. (2018). *Indian Cultures as Heritage. Contemporary Pasts*. New Delhi: Aleph Book Company.

Teaching Learning Process:


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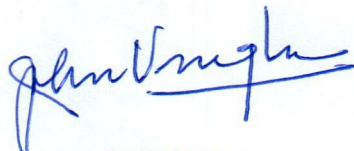
Classroom lectures on the key concepts, case studies and important arguments/debates reflected in the course readings. Classroom lectures shall be combined with group discussions on specific readings and presentations stemming from field work. Overall, the Teaching Learning Process shall be geared towards closely linking essential theoretical assessments with active practical work, i.e. the practical/application aspect of historical analysis. Moreover, the process shall work towards providing basic exposure to related fields of studies connected to the discipline history and to avenues of interdisciplinary postgraduate studies.

Assessment Methods:

Students will be assessed on the basis of regular group presentations and a detailed (individual) project submission-cum-presentation. The project has to be based on a field visit/field work.

Keywords:

Institutionalization of Indian Art, Colonial Knowledge, Kew Gardens London, India Museum, Colonial Heritage — Tranquebar & Kolkata, Religious Kashi, Ajmer, Amritsar, Sarnath, Tourism, Nostalgia, Handicrafts, Heritage Walks, Conservation.



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SEC VI

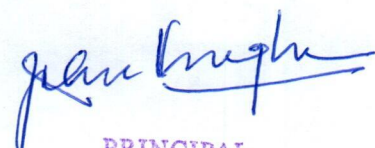
Popular Culture

- I. Defining popular culture
- II. Theatre-folk, tales, songs and dances
- III. Folklore and oral traditions of kathas, narratives, legends
- IV. Festivals, fairs and rituals
- V. Pilgrimage and pilgrim practices
- VI. Food cultures of India

A visit to a cultural event/ exhibition/performance is part of this course.

ESSENTIAL READINGS:

- Acharya, K.T. *Indian Food: A Historical Companion*. New Delhi: OUP, 1994.
- Bhardwaj, R.M. *Vratas and Utsavas in North and Central India (Literary and Epigraphic Sources : c400-1200)*, New Delhi: Eastern Book Linkers, 2015.
- Buck, C.H. *Faiths, Fairs and Festivals of India*. New Delhi: Asian Publishing Services, 1977.
- Jha, M., ed. *Social Anthropology of Pilgrimage*. New Delhi: Inter-India Publication, 1991.
- Storey, J. *Cultural Theory and Popular Culture*. Delhi: Pearson Prentice Hall, 2009.
- Thakran, R.C., Shiv Dutt and Sanjay Kumar, eds. *भारतीय उपमहाद्वीप की संस्कृतियाँ*, Vol. I&II, Delhi: Hindi Madyam Karyanvay Nideshalay, 2013.
- Verma, L.B. *भारत की जन्कथा*. Allahabad: Itihasbodh Prakashan, 2012.


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Courses for B.A. (Programme) Political Science

Paper IV - Introduction to International Relations

(62324407)

Core Course - (CC) Credit:6

Course Objective

This Course is designed to give students a sense of some important theoretical approaches to understand international relations; a history from 1945 onwards to the present; and an outline of the evolution of Indian foreign policy since independence and its possible future trajectory.

Course Learning Outcomes

- Students will learn about major theoretical approaches and the history of International Relations.
- The course will enhance students' understanding on the major political developments in international relations since 1945.
- The paper will develop in-depth knowledge on the emerging centers of power like European Union, China, Russia and Japan.
- Students will also learn about basic determinants of India's foreign policy and understand it in the context of India as an emerging power.

Unit 1

Early Debates in International Relations (27 lectures)

- (a) Idealism vs Realism
- (b) Liberalism to Neo Liberal Institutionalism
- (c) Structural Approaches: World Systems Approach (Immanuel Wallerstein) and Dependency School (Andre Gunder Frank)
- (d) Feminist Perspective (J. Ann Tickner)

Unit 2

Post War International Relations and the emergence of Cold War (20 lectures)

- (a) Second World War & Origins Cold War
- (b) Phases of Cold World War: First Cold War, Rise and Fall of Détente, Second Cold War End of Cold War and Collapse of the Soviet Union
- (c) Post-Cold War Era and Emerging Centers of Power (European Union, China, Russia and Japan)

Unit 3

India's Foreign Policy (13 lectures)

- (a) Basic Determinants (Historical, Geo-Political, Economic, Domestic and Strategic)
- (b) India's Policy of Non-alignment
- (c) India: An Emerging Power


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References

1. Approaches to International Relations

Grieco, Joseph, Ikenberry John G., and Mastanduno Michael. (eds.) (2018), *Introduction to International relations: Perspectives, Connections and Enduring Questions*, USA, Red Globe press.

William, P., Goldstein, D. M. and Shafritz, J. M. (eds.) (1999) *Classic Readings of International Relations*. Belmont: Wadsworth Publishing Co, pp. 30-58; 92-126.

Art, R. J. and Jervis, R. (eds.) (1999) *International Political Enduring: Concepts and Contemporary Issues*. 5th Edition. New York: Longman, pp. 7-14; 29-49; 119-126.

Jackson, R. and Sorenson, G. (2008) *Introduction to International Relations: Theories and Approaches*. New York: Oxford University Press, pp. 59-96.

E. Carr, (1981) *The Twenty Years Crisis, 1919-1939: An Introduction to the Study of International Relations*, London: Macmillan, pp. 63-94.

H. Morgenthau, (2007) 'Six Principles of Political Realism', in R. Art and R. Jervis, *International Politics*, 8th Edition, New York: Pearson Longman, pp. 7-14.

T. Dunne and B. Schmidt, (2008) 'Realism', in J. Baylis and S. Smith (eds), *The Globalization of World Politics: An Introduction to International Relations*, New York: Oxford University Press, pp. 90-107.

K. Waltz, (2007) 'The Anarchic Structure of World Politics', in R. Art and R. Jervis, *International Politics*, 8th Edition, New York: Pearson Longman, pp. 29-49.

T. Dunne, (2008) 'Liberalism', in J. Baylis and S. Smith (eds.), *The Globalization of World Politics: An Introduction to International Relations*, New York: Oxford University Press, pp. 108-123.

R. Keohane and J. Nye, (2000) 'Transgovernmental Relations and the International Organization', in M. Smith and R. Little (eds.), *Perspectives on World Politics*, New York: Routledge, pp. 229-241.

S. Hobden and R. Jones, (2008) 'Marxist Theories of International Relations' in J. Baylis and S. Smith (eds), *The Globalization of World Politics: An Introduction to International Relations*, New York: Oxford University Press, pp. 142-149; 155-158.

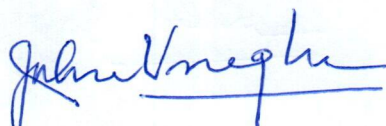
I. Wallerstein, (2000) 'The Rise and Future Demise of World Capitalist System: Concepts for Comparative Analysis', in Michael Smith and Richard Little (eds), *Perspectives on World Politics*, New York: Routledge, pp. 305-317.

A.G. Frank, (1966), "The Underdevelopment of Development", *Monthly Review*, 18,4, pp.17-31.

Goldstein, J. and Pevehouse, J.C. (2009) *International Relations*. New Delhi: Pearson, pp. 81-111.

Tickner, J. A. (2001) *Gendering World Politics: Issues and Approaches in the Post-Cold War Era*. Columbia University Press.

2. Cold War & Post-Cold War Era


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Carr, E.H. (2004) *International Relations between the Two World Wars: 1919-1939*, New York: Palgrave, pp. 197-231 and 258-278.

Taylor, A.J.P. (1961) *The Origins of the Second World War*. Harmondsworth: Penguin, pp.29-65.

Carrtuthers, S.L. (2008) 'International History, 1900-1945' in Baylis, J. and Smith, S. (eds.) *The Globalization of World Politics. An Introduction to International Relations*. 4th edn. Oxford: Oxford University Press, pp. 76-84.

Calvocoressi, P. (2001) *World Politics: 1945—2000*. Essex: Pearson, pp. 3-91.

Scott, L. (2005) 'International History, 1945-1990' in Baylis, J. and Smith, S. (eds.) (2008) *The Globalization of World Politics. An Introduction to International Relations*. 4th edn., Oxford: Oxford University Press, pp. 93-101.

Hobsbawm, E. (1995) *Age of Extreme: The Short Twentieth Century, 1914—1991*. London: Abacus, pp. 225-226.

Hobsbawm, E. (1995) *Age of Extreme: The Short Twentieth Century, 1914—1991*. London: Abacus, pp. 207-222.

3. India's Foreign Policy

Ian Hall (ed) (2014), "The Engagement of India: Strategies and Responses", Washington, DC, Georgetown University Press

Muchkund Dubey, (2016), "India's Foreign Policy: Coping with the Changing World", New Delhi, Orient Blackswan Pvt. Ltd.

Harsh V. Pant (ed), (2009) "India's foreign Policy in a Unipolar World", New Delhi, Routledge.

Harsh, V. Pant, (2016), *India's Foreign Policy-An Overview*, New Delhi: Orient Blackswan.

Harsh, V. Pant, (ed) (2019), "New Directions in India's foreign Policy: Theory and Praxis", New Delhi: Cambridge University Press

Sumit Ganguly (ed) (2016) "Engaging the World-Indian Foreign Policy since 1947" New Delhi, Oxford University Press

S. Ganguly and M.S. Pardesi, "Explaining Sixty Years of India's Foreign Policy", in *India Review*, Vol.8 (1) pp.4-19

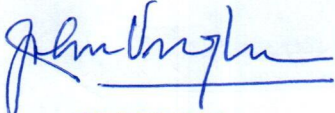
Amitabh Mattoo and Happymon Jacob, (eds), (2014), "India and the Contemporary International System", New Delhi, Manohar Publications in collaboration with RCSS Colombo.

W. Anderson, (2011) 'Domestic Roots of Indian Foreign Policy', in W. Anderson, *Trusts with Democracy: Political Practice in South Asia*, Anthem Press: University Publishing Online.

Additional Resources:

Classic Readings

Hans J. Morgenthau (1948), *Politics among Nations*, 8th edition, revised by K Thompson and D. Clinton, New York, McGraw Hill, 2006.


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E. H. Carr (1985), *International Relations between the two world wars 1919-1939*, London, MacMillan.

Kenneth Waltz (1959) *Man, the State and War*, Columbia, Columbia University Press.

Daniel Philpott (1999), "Westphalia, Authority and International Society", *Political Studies*, XLVII, pp. 566-539.

Readings in Hindi

सुमित गांगुली (2018), *भारत की विदेश नीति: पुनरावलोकन एवं संभावनाएँ*, नई दिल्ली: ऑक्सफोर्ड यूनिवर्सिटी प्रेस (अनुवाद: अभिषेक चौधरी).

अजय कुमार (2011), *अन्तराष्ट्रीय संबंधों के सिद्धांत : एक परिचय*, दिल्ली: पियर्सन एजुकेशन.

पुष्पेश पन्त (2017), *21वीं शताब्दी में अन्तराष्ट्रीय सम्बन्ध*, दिल्ली: मक्या हिल पब्लिशिंग, पांचवा एडिशन.

रुम्की बासु (2015), *अन्तराष्ट्रीय राजनीति: अवधारणाएँ, सिद्धांत तथा मुद्दे*, दिल्ली: सेज भाषा पब्लिकेशन.

Additional Readings:

1. Approaches to International Relations

R. Mansbach and K. Taylor (2008) *Introduction to Global Politics*, New York: Routledge, pp. 2-68.

K. Mingst (2011) *Essentials of International Relations*, New York: W.W. Norton and Company, pp. 16-63.

P. Viotti and M. Kauppi, (2007) *International Relations and World Politics: Security, Economy, Identity*, Pearson Education, pp. 40-85.

J. Singer, (1961) 'The International System: Theoretical Essays', *World Politics*, Vol. 14(1), pp. 77-92.

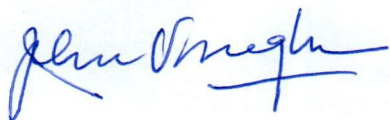
2. Cold War & Post-Cold War Era

M. Nicholson, *International Relations: A Concise Introduction*, New York: Palgrave, 2002, pp. 120-122.

J. Goldstein and J. Pevehouse, (2007) *International Relations*, New York: Pearson Longman, pp. 127-148.

S. Smith and P. Owens, (2008) 'Alternative Approaches to International Theory' in J. Baylis and S. Smith (eds), *The Globalization of World Politics: An Introduction to International Relations*, New York: Oxford University Press, pp. 181-184.

R. Jackson and G. Sorensen, (2007) *Introduction to International Relations: Theories and Approaches*, 3rd Edition, Oxford: Oxford University Press, pp. 97-128.



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3. India's Foreign Policy

H. Pant, (2008) 'The U.S.-India Entente: From Estrangement to Engagement', in H. Pant, *Contemporary Debates in Indian Foreign and Security Policy: India Negotiates Its Rise in the International System*, Palgrave Macmillan: London.

D. Mistry, (2006) 'Diplomacy, Domestic Politics, and the U.S.-India Nuclear Agreement', in *Asian Survey*, Vol. 46 (5), pp. 675-698.

H. Pant, (2011) 'India's Relations with China', in D. Scott (ed.), *Handbook of India's International Relations*, London: Routledge, pp. 233-242.

A. Tellis and S. Mirski, (2013) 'Introduction', in A. Tellis and S. Mirski (eds.), *Crux of Asia: China, India, and the Emerging Global Order*, Carnegie Endowment for International Peace: Washington.

S. Muni, (2003) 'Problem Areas in India's Neighbourhood Policy', in *South Asian Survey*, Vol. 10 (2), pp. 185-196.

S. Cohen, (2002) *India: Emerging Power*, Brookings Institution Press.

V. Sood, (2009) 'India and regional security interests', in Alyssa Ayres and C. Raja Mohan (eds), *Power realignments in Asia: China, India, and the United States*, New Delhi: Sage.

Teaching Learning Process

This course will help the students in getting introduced to major theoretical approaches and the history of International Relations and will enhance their understanding on the major political developments in international relations since 1945 as well as emerging centers of power like European Union, China, Russia, Japan and India. In this course the teaching process would include a combination of different pedagogic tools like class lecture, class discussion, class presentations, group discussion and debates. The students will also learn through power-point presentations and film screening. The teaching-learning process would also focus on regular revision through different methods like holding quiz after the end of every unit, dividing the class into different groups based on different ideologies in the discipline and holding a free debate amongst them on different issues relevant for the course. Students will also be asked to do small write-ups on a question or a topic given to them based on their understanding of the problem/issue after completing every unit.

Assessment Methods

Students will be assessed at different stages during the completion of this course. They will be assessed on the basis of their performance in group discussions after completion of every unit, class presentations and one assignment on a given topic.

Keywords

International Relations, Idealism, Realism, Liberalism, Structuralism, Feminism, Post-war IR, India's Foreign Policy


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AE2 - Public Opinion and Survey Research (62323412)

AECC (Electives) - (AECCE) Credit:4

Course Objective

This course will introduce the students to the debates, principles and practices of public opinion polls in the context of democracies, with special reference to India. It will familiarize the students with the principles and practice of survey research and conceptualizing and measuring public opinion using quantitative methods. The course will give special attention to developing basic skills pertaining to the collection, analysis and utilization of quantitative data.

Course Learning Outcomes

On the successful completion of the course, students will be able to:

- Understand the importance of public opinion in a democracy and the role of survey research in comprehending the working of a democratic political system
- Learn about the methods used for conducting surveys and interpreting survey data
- Acquire basic skill sets related to understanding public opinion formation and conducting research through the use of sample date, framing a questionnaire, etc.
- Acquire basic skill sets related to measurement of public opinion such as data analysis using statistical methods.

Unit 1

Introduction to the course (6 lectures)

Definition and characteristics of public opinion, conceptions and characteristics, debates about its role in a democratic political system, uses for opinion poll

Unit 2

Measuring Public Opinion with Surveys: Representation and sampling (6 lectures)

- a. What is sampling? Why do we need to sample? Sample design.
- b. Sampling error and non-response
- c. Types of sampling: Non random sampling (quota, purposive and snowball sampling); random sampling: simple and stratified

Unit 3

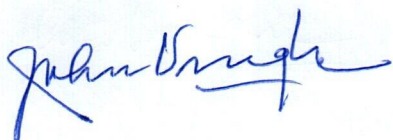
Survey Research (2 lectures)

- a. Interviewing: Interview techniques pitfalls, different types of and forms of interview
- b. Questionnaire: Question wording; fairness and clarity.

Unit 4

Quantitative Data Analysis (4 lectures)

- a. Introduction to quantitative data analysis
- b. Basic concepts: correlational research, causation and prediction, descriptive and inferential Statistics



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Unit 5

Interpreting polls (6 lectures)

Prediction in polling research: possibilities and pitfalls
Politics of interpreting polling

References

I. Introduction to the course

R. Erikson and K. Tedin, (2011) *American Public Opinion*, 8th edition, New York: Pearson Longman Publishers, pp. 40-46.

G. Gallup, (1948) *A guide to public opinion polls* Princeton, Princeton University Press, 1948. Pp. 3-13.

II. Measuring Public Opinion with Surveys: Representation and sampling

G. Kalton, (1983) *Introduction to Survey Sampling* Beverly Hills, Sage Publication.

Lokniti Team (2009) 'National Election Study 2009: A Methodological Note', *Economic and Political Weekly*, Vol. XLIV (39)

Lokniti Team, (2004) 'National Election Study 2004', *Economic and Political Weekly*, Vol. XXXIX (51).

'Asking About Numbers: Why and How', *Political Analysis* (2013), Vol. 21(1): 48-69, (first published online November 21, 2012)

III. Survey Research

H. Asher, (2001) 'Chapters 3 and 5', in *Polling and the Public: What Every Citizen Should Know*, Washington DC: Congressional Quarterly Press.

R. Erikson and K. Tedin, (2011) *American Public Opinion*, 8th edition, New York, Pearson Longman Publishers, pp. 40-46.

IV. Quantitative Data Analysis

A. Agresti and B. Finlay, (2009) *Statistical methods for the Social Sciences*, 4th edition, Upper saddle river, NJ: Pearson-Prentice Hall,

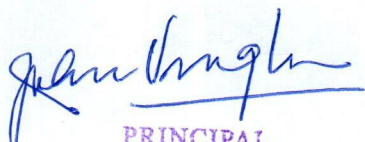
S. Kumar and P. Rai, (2013) 'Chapter 1', in *Measuring Voting Behaviour in India*, New Delhi: Sage.

V. Interpreting polls

R. Karandikar, C. Pyne and Y. Yadav, (2002) 'Predicting the 1998 Indian Parliamentary Elections', *Electoral Studies*, Vol. 21, pp.69-89.

M. McDermott and K. A. Frankovic, (2003) 'Horserace Polling and Survey Methods Effects: An Analysis of the 2000 Campaign', *Public Opinion Quarterly* 67, pp. 244-264.

Additional Resources:


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Additional Readings:

K. Warren, (2001) 'Chapter 2', in *In Defense of Public Opinion Polling*, Boulder: Westview Press, pp. 45-80.

W. Cochran, (2007) 'Chapter 1', *Sampling Techniques*, John Wiley & Sons.

G. Gallup, (1948) *A Guide to Public Opinion Polls*. Princeton: Princeton University Press, pp. 14-20; 73-75.

D. Rowntree (2000) *Statistics Without Tears: An Introduction for Non Mathematicians*, Harmondsworth: Penguin.

Teaching Learning Process

Students will be taught different forms of sampling methods and will receive training in conducting surveys. They will be given interactive lectures on measuring public opinion and will be taught quantitative methods and imparted with basic skills of collection, verification and analysis of data.

Suggested Student Exercises:

1. Discussion of readings and Indian examples. Groups of students to collect examples of and discuss various sample based studies across many fields: e.g. consumer behaviour, unemployment rates, educational standards, elections, medicinal trials etc.
2. Non-random sampling: The students have to identify one group of people or behaviour that is unique or rare and for which snowball sampling might be needed. They have to identify how they might make the initial contact with this group to start snowball rolling.
3. Give the students the electoral list of an area in Delhi (<http://ceodelhi.gov.in>). The students have to draw a random sample of n number of respondents.
4. For this activity, working with a partner will be helpful. The class should first decide on a topic of interest. Then each pair should construct a five-item self report questionnaire. Of the five items, there should be at least one nominal response, one ordinal response and one interval. After the common questionnaire is constructed putting together the questions from everyone, working in pairs, the questionnaire should be administered on different individuals.
5. Give the students a questionnaire from any public opinion survey and ask them to identify the type of variables.

Assessment Methods

Students will be assessed on continuous basis followed by end term examination. Internal assessment will be conducted at the end of each unit which may include term papers, assignments, projects and viva- voce. They will be assessed on the basis of their ability to critically apply their conceptual understanding to the field work. They will be required to submit project report on any one unit of the syllabus before end term examination.

Keywords

Analysis, Collection, Data, Public Opinion, Quantitative, Sampling, Survey


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AE1 - Legislative Support
(62323312)
AECC (Electives) - (AECCE) Credit:4

Course Objective

To acquaint the student with the legislative process in India at various levels, introduce them to the functions of peoples' representatives and provide elementary skills to be part of a legislative support team. Peoples' representatives need support for the multiple tasks they are supposed to undertake.

The need to understand complex policy issues, draft new legislation, track and analyse ongoing bills, make speeches and floor statements, write articles and press releases, attend legislative meetings, conduct meetings with various stakeholders, monitor media and public developments, manage constituent relations and handle inter-office communications. All over the world, elected representatives have an office with specialised support team to carry out these tasks.

With about 5000 MPs and MLAs, and more than 30 lakhs representatives at the Panchayati Raj level, there is a vast need for legislative support among representatives that needs to be addressed. This course will equip the students with basic skills for this task and expose them to real life legislative work. In the process of learning legislative support skills, students will also build and deepen their understanding of the Indian political process.

Course Learning Outcomes

On successful completion of the course, students will be able to:

- Demonstrate knowledge of the structure and the functions of legislating bodies in India
- Demonstrate knowledge of the law making procedure in India
- Acquire skills related to a close reading of legislative documents
- Understand the relationship between the people and their elected representatives
- Develop basic skills to become a part of a support team engaged at different levels of the law making functions

Unit 1

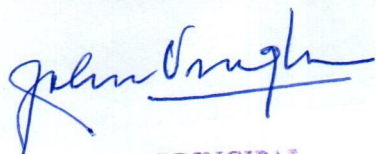
Powers and functions of people's representatives at different tiers of governance

Members of Parliament, State Legislative Assemblies, functionaries of rural and urban local self-government from Zila Parishads/Municipal Corporation to Panchayat/Ward. (Weeks 1-3)

Unit 2

Supporting the legislative process:

How a Bill becomes a Law, Role of the Standing Committee in reviewing a Bill, Legislative Consultations, amendments to a Bill, the framing of Rules and Regulations. (Week 4)



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Unit 3

Supporting the legislative committees

Types of committees, Role of committees in reviewing government finances, policy, programmes, and legislation (Weeks 5-7)

Unit 4

Reading the budget document:

Overview of Budget Process, Role of Parliament in reviewing the Union Budget, Railway Budget, Examination of Demands for Grants of Ministries, Working of Ministries. (Weeks 8-10)

Unit 5

Support in media monitoring and communication:

Types of media and their significance for legislators. Basics of communication in print and electronic media (Weeks 11-12)

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Madhavan, M.R. & N. Wahi, Financing of Election Campaigns PRS, Centre for Policy Research, New Delhi, 2008. URL:

http://www.prsindia.org/uploads/media/conference/Campaign_finance_brief.pdf

Vanka, S., Primer on MPLADS Centre for Policy Research, New Delhi, 2008. URL:

<http://www.prsindia.org/parliamenttrack/primers/mplads-487/>

Kalra, H., Public Engagement with the Legislative Process PRS, Centre for Policy Research, New Delhi, 2011. URL:

<http://www.prsindia.org/administrator/uploads/media/Conference%202011/Public%20Engagement%20with%20the%20Legislative%20Process.pdf>

Government of India (Lok Sabha Secretariat) Parliamentary Procedures (Abstract Series), 2009. URL: <http://164.100.47.132/LssNew/abstract/index.aspx>

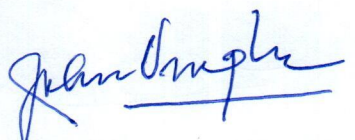
Government of India, (Ministry of Parliamentary Affairs) Legislation, Parliamentary Procedure, 2009. URL: http://mpa.nic.in/Manual/Manual_English/Chapter/chapter-09.htm

Government of India, (Ministry of Parliamentary Affairs) Subordinate Legislation, Parliamentary Procedure, 2009. URL: http://mpa.nic.in/Manual/Manual_English/Chapter/chapter-11.htm

Kapur, Devesh and Pratap Banu Mehta, "The Indian Parliament as an Institution of Accountability," Democracy, Governance and Human Rights, Programme Paper Number 23, United Nations Research Institute for Social Development, January 2006. URL: [http://www.unrisd.org/UNRISD/website/document.nsf/240da49ca467a53f80256b4f005ef245/8e6fc72d6b546696c1257123002fcceb/\\$FILE/KapMeht.pdf](http://www.unrisd.org/UNRISD/website/document.nsf/240da49ca467a53f80256b4f005ef245/8e6fc72d6b546696c1257123002fcceb/$FILE/KapMeht.pdf)

Agarwal, O.P. and T.V. Somanathan, "Public Policy Making in India: Issues and Remedies," February, 2005. URL:

http://www.cprindia.org/admin/paper/Public_Policy_Making_in_India_14205_TV_SOMANATHAN.pdf


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Debroy, Bibek, "Why we need law reform," Seminar January 2001.

Mehta, Pratap Bhanu, "India's Unlikely Democracy: The Rise of Judicial Sovereignty," Journal of Democracy Vol.18, No.2, pp.70-83.

Additional Resources:

Government links:

<http://loksabha.nic.in/>

<http://rajyasabha.nic.in/>

<http://mpa.nic.in/>

Sanyal, K. Strengthening Parliamentary Committees PRS, Centre for Policy Research, New Delhi, 2011. URL: <http://www.prsindia.org/administrator/uploads/media/Conference%202011/Strengthening%20Parliamentary%20Committees.pdf>

Celestine, A. How to read the Union Budget PRS, Centre for Policy Research, New Delhi, 2011. URL: <http://www.prsindia.org/parliamenttrack/primers/how-to-read-the-union-budget-1023/>

Teaching Learning Process

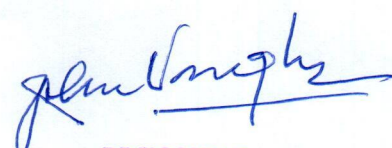
Students will engage in discussion on legislative procedures. They will be imparted elementary skills to become part of legislative support team and engage in real legislative work by attending legislative meetings and monitoring media and public developments. They will be given interactive lectures on powers and functions of representatives at different tiers of governance.

Assessment Methods

Students will be assessed on continuous basis followed by end term examination. Internal assessment will be conducted at the end of each unit which may include assignments, participation in class discussions and viva voce. They will be evaluated on the basis of their skills to become part of legislative support team and engage in real legislative work. They will be required to submit project report on any one unit of the syllabus before end term examination.

Keywords

Functions, Governance, Legislature, Powers, Procedures, Representative


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3. Democratic Awareness Through Legal Literacy

Course Objective: The Proposed course aims to acquaint student with the structure and manner of functioning of the legal system in India.

Expected Learning Outcome: The student should be aware of the institutions that comprise the legal system - the courts, police, jails and the system of criminal justice administration. Have a brief knowledge of the Constitution and laws of India, an understanding of the formal and alternate dispute redressal (ADR) mechanisms that exist in India, public interest litigation. Have some working knowledge of how to affirm one's rights and be aware of one's duties within the legal framework; and the opportunities and challenges posed by the legal system for different sections of persons.

This course consists of 100 marks - comprising 25 marks for evaluation of the practical work and a written paper of 75 marks.

Course Content:

Unit I

- Outline of the Legal system in India
- System of courts/tribunals and their jurisdiction in India - criminal and civil courts, writ jurisdiction, specialized courts such as juvenile courts, Mahila courts and tribunals.
- Role of the police and executive in criminal law administration.
- Alternate disputes mechanisms such as lok adalats, non - formal mechanisms.

Unit II

- Brief understanding of the laws applicable in India
- Constitution - fundamental rights, fundamental duties, other constitutional rights and their manner of enforcement, with emphasis on public interest litigation and the expansion of certain rights under Article 21 of the Constitution.
- Laws relating to criminal jurisdiction - provision relating to filing an FIR, arrest, bail search and seizure and some understanding of the questions of evidence and procedure in Cr. P.C. and related laws, important offences under the Indian PenalCode, offences against women, juvenile justice, prevention of atrocities on Scheduled Castes and Scheduled Tribes.
- Concepts like Burden of Proof, Presumption of Innocence, Principles of Natural Justice, Fair comment under Contempt laws.
- Personal laws in India : Pluralism and Democracy
- Laws relating to contract, property; tenancy laws, labour laws, and environmental laws.
- Laws relating to dowry, sexual harassment and violence against women
- Laws relating to consumer rights
- Labour laws in the context of globalisation

- Laws relating to cyber crimes
- Anti-terrorist laws: implications for security and human rights
- Practical application: Visit to either a (i) court or (ii) a legal aid centre set up by the
- Legal Services Authority in Delhi or an NGO or (iii) a Lok Adalat, and to interview a litigant or person being counselled. Preparation of a case history.

Unit III

Access to courts and enforcement of rights

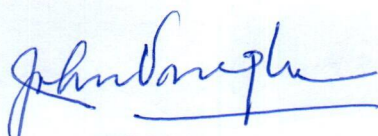
- Critical Understanding of the Functioning of the Legal System
- Legal Services Authorities Act and right to legal aid, ADR systems
- What to do if you are arrested ; if you are a consumer with a grievance; if you are a victim of sexual harassment; domestic violence, child abuse, caste, ethnic and religious discrimination; filing a public interest litigation. How can you challenge administrative orders that violate rights, judicial and administrative remedies
- Human Rights - emerging trends; Role of legal aid agencies, Human Rights Commissions, NGOs and civil liberties groups.
- Practical application - Using a hypothetical case of (for example) child abuse or sexual harassment or any other violation of a right, preparation of an FIR or writing a complaint addressed to the appropriate authority.

Essential Reading

Creating Legal Awareness, edited by Kamala Sankaran and Ujjwal Singh (Delhi: OUP, 2007)

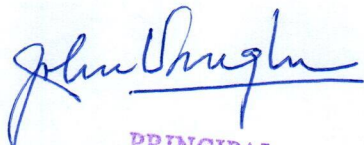
Reading list for course on Legal Literacy

- Multiple Action Research Group, *Our Laws Vols 1-10*, Delhi. Available in Hindi also.
- Indian Social Institute, New Delhi, *Legal Literacy Series Booklets*. Available in Hindi also.
- S.K. Agarwala, *Public Interest Litigation in India*, K.M. Munshi Memorial Lecture, Second Series, Indian Law Institute, Delhi, 1985.
- S.P. Sathe, *Towards Gender Justice*, Research Centre for Womens' Studies, SNDT Women's University, Bombay, 1993.
- Asha Bajpai, *Child Rights in India : Law, Policy, and Practice*, Oxford University Press, New Delhi, 2003
- Agnes, Flavia *Law and Gender Equality*, OUP, 1997.
- Sagade, Jaga, *Law of Maintenance: An Empirical Study*, ILS Law College, Pune 1996.
- B.L. Wadhera, *Public Interest Litigation - A Handbook*, Universal, Delhi, 2003.
- Nomita Aggarwal, *Women and Law in India*, New Century, Delhi, 2002.


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- P.C. Rao and William Sheffiled *Alternate Dispute Resolution: What it is and How it Works*, , Universal Law Books and Publishers, Delhi, 2002
- V.N. Shukla's *Constitution of India* by Mahendra P. Singh, Eastern Book Co. 10th edition 2001.
- Parmanand Singh, 'Access to Justice and the Indian Supreme Court', 10 & 11 Delhi Law Review 156, 1981-82.


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AE4 - Conflict and Peace Building
(62323601)
AECC (Electives) - (AECCE) Credit:4

Course Objective

This course is designed to help build an understanding of a variety of conflict situations among students in a way that they can relate to them through their lived experiences. It's an interdisciplinary course that draws its insights from various branches of social sciences and seeks to provide a lively learning environment for teaching and training students how to bring about political and social transformations at the local, national and international levels. The course encourages the use of new information technologies and innovative ways of understanding these issues by teaching students skills of managing and resolving conflicts and building peace through techniques such as role-play, simulations, street theatre, cinema and music on the one hand and by undertaking field visits, interacting with different segments of the civil society including those affected by conflicts as well as diplomats, journalists and experts, on the other.

Course Learning Outcomes

- The course will enhance students' understanding on the meaning, nature and significance of peace, conflict management, conflict resolution and conflict transformation.
- The students will also learn the importance of resource sharing in the conflict zones.
- The paper will develop students' knowledge on ideological and socio-cultural dimensions of conflict at local, sub-national and international levels.
- Students will also learn about negotiation and mediation skill for conflict resolution through active listening, different tracks of diplomacy and Gandhian methods.

Unit 1

Concepts (6 Lectures)

- a. Understanding Conflict (Week 1)
- b. Conflict Management, Conflict Resolution and Conflict Transformation (Week 2)
- c. Peace Building: Meaning and Concept (Week 3)

Unit 2

Dimensions of Conflict (6 Lectures)

- a. Ideology (Week 4)
- b. Economic/Resource Sharing Conflicts (Week 5)
- c. Socio-Cultural Conflicts (Ethnic, Religious, Gender-based) (Week 6)

Unit 3

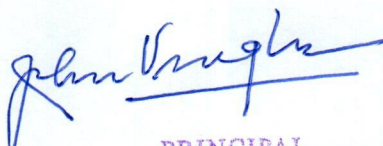
Levels of Conflict (6 Lectures)

- a. Local (Week 7)
- b. Sub-National (Week 7)
- c. International (Week 8)

Unit 4

Conflict Responses: Skills And Techniques (6 Lectures)

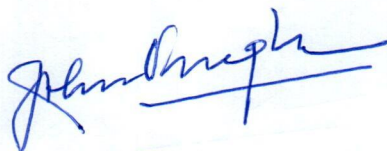
- a. Negotiations: Trust Building (Week 9)
- b. Mediation: Skill Building; Active Listening (Week 10)
- c. Track I, Track II & Multi Track Diplomacy (Week 11)
- d. Gandhian Methods (Week 12)


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- C. Mitchell, (2002) 'Beyond Resolution: What Does Conflict Transformation Actually Transform?', in *Peace and Conflict Studies*, 9:1, May, pp.1-23.
- S. Ryan, (1990) 'Conflict Management and Conflict Resolution', in *Terrorism and Political Violence*, 2:1, pp. 54-71.
- M. Lund, (2001) 'A Toolbox for Responding to Conflicts and Building Peace', in L. Reyckler and T. Paffenholz, eds., *Peace-Building: A Field Guide*, Boulder: Lynne Rienner, pp. 16-20.
- L. Schirch, (2004) *The Little Book Of Strategic Peacebuilding*, London: Good Books.
- R. Rubenstein, (2003) 'Sources', in S. Cheldelin, D. Druckman and L. Fast (eds.) *Conflict: From Analysis to Intervention*, London: Continuum, pp.55-67.
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- P. Wallenstein, (2007) *Understanding Conflict Resolution* (2nd ed.), London: Sage Publications.
- H. Saunders, (1999) *A Public Peace Process: Sustained Dialogue To Transform Racial and Ethnic Conflicts*, Palgrave Macmillan: New York, pp. 1-30.
- N. Behera, 'Forging New Solidarities: Non-official Dialogues', in M. Mekenkamp, P. Tongeren and H. van De Veen (eds.), *Searching For Peace In Central And South Asia*, London: Lynne Rienner Publishers, pp. 210-236.
- J Bercovitch, V. Kremenyuk, and I. Zartman (eds.), (2009) *The Sage Hand Book of Conflict Resolution*, London: Sage Publications.
- M. Steger , (2001) 'Peacebuilding and Non-Violence: Gandhi's Perspective on Power', in D. Christie, R. Wagner and D. Winter, (eds.), *Peace, Conflict, and Violence: Peace Psychology for the 21st Century Englewood Cliffs*, New Jersey: Prentice-Hall.
- P. Wallenstein, (2012) 'Armed Conflicts', in *Understanding Conflict Resolution*, (Third Edition), London: Sage, pp. 13-28.


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- J. Davies and E. Kaufman (eds.), (2003) *Second Track/Citizens' Diplomacy: Concepts and Techniques for Conflict Transformation*, Rowman & Littlefield: Maryland.
- C. Webel and J. Galtung (eds.), (2007) *The Handbook of Peace and Conflict Studies*, London: Routledge.
- J. Lederach, (2003) *The Little Book of a Conflict Transformation*, London: Good Books.
- I. Doucet, (1996) *Thinking About Conflict, Resource Pack for Conflict Transformation: International Alert*.
- S. Mason and M. Siegfried, (2010) *Debriefing Mediators to Learn Their Experiences*, Washington D.C: United States Institute of Peace.
- I. Zartman and A. De Soto, (2010) *Timing Mediation Initiatives*, Washington D.C: United States Institute of Peace.
- H. Burgess and G. Burgess, (2010) *Conducting Track II*, Washington D.C: United States Institute of Peace.
- John Paul Lederach, *The Journey Toward Reconciliation*, London: Herald Press, 1999
- Charles Lerche, "Peace Building Through Reconciliation," *International Journal of Peace Studies*, Vol. 5. No. 2, 2000. http://www.gmu.edu/programs/icar/ijps/vol5_2/lerche.htm

Additional Resources:

Classic Readings

- Galtung, Johan, *The True Worlds: A Transnational Perspective*, New York, Free Press, 1980, pp. 107-149.
- Galtung, Johan. 1967. "Theories of Peace: A Synthetic Approach to Peace Thinking". International Peace Research Institute, Oslo.
- Rummel, R.J. 1981. *Understanding Conflict and War*, Vol:5. Beverly Hills, CA: Sage Publications.
- Gurr, Ted R. (1985), "On the Political Consequences of Scarcity and Economic Decline", *International Studies Quarterly*, 29 (1): 51-75.

Additional Readings

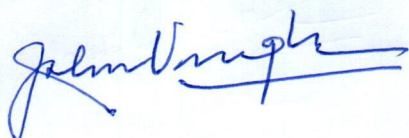
- A. Smith and D. Smock, (2010) *Managing A Mediation Process*, Washington D.C: United States Institute Of Peace.

Online Resources

Conflict Resolution in Popular Art and Culture: The International Network of Peace Museums, at www.museumsforpeace.org/, contains links to visit the websites of many of the world's peace museums.

<http://www.peacebuildinginitiative.org>

Theatre, peace and conflict at Theatre Without Borders, www.theatrewithoutborders.com/peacebuilding



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Global Peace Film Festival, www.peacefilmfest.org/

Football for Peace International, www.football4peace.eu/contact.html

Facilitation: http://www.pgexchange.org/images/toolkits/pgx_facilitation_tool.pdf

<http://www.beyondintractability.org/bi-essay/facilitation>

Negotiation:

Roger Fisher et al, Getting to Yes: Negotiating Agreement without Giving In, New York: Penguin, 1991.

Wadsworth/course_products_wp.pl?fid=M20bI&product_isbn_issn=9781133602101

http://www.cengage.com/cgi_wadsworth/course_products_wp.pl?fid=M20bI&product_isbn_issn=9781111344238

Crossword Puzzle: <http://www.cengage.com/cgi>

Dialogue: http://www.pgexchange.org/images/toolkits/PGX_D_Sustained%20Dialogue.pdf

Mediation: http://www.initiativeforpeacebuilding.eu/resources/A_guide_to_Mediation_HDC.pdf

<http://www.pgexchange.org/images/toolkits/civics%20mediation%20tool.pdf>

<http://www.beyondintractability.org/bi-essay/mediation>

Teaching Learning Process

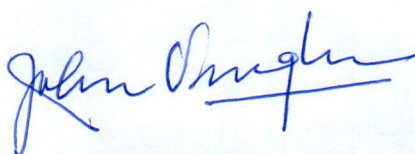
The overall purpose in this course would be to enhance students' understanding on the meaning, nature and significance of peace, conflict management, conflict resolution and conflict transformation and also to make them understand the importance of resource sharing in the conflict zones. Students will also learn about negotiation and mediation skill for conflict resolution through active listening, different tracks of diplomacy and Gandhian methods. In this course the teaching process would include a combination of different pedagogic tools like class lecture, class discussion, class presentations, group discussion and debates. The students will also learn through power-point presentations and film screening. The teaching-learning process would also focus on regular revision through different methods like holding quiz after the end of every unit, dividing the class into different groups based on different ideologies in the discipline and holding a free debate amongst them on different issues relevant for the course. Students will also be asked to do small write-ups on a question or a topic given to them based on their understanding of the problem/issue after completing every unit.

Assessment Methods

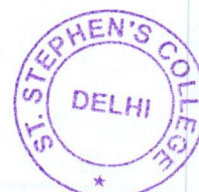
Students will be assessed at different stages during the completion of this course. They will be assessed on the basis of their performance in group discussions after completion of every unit, class presentations and one assignment on a given topic.

Keywords

Conflict, Conflict Management, Peace building, Trust building, Diplomacy



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16

B.A. PROGRAMME WITH PHYSICALEDUCATION
Skill Enhancement Courses (Semester-3)
Opt any one of SEC-1: (i) or (ii)

(ii) SPORTS JOURNALISM

PART A: THEORY

Duration: 3 Hrs

Maximum Marks : 75

Unit-I : Introduction

- 1.1. Meaning and changing trends of Journalism, Role of journalism in sports promotion & vice-versa, Social Media
- 1.2. Historical development & role of print and electronic media in sports promotion, Media Ethics, Responsibilities of journalist & editor (social, legal and professional)
- 1.3. Principles of Advertising in sports - press release, conferences, exhibitions, fairs, street drama, public speaking, radio, televisions, newspapers, films, posters, pictures, and graphics

Unit-II: News Writing and Designing

- 2.1. Language - vocabulary, spellings, figure of speech, dialect, grammar, punctuation, Sports Terminology and its use, Fundamentals of a sports story/ news.
- 2.2. Write-ups - feature, follow-ups, advance story, curtain raiser, flash back, articles, filters, editorials, boxes, radio and T.V. commentary anchoring, interviews, group discussions, talk-shows, Sports photo feature and writing captions of photos; Writing on Social Media i.e. Twitter & Blog, Creating a Blog
- 2.3. Designing - headings, front reading, layout & page making, stories, editorial tools, marks & skills, Web Page

UNIT-III : Organizational and Presentation Skills for Media

- 3.1 Organizational set-up of a newspaper printing press, sequence of operations in the printing of a newspaper/journal.
- 3.2 Research tools for developing a sports story, Use of personal library, statistics, records and computers in sports
- 3.3 Introduction to various types of information technology, Satellite communication: use of satellite in radio and T.V. communication for sports information

PART B : INTERNAL ASSESSMENT

Maximum Marks : 25

1. Presentation/ Written Test : 10 Marks
2. Project / Assignment : 10 Marks
3. Attendance : 05 Marks

MARKING SCHEME : Theory = 75 Marks, Internal Assessment = 25 Marks

SEMESTER CREDITS FOR THE PAPER = 4 CREDITS

- Each period will be of one hour.
- 4 theory periods per week per semester = 4 credits

INSTRUCTIONS TO THE EXAMINERS

- The examiners will set nine questions (eight descriptive and one question on short notes containing three options, whereby, a student has to attempt any two) equally distributed throughout the entire syllabus.
- The students will be required to attempt any five questions.
- Each question will carry fifteen marks.

SUGGESTED READINGS

1. Aamidor, A (2003). Real Sports Reporting. Indiana University Press. Valparaiso. Indiana. U.S.A.
2. Ahuja, B.N (1988) Theory and Practice of Journalism. Surjeet Publications, Delhi.
3. Andrews P (2005). Sports Journalism: A Practical Introduction. Sage Publications Ltd. Delhi.
4. Boyle R (2006). Sports Journalism: Context and Issues. Sage Publications Ltd.
5. Kamath, M V (1980). Professional Journalism. K.S.K. New Delhi.

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Amanab, Jhan, 15/08/18, John Singh, Nuber, J.S. Conan, B.H.
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	SEMESTER-6 DSE (iii) Sports Administration & Management	SEMESTER-6 : DSE-II (ii) Organization and Administration in Physical Education	
PART-A : Theory	Unit-I: Planning, Administration and Supervision 1.1 Concept and Scope of Planning and Organization 1.2 Administration and Supervision with reference to Physical Education Unit-II: 1.1 Office Management and Budgeting 1.2 Maintenance of Records and Accounts Unit-III: Sports Management 1.1 Sports Facilities Management 1.2 Marketing and Publicity Management in Sports 1.3 Organization and conduct of inter-college competitions	Unit I: Introduction to Planning, Organization, Administration, Supervision and Management 1.1 Concept and Significance of Planning, Organization, Administration and Supervision in Physical Education and Sports 1.2 Concept, Significance and process of Management in Physical Education and Sports 1.3 Office Management, Budgeting, Maintenance of Records and Accounts Unit II: Sports Management 2.1 Management of Facilities (Location, Preparation, Layout, and Maintenance of Play Fields and Indoor Sports Facilities), Equipment (Criteria of selection, procedure of purchase, care and maintenance of equipment), Marketing and Publicity 2.2 Organization of Intramural / Extramural Competitions (Formation of Committees and their specific roles, fixtures, conduct of Competition, opening and closing ceremony, prize distribution) 2.3 Organization of other Events in Physical Education and Sports (Seminar, Workshop, Clinic, Lecture) Unit III: Technology, Media and Career in Physical Education and Sports 3.1 Use of Technology in Physical Education and Sports, Audio-Visual Aids 3.2 Role of Media and Public Relations in Physical Education 3.3 Professional Courses and Career in Physical Education, Sports and allied areas	- Contents re-arranged and specified - Topics of Media & Career incorporated in this paper
PART-B PRACTICAL	1. Demonstration of Supervision activities in Sports Management. 2. Demonstration of skills of Management. 3. Demonstration of fixers of various kinds in sports competitions. 4. Demonstration of technical and non-technical purchase procedure.	1. Plan and Organize an event / intramural / extramural tournament in your college. 2. Learn and explain the procedure of purchase and stock maintenance. 3. Presentation on any topic from Physical Education using an audio-visual aid.	Revised



SPORTS PSYCHOLOGY**UNIT- I**

Introduction to Sport Psychology: Meaning and scope, Importance, relationship with other sport sciences, development of sport psychology in India.

Sensory Perceptual Process: Meaning, mechanism and stages, Classification of senses and sensory perceptual process, Factors in perception, Implication of sensory-perceptual process in exercise and sport

UNIT-II

Concept and meaning of motor learning, motor skill, motor control, motor performance, Stages of learning, transfer of training, assessment of learning and factors affecting of motor learning.

Growth & Development: Concept of growth & development, physical and motor development, mental, social and emotional characteristics of infancy childhood and Adolescents, facilitating psychological development.

UNIT III

Personality in Sport: Concept and definition, Modern perspective, (trait, humanistic, social cognitive and biological), Dynamics of personality in sport

Anxiety in Sport: Concept, definition and types, Anxiety and arousal, role of anxiety on physical performance

Motivation in Sport: Concept, definition, (drive, need and motives, instinct, attitude, achievement motivation,) techniques and types of motivation, Perceived competence.

UNIT-IV

Psychological Preparation and Competition: Phenomenon of competitive sport, long term Psychological preparation for competition (arousal regulation, imagery, self-confidence, goal setting, concentration.), short term psychological preparation (upcoming competition) Mind to muscle and muscle to mind relaxation techniques.

UNIT-V

Social Psychology in sport: social psychological aspects of Sport:

Socio-Culture Factors Affecting Performance: ethics and sport, values and sports, Team (group) cohesion. Spectators and Performance.

Note: Question Paper will be divided into two parts A and B. The Examiner is required to set 5 questions for Part-A and 5 questions for Part-B taking one question for each part from each of the five units of the syllabus. The questions of Part-A shall carry 5 marks each and questions for Part-B shall carry 10 marks each. The student is required to attempt any 4 questions from Part-A and any 3 questions from Part-B.

Practical

1. To make a project on sports psychology
2. To make a project on the role of sports psychology in improving the performance in sports
3. Make a project on application of psychology perspective in sports situation
4. Make a project on psychology implications between individual and team games

SUGGESTED READINGS

- Cohen RJ and Swerdlik ME (2002). Psychological testing and Assessment: An Introduction to Tests and Measurement. McGraw Hill. New York. U.S.A.
- Cox RH (2002). Sport Psychology. McGraw Hill. London.
- Dixit S (2006). Khel- Manovigyan. Sports Publications. Delhi
- Kamlesh ML (1998). Psychology in Physical Education and Sport. Metropolitan Book Co. New Delhi
- Liukkonen JED (2007). Psychology for Physical Educators. Human Kinetics. U.S.A.
- Mortin GL (2003). Sports Psychology, Sports Science. Press.USA.
- Sahni SP (2005). Psychology and Its Application in Sports. D.V.S. Delhi.
- Shaw D and Other (2005). Sport & Exercise Psychology. Bios. U.K.
- Singh MK (2008). Comprehensive Badminton Psychological Preparation. Friends Publication. Delhi.
- Verma V (1999). Sport Psychology & All Round Development. Sport Pub. New Delhi.
- Wann DL (1997). Sport Psychology. Prentice Hall. New Jersey.
- Weinberg RS and Gould D (2003). Foundations of Sport and Exercise Psychology. Human Kinetics. USA.

SEMESTER-VI

B.A. PROGRAMME: PHYSICAL EDUCATION & HEALTH EDUCATION **Opt any one of DSE-II: (i)/(ii)/(iii)**

(i) MEDIA AND CAREERS IN PHYSICAL EDUCATION

B.A. (PEHE)

DSE-II (i)

Time: 3 Hrs

Max. Marks: 75

THEORY

Unit-I: Audio-Visual Aids

- 1.1 Use of Audio-Visual Aids in Physical Education
- 1.2 Role of Media and Public Relations in Physical Education

Unit-II: Media and Careers in Physical Education

- 2.1 Professional Courses in Physical Education and Sports in India
- 2.2 Careers in Fitness, Health, Physical Education, Sports Management and Sports Journalism

Unit-III

- 3.1 Steps in the Organization of Intramural / Extramural Competitions (Formation of Committees and their Specific Roles, Publicity, Fixtures, Actual Competition, Prize Distribution Function, Report)
- 3.2 Organization of other Physical Education and Sports Events (Seminar, Clinic, Lecture)

PART-B: PRACTICAL: 50 Marks

1. Organise an event / intramural tournament in your college
2. Prepare a News Report of an observed Sports competition.
3. Create a presentation on any topic from Physical Education using an audio-visual aid.

PRACTICAL ASSESSMENT

4. Practical	30 Marks
5. VIVA	10 Marks
6. Record Book	10 Marks
Total	50 Marks

PART C: INTERNAL ASSESSMENT (25 Marks)

4. Written Test (10 marks)
5. Project / Assignment (10 marks)
6. Attendance (5 marks)

SEMESTER CREDITS FOR THE PAPER = 6 CREDITS

- Each period will be of one hour.
- 4 theory periods per week x 13 weeks = 4 credits
- 4 Laboratory hours per week per semester = 2 credits

Notes for Examiners, Teachers and Students (Common for all papers):

Part A: Practical (50 Marks)

The candidates will be asked to perform two practicals in final practical examination (15 marks each), Viva-Voce (10 marks) and will be required to show their record book (10 marks).

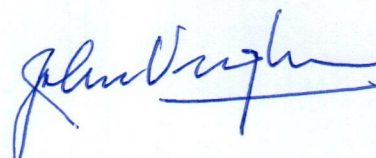
SUGGESTED READINGS

THEORY

1. Chakraborty, S.(2002) **Sports Management** (Delhi : Khel Sahitya Kendra)
2. Covey, S. (1989) **7 Habits of Highly Effective People**, Covey Publications, USA
3. Magill, R.A. (2004) **Motor Learning and Control: Concepts and Applications**, McGraw Hill, New York, USA.
4. Masteralexis, L.P., C. Barr and M. Humms (2008) **Principles and Practices of Sport Management**, Jones and Bartlett Publisher, U.S.A.
5. Sandhu, K.,(2006) **Trends and Developments in Professional Preparation in Physical Education** (New Delhi : Friends Publication).
6. Sandhu, K., (1993), **Sports Dynamics-Psychology, Sociology and Management**, Delhi: Galgotia Publishers.
7. Shaw, and Kaushik, (2001) **Lesson-Planning, Teaching Methods and Class-Management in Physical Education** (New Delhi : Khel Sahitya Kendra).
8. Siendentop, P. (2003) **Introduction to Physical Education, Fitness & Sports**. McGraw Hill, New York, USA.

PRACTICAL

1. Parks, J. Band J. Quarterman, Editors (2006) **Contemporary Sports Management**. Human Kinetics, Champaign



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PHYSICAL EDUCATION
For all Programme Courses (B.A./B.Com.)
General Elective (Semester-5)

GE-1 (P) : WELLNESS, FITNESS AND NUTRITION

PART A: THEORY

Duration: 2 Hrs

Maximum Marks : 50

Unit-I: Introduction to Physical Activity and Wellness

- 1.1. Introduction to Physical Activity, Aerobic and Anaerobic Activities, Benefits of Participation in Physical Activities
- 1.2. Types of Physical Activities – Walking, Jogging, Running, Calisthenics, Rope Skipping, Cycling, Swimming, Circuit Training, Weight training, Adventure Sports
- 1.3. Concept, Components and Significance of Wellness, Wellness Programmes

Unit-II: Physical Fitness and Aerobics

- 2.1. Concept, Components, Significance and Measurement and Evaluation of Physical Fitness
- 2.2. General Principles of Training for Fitness (Overload, Progression, Specificity, Recuperation, Reversibility, Overuse); Warming-up, Conditioning, Cooling down, Target Heart Rate; Development and Maintenance of Physical Fitness Components, Effect of Exercise on Various Systems (Skeletal, Muscular, Respiratory, Circulatory)
- 2.3. Introduction to Aerobics, Forms of Aerobics (Floor, Step, Weight and Aqua Aerobics), Role of appropriate Music and Aerobic Gear, Development of Aerobic Fitness Programmes

Unit-III: Nutrition

- 3.1. Concept of Nutrition, Nutrients, Balanced Diet, Dietary Aids and Gimmicks
- 3.2. Energy and Activity, Energy Balance Equation, Calorie Intake and Expenditure
- 3.3. Common illnesses due to Nutritional Deficiency

PART B : PRACTICAL

Maximum Marks : 25

1. Measurement of Fitness Components – Kraus Weber Muscular Strength Test/Standing Broad Jump (Muscular Strength), One minute Sit-ups test (Muscular Endurance), Harvard Step Test or Cooper's 12 minute Run/Walk Test (Cardiovascular Endurance), Sit and Reach Test (Flexibility).
2. Developing a 5-10 minute routine of aerobics with appropriate music.
3. Preparation of Diet Chart.

Assessment of Practical

Practical (Demonstration/ Performance) :	10 Marks
Viva :	10 Marks
Record Book on all topics of Practical :	05 Marks

PART C : INTERNAL ASSESSMENT

Maximum Marks : 25

1. Presentation/ Written Test : 10 Marks
2. Project / Assignment : 10 Marks
3. Attendance : 05 Marks

MARKING SCHEME : Theory = 50 Marks, Practical = 25 Marks, Internal Assessment = 25 Marks

SEMESTER CREDITS FOR THE PAPER = 6 CREDITS

- Each period will be of one hour.
- 4 theory periods per week per semester = 4 credits
- 4 Practical periods per week per semester = 2 credits

INSTRUCTIONS TO THE EXAMINERS

- The examiners will set nine questions (eight descriptive and one question on short notes containing three options whereby, a student has to attempt any two) equally distributed throughout the entire syllabus.
- The students will be required to attempt any five questions.
- Each question will carry ten marks.

SUGGESTED READINGS

1. ACSM'S (2001), ACSM Fitness Book (U.K., Human Kinetics).
2. Agarwal, Mukesh; Arora, Sunita; and Singh, Neeva (2016), Aerobics : Fitness and Style, Friends Publications, Delhi.
3. Anspaugh, David J.; Hamrick, Michael H.; and Rasato, Frank D. (2003), Wellness- Concepts and Applications, McGraw Hill, New York.
4. Bishop, J.G. (2004), Fitness through Aerobics, Benjamin Cummings, USA.
5. Brown, K.M. (2002), Physical Activity and Health: An Interactive Approach, Jones and Barlett Publisher, USA.
6. Department of Physical Education and Sports Sciences, University of Delhi (2007), Draft Resource Material – Fitness, Aerobics and Gym-Operations.
7. Kumari, Sheela, S., Rana, Amita, and Kaushik, Seema, (2008), Fitness, Aerobics and Gym Operations, KhelSahitya, New Delhi.
8. Sharma K. et al. (2014), Fitness Aerobics & Gym Operations, Jyoti Enterprises, Delhi.
9. Uppal, A.K. (2004), Fitness and Health, 5th Ed. (U.K., Human Kinetics).

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(ii) Balanced Education

B.A. (PEHE)

DSE-II (ii)
Time: 3 Hrs
Max. Marks: 75

THEORY

Unit 1

Balanced Education: Introduction, Meaning, definition, Significance, Aims & Objectives; Components- Health, Wealth, Physical Fitness, Wellness; Longevity, Success; Happiness approach; Components of Balanced Education as Body, Mind, Intellect, Heart, Social, Spiritual, Environment and Genetics etc.

Unit 2

Health : Introduction, Meaning, Definition of Positive & Negative Health, Relation to Fitness, Illness, Wellness, Personality; Components of Health-Physical, Emotional, Mental, Spiritual, Social, Environmental, Genetic, Interdependence of health on sound body, mind, heart, soul, environment, genetics; wholistic nature of health with examples of all components role on each component concept of divisions for convenience of understanding, Goal setting, Decision making for health enhancement; Analysing information, Awareness to current status, Measurement & Management of Health.

Unit 3

Wealth: Introduction, Meaning, Generation by work for all, Relation to MDG-2015; Right to Work, Equality, Occupational Skills; Vocational decision making, Goal Setting, Application of knowledge and enriching knowledge for progress harmony and development.

Unit 4

Physical Fitness: Introduction, Relation to health, Definition, the related division fitness and its components, Skill related physical fitness and its components, exercises to improve and maintain physical fitness with physical fitness, technologies and principles of development of physical fitness.

Wellness : Introduction, meaning, definition, components, development of wellness prevention of illness, Measurement & management of Wellness.

Unit 5

Longevity: Introduction, Meaning, Definition, age, expected healthy years of age; lifestyles and their impact on longevity, Measurement and management by change in behaviours.

Success : Introduction, Meaning, Definition, relation to best efforts and results, understanding the satisfactory level of success; goal setting, critical thinking and decision making with respect to success and performance.

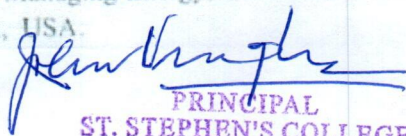
Happiness: Introduction, Meaning, Definition, Concepts, relation to success, dependence on success, wealth, health etc. Acquiring happiness irrespective to possessions of health, wealth, fitness, role of genes & environment.

PRACTICALS

1. Measurement of body height, weight, BMI, and Pulse rate.
2. Demonstration of Meditation techniques.
3. Demonstration of the importance of man made and natural environment.
4. Demonstrations of healthy environmental choices with the help of meditation, exercise and nutritional habits.
5. Demonstrate management of wellness.

BOOKS RECOMMENDED

1. Ansbaugh, D.J., M.H. Hamrick & F.D. Rosato (2005). Wellness: Concepts and Application. McGraw Hill, USA.
2. Chopra, D. (1994). The Seven Spiritual Laws of Success. Amber-Allen Publishers, New World Library, New Delhi.
3. Covey, S.R. (2004). The Eighth Habit: From Effectiveness to Greatness. Franklin Covey Co., USA.
4. Kansal, D.K. (2013) Wholistic Personality Development. Sports & Spiritual Science Publications, New Delhi.
5. Kansal, D.K. (2015) Balanced Education, Sports & Spiritual Science Publications, In Press.
6. Loehr, J. And T. Schwartz (2003). The Power of Full Engagement : Managing Energy, not Time, Is the Key to High Performance and Personal Renewal. Free Press Paperbacks, New York, USA.


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Skill Enhancement Elective Courses

Data Analysis (HS31)

Skill Enhancement Elective Courses (SEC) Credit: 4

Course Objective

This is a skill enhancement course for data analysis. The students will be given hands on training on using statistical and computing software to better visualize and understand data concepts. The course is designed to be delivered through 2 classroom lectures and 4 computer lab classes per week.

Course Learning Outcomes

The course will use data simulations and publicly available data sources to help students learn about data types, their organization and visual representation. They will learn how to compute summary statistics and do some basic statistical inference.

Unit 1

Introduction to the course: How can the representation and analysis of data help us study real-world problems. Publicly available data sets

Unit 2

Using Data: Available statistical software, steps in data storage, organisation and cleaning

Unit 3

Visualisation and Representation: Alternative forms of presenting summarising and presenting data

Unit 4

Simple estimation techniques and tests for statistical inference

References

1. Levine, D., Stephan, D., Szabat, K. (2017). *Statistics for managers using Microsoft Excel, 8th ed.* Pearson.
2. Tattar, P., Ramaiah, S., Manjunath, B. (2018). *A course in statistics with R.* Wiley.

Teaching Learning Process

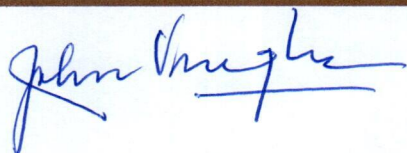
Lectures and tutorials

Assessment Methods

Internal assessment and final examination as per CBCS rules

Keywords

Data representation, statistical software, estimation



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Teaching Learning Process

Lectures and tutorials

Assessment Methods

Internal assessment and final examination as per CBCS rules

Keywords

Data, sampling, surveys

Contemporary Economic Issues (HS42)

Skill Enhancement Elective Courses (SEC) Credit: 4

Course Objective

The course seeks to familiarize students with basic concepts related to the Economic Survey and Union Budget. It aims to equip students with sufficient knowledge and skills to analyse these documents.

Course Learning Outcomes

Students will have the capability to understand government policies and will in general be informed participants in economic decision making.

Unit 1

Concepts

- Fiscal policy, areas of government spending in India
- Capital and revenue expenditure, plan and non-plan expenditures
- Deficits (fiscal, primary, revenue), impact of fiscal deficits on the economy
- Capital receipts, revenue receipts, tax and non-tax revenue, direct and indirect taxes, need for rationalisation of tax structure, Goods and Services Tax (GST)
- Actual, revised and budget estimates
- Zero-base budgeting
- Gender budgeting
- Fiscal devolution and centre-state financial relations

Unit 2

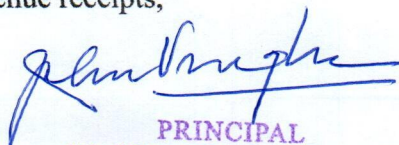
The economic survey

- Analysis of current and past policy emphasis

Unit 3

The union budget

- Need for the budget, understanding the process of budget making in India
- Analysis of fiscal and revenue deficits
- Analysis of sources of revenue and expected growth in revenue, tax simplification, improvement in administration, expansion of tax net and other measures to improve revenue receipts,


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- Analysis of expenditure pattern and expected growth in expenditure, thrust areas of budget, sectors that have received higher/lower shares of expenditure, the reasons and consequences thereof, steps proposed to ensure effective spending

References

Given the nature of the course, the readings will be updated every year.

1. Centre for Budget and Governance Accountability. Recent reports.
2. Chakraborty, P. (2015). Intergovernmental fiscal transfers in India: Emerging trends and realities. In P. Patnaik (ed.): *Macroeconomics*. Oxford University Press.
3. Dasgupta, D., De, S. (2012). Fiscal deficit. In *The new Oxford companion to economics in India*. Oxford University Press.
4. Kapila, U. (2016). *Fiscal and budgetary developments in Indian economy since independence*. Academic Foundation.
5. Ministry of Finance. Economic and social classification of the budget.
6. Ministry of Finance. Economic survey (latest).
7. Ministry of Finance. Finance Commission report (latest).
8. Ministry of Finance. Union Budget.
9. Mukherjee, P. (2012). Budget making. In K. Basu, A. Maertens (eds.): *The new Oxford companion to economics in India*. Oxford University Press.
10. Mukherjee, S. (2015). Present state of goods and services tax (GST) reform in India. Working Paper No. 154. *National Institute of Public Finance and Policy*.
11. Reddy, Y. (2015). Continuity, change and the way forward: The fourteenth finance commission. *Economic and Political Weekly*, 50(21), 27-36.
12. Spiegel, M. (2003). *Theory and problems of probability and statistics*. Chapter 19. McGraw-Hill.

Teaching Learning Process

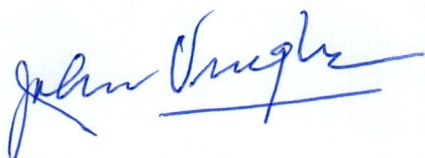
Lectures and tutorials

Assessment Methods

Internal assessment and final examination as per CBCS rules

Keywords

Union budget, economic survey, government policy



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Teaching Learning Process

Lectures and tutorials

Assessment Methods

Internal assessment and final examination as per CBCS rules

Keywords

Finance, economics

Applied Econometrics (HE55)

Discipline Specific Elective (DSE) Credit: 6

Course Objective

The course assumes that students have a basic knowledge of statistics, mathematics as well as basic econometric theory. It builds on the compulsory Introductory Econometrics course and teaches students a broad set of commonly used econometric methods. These include estimating models with limited dependent variables and the use of instrumental variables to estimate models with endogenous regressors.

Course Learning Outcomes

Students will learn the theoretical basis for techniques widely used in empirical research and consider their application in a wide range of problems.

Unit 1

Stages in empirical econometric research

Unit 2

The linear regression model: estimation, specification and diagnostic testing: estimation, specification and inference

Unit 3

Advanced topics in regression analysis: dynamic econometric models, instrumental variable estimation, measurement errors

Unit 4

Panel data models and estimation techniques: pooled regression, fixed and random effects models

Unit 5

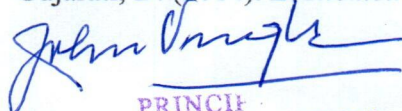
Limited dependent variables: logit and probit models for binary responses, tobit models for truncated data.

Unit 6

Introduction to econometric software; publicly available data sets and software will be used to estimate models and apply the techniques learned in class

References

1. Gujarati, D. (2014). *Econometrics by example*, 2nd ed. Palgrave Macmillan.


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2. Gujarati, D., Porter, D. (2012). *Basic econometrics, 5th ed.* McGraw-Hill.
3. Wooldridge, J. (2014). *Introduction to econometrics: A modern approach, 5th ed.* Cengage Learning.

Teaching Learning Process

Lectures and tutorials

Assessment Methods

Internal assessment and final examination as per CBCS rules

Keywords

Regression, instrumental variables, panel data

Economic History of India 1857-1947 (HE56)

Discipline Specific Elective (DSE) Credit: 6

Course Objective

This course analyses key aspects of Indian economic development during the second half of British colonial rule. In doing so, it investigates the mechanisms that linked economic development in India to the compulsions of colonial rule.

Course Learning Outcomes

The course develops critical analytical skills and exposes students to understanding the intricacies of India's economic, political and social developments both in the past and present times. It increases their employability by enhancing their ability to deal with a variety of textual and statistical sources, and to draw upon them to construct a coherent argument. These skills would be useful in a variety of careers in academics, research, journalism and the government.

Unit 1

Colonial India: background and introduction

Unit 2

Trends in national income, population; labour and occupational structure

Unit 3

Agriculture, agrarian structure and land relations

Unit 4

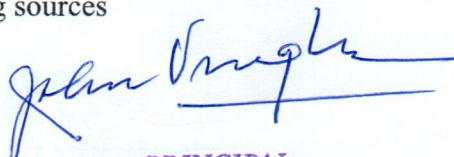
Railways and industry

Unit 5

Economy and state in the imperial context

References

Some readings may be updated periodically. Material for the course will be drawn from the following sources



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4. World Health Organisation (2013). *The economics of the social determinants of health and health inequalities: A resource book*. World Health Organisation.

Teaching Learning Process

Lectures and tutorials

Assessment Methods

Internal assessment and final examination as per CBCS rules

Keywords

Education, health, economics, India

Environmental Economics (HE63)

Discipline Specific Elective (DSE) Credit: 6

Course Objective

This course focuses on economic causes of environmental problems. In particular, economic principles are applied to environmental questions viewed as externalities and their management through various economic institutions, economic incentives and other instruments and policies. Methods for analysing economic implications of environmental policy are also addressed as well as the valuation of environmental quality, assessment of environmental damages, and tools needed for the evaluation of projects such as cost-benefit analysis, and environmental impact assessments. Selected topics on international environmental issues are also discussed.

Course Learning Outcomes

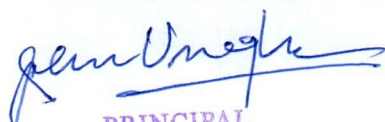
The module aims to introduce students to the main theoretical and empirical concepts in environmental economics, equip students with a thorough analytical grasp of environmental policy theory, ranging from externalities to international environmental agreements, and familiarise students with the main issues in environmental valuation and with the basic features of the environmental policy tools. At the end of the module the students should be able to demonstrate their understanding of the economic concepts of environmental policy. In some models, the student will be required to deal with simple algebra problems that will help them to better understand these concepts, use diagrammatic analysis to demonstrate and compare the economic welfare effects of various environmental policy options, demonstrate their understanding of the usefulness and problems related to environmental valuation, and demonstrate their critical understanding of environmental policies.

Unit 1

Introduction: What is environmental economics? Review of microeconomics and welfare economics

Unit 2

The theory of externalities: Pareto optimality and market failure in the presence of externalities; property rights and the Coase theorem


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Unit 3

The design and implementation of environmental policy: overview; Pigouvian taxes and effluent fees; tradable permits; choice between taxes and quotas under uncertainty; implementation of environmental policy

Unit 4

International environmental problems: trans-boundary environmental problems; economics of climate change; trade and environment

Unit 5

Measuring the benefits of environmental improvements: non-market values and measurement methods; risk assessment and perception

Unit 6

Sustainable development: concepts; measurement

References

1. Aldy, J. et al. (2010). Designing climate mitigation policy. *Journal of Economic Literature*, 48, 903-934.
2. Cropper, M., Oates, W. (1992). Environmental economics: A survey, *Journal of Economic Literature*, 30, 675-740.
3. Heal, G. (2012). Reflections – defining and measuring sustainability. *Review of Environmental Economics and Policy*, 6, 147-163.
4. Kolstad, C. (2010). *Intermediate environmental economics*, 2nd ed. Oxford University Press.
5. Newell, R., Pizer, W., Raimi, D. (2013). Carbon markets 15 years after Kyoto: Lessons learned, new challenges. *Journal of Economic Perspectives*, 27, 123-46.
6. Perman, R., Ma, Y., McGilvray, J., Common, M. (2011). *Natural resource and environmental economics*, 3rd ed. Pearson Education/Addison Wesley.
7. Stavins, R. (ed.) (2012). *Economics of the environment: Selected readings*, 5th ed. W. W. Norton.

Teaching Learning Process

Lectures and tutorials

Assessment Methods

Internal assessment and final examination as per CBCS rules

Keywords

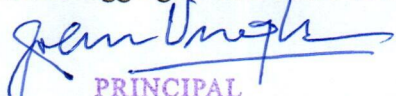
Pollution, externalities, natural resources

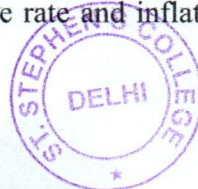
Open Economy Macroeconomics (HE64)

Discipline Specific Elective (DSE) Credit: 6

Course Objective

This course intends to emphasise on how a country's relations to the rest of the world influence aggregate economic activity, employment, exchange rate and inflation and


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Skill Enhancement Course

Soft skills

Soft skills is a paper that aims to impart or cultivate certain skills in students that would aid them in their personal growth and development; the idea is to enable them to not only grow as individuals but also learn to work with and respect their fellow students, and thereby cultivate certain personality traits that would allow them to function better in a social setting. The course requires students to do group presentations and projects, and these projects range from conducting surveys and interviews of people from different communities and professions to understand their perspective, to field trips to historically and culturally significant locations within and around the city. These projects require students to work as a team and thereby teach them to be adaptable and help develop their emotional intelligence, in addition to equipping them with problem solving and leadership skills.


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V. Skill Enhancement Course (Any Two) Credits: 4

Paper 1: English Language Teaching

1. Knowing the Learner
2. Structures of English Language
3. Methods of teaching English Language and Literature
4. Materials for Language Teaching
5. Assessing Language Skills
6. Using Technology in Language Teaching

Suggested Readings

1. Penny Ur, *A Course in Language Teaching: Practice and Theory* (Cambridge: CUP, 1996).
2. Marianne Celce-Murcia, Donna M. Brinton, and Marguerite Ann Snow, *Teaching English as a Second or Foreign Language* (Delhi: Cengage Learning, 4th edn, 2014).
3. Adrian Doff, *Teach English: A Training Course For Teachers (Teacher's Workbook)* (Cambridge: CUP, 1988).
4. *Business English* (New Delhi: Pearson, 2008).
5. R.K. Bansal and J.B. Harrison, *Spoken English: A Manual of Speech and Phonetics* (New Delhi: Orient BlackSwan, 4th edn, 2013).
6. Mohammad Aslam, *Teaching of English* (New Delhi: CUP, 2nd edn, 2009).

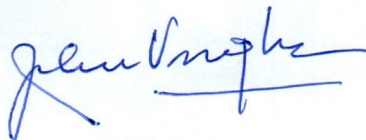
Paper 2: Soft Skills

Teamwork
Emotional Intelligence
Adaptability
Leadership
Problem solving

Suggested Readings

1. S.P. Dhanavel, *English and Soft Skills*. Orient BlackSwan, 2013.
2. Dale Carnegie, *How to Win Friends and Influence People* (1936) Gallery Books.
3. Gopalaswamy Ramesh & Mahadevan Ramesh, *The Ace of Soft Skills: Attitude, Communication and Etiquette for Success*. Pearson, 2010.

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Core Course VI
Rise of the Modern West- I

Course Objectives:

The focus of the course is on transition from feudalism to capitalism in Europe. The paper familiarises the student with important transitions and transformations in the economy, polity, and socio-cultural life from late medieval period to 1600 in various parts of Europe. The course shall critically examine the dynamics of economic and political power within Europe, and contact with the New World. The processes by which Europe's economy benefited from colonial expansion and exploitation of indigenous and slave labour will be explained. Students shall also engage with continuities and changes in intellectual and artistic realms; the social and economic milieu which influenced developments in religion; trends in state formation; and the relationship between state and religion. Students will be introduced to the concept of Eurocentrism in our understanding of the Rise of the Modern West.

Learning Outcomes:

Upon completion of this course the student shall be able to:

- Outline important changes that took place in Europe from the medieval period.
- Acquire an integrated approach to the study of economic, social, political and cultural developments in Europe.
- Explain the processes by which major transitions unfolded in Europe's economy, state forms, social structure and cultural life. Examine elements of early modernity in these spheres.
- Critically analyse linkages between Europe's state system and trade and empire.

Course Content:

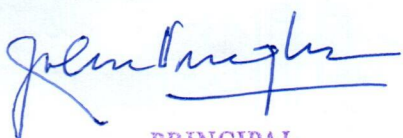
I. Transition from Feudalism to Capitalism

- [a] Issues and debates
- [b] Question of Eurocentrism

II. Early colonial expansion

- [a] Factors for colonization
- [b] Trade and Empire
- [c] Mines and plantations
- [d] Labour Systems - indigenous populations and African slaves

III. Renaissance



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- [a] In Italy: its social roots
- [b] Humanism and its spread in Europe
- [] Art

IV. Origins, course, and results of the European Reformation in the 16th century.

V. Economic developments of the 16th century

- [a] Shift of economic balance from the Mediterranean to the Atlantic
- [b] Commercial Revolution
- [c] Price Revolution

VI. Emergence of European State system: with two case studies (Spain, France, England, Russia).

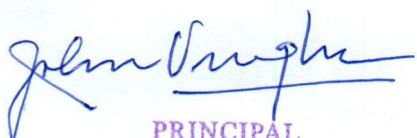
ESSENTIAL READINGS AND UNIT WISE TEACHING OUTCOMES:

Unit I: The Unit will give an overview to the paper through issues and debates related to transition from feudalism to capitalism in Europe. The concept of Eurocentrism will be introduced. **(Teaching Time: 3 Weeks Approx.)**

- Aston, T.H. and C.H.E. Philpin, (Ed.). (2005). *The Brenner Debate, Agrarian Class Structure and Economic Development in Pre-Industrial Europe*. Cambridge/Delhi: Cambridge University Press.
- Blaut, J.M., et.al. (1992). *1492 - The Debate on Colonialism, Eurocentrism, and History*. Trenton, N J: Africa World Press, Inc.
- Hilton, Rodney, (Ed.). (1985). *The Transition from Feudalism to Capitalism*. London: Verso.
- Sinha, Arvind. (2009). *Sankrantikaleen Europe (OOOOOOOOOO 000 00000000)*. New Delhi: Granth Shilpi. [and English edition].
- Wallerstein, Immanuel. (1974). *The Modern World System, Vol. I, Capitalist Agriculture and the Origins of the European World Economy in the Sixteenth Century*. New York: Academic Press. (Chaps: Introduction and 1)

Unit-II: The Unit discusses the process of early colonization, inter-linkages, and impact of trade and empire on Western Europe, the New World, West Africa and parts of Asia. **(Teaching Time: 2 weeks Approx.)**

- Braudel, Fernand. (1988). *Civilization and Capitalism, 15th to 18th Centuries, Vols. I, II, III*. London: Collins/Fontana Press.


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- Burbank, Jane and Frederick Cooper. (2010). *Empires in World History - Power and Politics of Difference*. Princeton: Princeton University Press.
- Crosby, Alfred W. (2004). *Ecological Imperialism: The Biological Expansion of Europe, 900-1900*. Cambridge: Cambridge University Press (2nd edition).
- Davis, Ralph. (1973). *The Rise of the Atlantic Economies*. London: Weidenfield and Nicolson.
- Waites, Bernard. (1999) *Europe and the Third World: From Colonisation to Decolonisation, c 1500-1998*. London: Palgrave Macmillan.

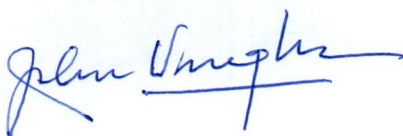
Unit- III: The Unit emphasizes social roots of Renaissance, elements of continuity and change in intellectual and cultural realms, and debates on Renaissance and Humanism. (Teaching Time: 3 weeks Approx.)

- Burke, Peter. (1999). *The Italian Renaissance, Culture and Society in Italy*. Princeton: Princeton University Press. (Chaps: Introduction, chaps: 1, 2, 3, 4 & 6)
- Kaborycha, Lisa. (2011). *A Short History of Renaissance Italy*. New York: Pearson.
- Mac Kenny, Richard. (2005). *Renaissances. The Cultures of Italy, 1300-1600*. London/New York: Palgrave Macmillan.
- Winks, Robin W. and Lee Palmer Wandel. (2003). *Europe in a Wider World, 1350-1650*. New York: Oxford University Press.
- Woolfson, Jonathan, (Ed.). (2004). *Palgrave Advances in Renaissance Historiography*. London: Palgrave Macmillan.

Unit-IV: The Unit outlines the economic, political, social and intellectual dimensions of Reformation and Reformation's impact on different regions of Europe. (Teaching Time: 2 weeks Approx.)

- Dixon, C. Scott. (2002). *The Reformation in Germany*. Oxford: Blackwell Publishers Limited.
- Ferguson, Niall. (2011). *Civilization. The West and the Rest*. London: Allen Lane.
- Greengrass, Mark. (2015). *Christendom Destroyed, Europe 1517-1648*. London: Penguin Books.
- Parish, Helen L. (2018). *A Short History of the Reformation*. New York: I. B. Tauris.
- MacCulloch, Diarmaid. (2004). *Reformation: Europe's House Divided, 1490-1700*. London: Penguin Books Ltd.

Unit- V: The Unit deals with European economy, decline of Mediterranean and rise of Atlantic regions, and the impact of Trans-Atlantic commerce on Europe. (Teaching Time: 2 weeks Approx.)



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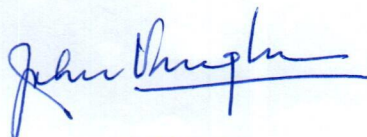
- Frankopan, Peter. (2015). *The Silk Roads: A New History of the World*. London: Bloomsbury.
- Heller, Henry. (2011). *Birth of Capitalism. a 21st Century Perspective*. London: Pluto Press. (Chapter 4.
- Hill, Christopher. (1969). *Reformation to Industrial Revolution*. London: Penguin Books. (Chap. 2, pp 11 - 93)
- Kriedte, Peter. (1983). *Peasants, Landlords and Merchant Capitalists: Europe and the World Economy, 1500-1800*. Cambridge: Cambridge University Press. (Chap- 1)
- Wiesner-Hanks, Merry E. (2006). *Early Modern Europe: 1450-1789*. Cambridge: Cambridge University Press.

Unit- VI: The Unit emphasizes the nature of the European state system and interconnections between economy, society, religion, and polity with case studies. **(Teaching Time: 2 weeks Approx.)**

- Anderson, Perry. (1979). *Lineages of the Absolutist State*. London: Verso Edition. (pp. 15-42, 60-84, 85-142, 195-220, 328-360).
- Cameron, Euan, (Ed.). (2001). *Early Modern Europe, An Oxford History*. Oxford: Oxford University Press.
- Cuttica, Cesare and Glenn Burgess, (Eds.). (2011). *Monarchism and Absolutism in Early Modern Europe*. London: Routledge.
- Ertman, Thomas. (1997). *Birth of the Leviathan: Building States and Regimes in the Medieval and Early Modern Europe*. Cambridge: Cambridge University Press.
- Kumin, Beat, (Ed.). (2013). *The European World 1500-1800. An Introduction to Early Modern History*. New York: Routledge.

SUGGESTED READINGS

- Cipolla, Carlo M., (Ed.). (1994), *Before the Industrial Revolution. European Society and Economy 1000-1700*. New York: WW Norton & Co.
- Cipolla, Carlo M., (Ed.). (1976). *Fontana Economic History of Europe*, Vols. II, III. New York: Barnes and Noble.
- Dickens, A.G. (1974). *German Nation and Martin Luther*. London: Edward Arnold.
- Dobb, Maurice. (1963). *Studies in the Development of Capitalism*. London: Routledge and Kegan Paul.
- Findlen, Paula, (Ed.). (2002). *The Italian Renaissance. The Essential Readings*. Oxford: Blackwell Publishers Ltd.



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- 000 000, 00000(2007) 000000000000 00 D000D DD00000000. New Delhi. Granth Shilpi.
- Kamen, Henry. (1996). *European Society, 1500-1700*. London: Routledge.
- Lee, Stephen. (1984). *Aspects of European History 1494-1789*. London: Methuen & Co. Ltd.
- Lynch, John. (1984). *Spain under the Habsburgs, Vol. I, Empire and Absolutism, 1516-1598*. New York: New York University Press.
- Parry, J. H. (1963). *Age of Reconnaissance*. London: Weidenfield & Nicolson.
- Scammell, G. V. (1989). *The First Imperial Age: European Overseas Expansion 1400-1715*. London/New York: Routledge.
- Tilly, Charles. (1992). *Coercion, Capital and European States, AD 990-1992*. Hoboken, NJ: Wiley-Blackwell.
- Verma, Lal Bahadur. (2008). *Europe ka Itihas*. Bhag 9. Delhi: Prakashan Sansthan.
- Wood, E. M. (2002). *The Origin of Capitalism: A Longer View*. London: Verso, (rev. ed.).

Teaching Learning Process:

Classroom teaching, classroom discussions and student presentations in class and/or in tutorials. Presentations shall focus either on important themes covered in the class lectures, or on specific readings. As this is a paper tracing the history of regions outside the Indian subcontinent, supporting audio-visual aids like documentaries, maps and power point presentations shall be used widely. Students shall also be encouraged to participate in talks/seminar presentations by specialists in the field. Since this history is of an unfamiliar region an overview of the feudal background will be provided to students. Overall, the teaching and learning process shall emphasise the interconnectedness of themes within the different rubrics to build a holistic view of the time period/region under study.

Assessment Methods:

Students will be regularly assessed for their grasp on debates and discussions covered in class. Two written assignments will be used for final grading of the students. Students will be assessed on their ability to engage with a sizeable corpus of readings assigned to the theme for written submissions, i.e. being able to explain important historical trends and tracing historiography reflected in the assigned readings.

Internal Assessment: 25 Marks

Written Exam: 75 Marks

Total: 100 Marks

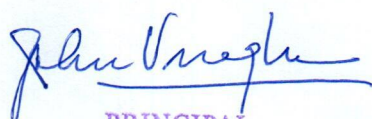
Keywords:


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History of Modern West II

This paper offers an in-depth historical analysis of economic, political and social transformations in Europe during the 17th and 18th centuries. The projects done by the student as part of the continuous internal assessment for the course gave the students the opportunities to experience the experiential aspect of the course and work on aspects of the course structure and do original research. For History students the process of research comprises an important experiential element in the subject as it gives them training in research from archives and secondary sources and academic writing required for professional history writing. Students access popular histories of the period available in the media of cinema and historical literature for the purposes of the projects. This method of experiential learning is very much in line with the objectives of Learning Outcome Based Curriculum Framework.



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Core Course VIII
Rise of the Modern West- II

- I. The 17th century European crisis: economic, social, and political dimensions
- II. The English Revolution
 - [a] Major issues
 - [b] Political and intellectual currents
- III. The rise of Modern Science in relation to European society from the Renaissance to the 17th century
- IV. Mercantilism and European economies: trade and empire in the 17th and 18th centuries
- V. The Enlightenment: ideas and impact
- VI. Origins of the Industrial Revolution: divergence debate

ESSENTIAL READINGS

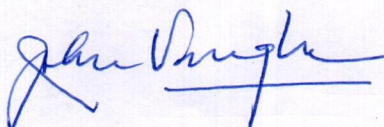
- Black, Jeremy. *Europe and the World, 1650-1830*. London: Routledge, 2002.
- Coleman, D.C., ed. *Revisions in Mercantilism*. London: Methuen Young Books, 1969.
- Deane, Phyllis. *The First Industrial Revolution*. Cambridge: Cambridge University Press, 1965.
- Hall, A.R. *From Galileo to Newton 1630-1720*. London: Fontana-Collins, 1970.
- Heller, Henry. *Birth of Capitalism: A 21st Century Perspective*. London: Pluto Press, 2011.
- Hill, Christopher. *The Collected Essays of Christopher Hill, Vol. 2, Religion and Politics in Seventeenth Century England*. Amherst: The University of Massachusetts Press, 1985.
- _____. *The Collected Essays of Christopher Hill, Vol. 3 People and Ideas in Seventeenth Century England*. Amherst: The University of Massachusetts Press, 1986.
- Hobsbawm, E. J. *Industry and Empire*. London: Penguin Books, 1999.
- Pagden, Anthony. *The Enlightenment: And Why it Still Matters*. Oxford: Oxford University Press, 2013.
- Parker, G. and L.M. Smith, eds. *The General Crisis of the Seventeenth Century*. London: Routledge, 1997.



- Parthasarathi, Prasannan. *Why Europe Grew Rich and Asia Did Not: Global Economic Divergence, 1600-1800*. Cambridge: Cambridge University Press, 2011.
- Pomeranz, Kenneth. *The Great Divergence: China, Europe and the Making of the Modern World*. Princeton: Princeton University Press, 2000.
- Wallerstein, Immanuel. *The Modern World System, Vol. II, Mercantilism and the Consolidation of the European World Economy, 1600-1750*. New York: Academic Press, 1980.

SUGGESTED READINGS

- Anderson, M. S. *Europe in the Eighteenth Century, 1713-1783*. Oxford: Oxford University Press, 1976.
- vanBath, B. H. Slicher. *The Agrarian History of Western Europe 500 AD to 1850*. New York: St. Martin's Press, 1963.
- Canny, Nicholas, ed. *The Oxford History of the British Empire, Vol. I, The Origins of Empire, British Overseas Enterprise to the Close of the Seventeenth Century*. Oxford: Oxford University Press, 1998.
- Fitzpatrick, Martin, et. al., ed. *The Enlightenment World*. London: Routledge, 2004.
- Floud, Roderick, and D.N. McCloskey, ed. *The Economic History of Britain Since 1700, Vol. I: 1700-1860*. Cambridge: Cambridge University Press, 1997.
- Harris, Tim. *Restoration: Charles II and his Kingdoms, 1660-1685*. London: Penguin, 2006.
- Hill, Christopher. *Puritanism and Revolution: Studies in the Interpretation of the English Revolution of the 17th Century*. London/New York: Palgrave Macmillan, 1997.
- Kamen, Henry. *European Society, 1500-1700*. London: Routledge, 1996.
- Mathias, Peter. *The First Industrial Nation*. London: Routledge, 2001.
- Marshall, P. J., ed. *The Oxford History of the British Empire, Vol. II, The Eighteenth Century*. Oxford: Oxford University Press, 1998.
- Mintz, Sidney W. *Sweetness and Power: The Place of Sugar in Modern History*. New York: Penguin Books, 1986.
- Scammell, G.V. *The First Imperial Age: European Overseas Expansion 1400-1715*. London/New York: Routledge, 1989.
- Stone, Lawrence. *The Causes of the English Revolution, 1529-1642*. New York: Routledge, 2002.
- deVries, Jan. *Economy of Europe in an Age of Crisis 1600-1750*. Cambridge: Cambridge University Press, 1976.
- deVries, Jan. *The Industrious Revolution: Consumer Behaviour and the Household Economy, 1650 to the Present*. Cambridge: Cambridge University Press, 2008.
- Waites, Bernard. *Europe and the Third World: From Colonization to Decolonisation, 1550-1998*. London: Palgrave Macmillan, 1999.
- Williams, Eric. *Capitalism and Slavery*. Chapel Hill: University of North Carolina Press, 1944.


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Case studies where ever applicable

Power Point presentations

Questionnaires

Assessment Methods

Internal assessment

Presentation

Central examination.

Keywords

Human Rights, Punishment, Artificial Intelligence, Medical Ethics, Euthanasia, Living Will, Media Ethics, Environmental Ethics

Critical Thinking and Decision Making (SEC (1))

Skill-Enhancement Elective Course - (SEC) Credit:4

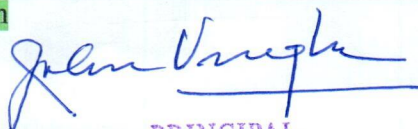
Course Objective(2-3)

This course is primarily focused to develop thinking skills. It aims at enabling a person to take decision in difficult situations. It is the ability to analyze the way one thinks and presents the evidence for ones own ideas rather than simply accepting it. It is creative, clear and to some extent reflective thinking. This paper helps in developing ideas and ability to create a vision, plan for the future and anticipate and solve problems.

Course Learning Outcomes

This course

1. Helps in generating productive/creative ideas for further use in difficult situation.
2. Creates enthusiasm for taking a risk of dealing with difficult issues and finding a way out for solution



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3. Provides valuable intellectual traits like how to critically read, listen and write and develop faith in reason and encourage a flair for fairness and justice. As a result a learner learns step by step how to arrive at an ideal solution keeping in mind all situational factors.
4. Provides clarity in thinking as well as proper understanding of an issue to make it precise for further analysis.
5. Helps to use the skills of observation, analysis and evaluation and also provides sound reason for doubting and questioning.
6. Finally the learner becomes self-directed, self-monitored and self-corrective through this process of reflective thinking, and can proceed for right choice.

Unit 1

Unit I: CRITICAL THINKING: BASIC COMPONENTS

1. Critical Thinking: An Introduction
2. Cognitive Biases
3. Beliefs, Claims, issues and arguments.
4. Persuasion through Logic: Logos, Ethos and Pathos

Recommended Reading:

1. Moore, Brooke N., et al. *Critical thinking*. Dubuque: McGraw-Hill Companies, Inc, 2015, Ch 1-2.
2. Dewey, John, *How we think*. Mineola, N.Y. Dover Publications, 1997, Ch 6

Unit 2

Unit II: CRITICAL THINKING: A SECOND ORDER ACTIVITY

1. Clear thinking.
2. Vagueness, Ambiguity, Generality and Definition of terms
3. Argumentative essays
4. Credibility of claims and their sources

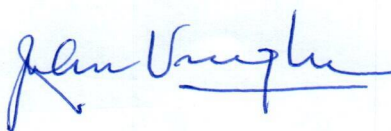
Recommended Reading:

1. Moore, Brooke N., et al. *Critical thinking*. Dubuque: McGraw-Hill Companies, Inc, 2015, Ch 3-4.

Unit 3

Unit III: RHETORIC AND ITS FALLACIES

1. Persuasion through rhetoric
2. Fallacies involved in rhetoric


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Recommended Reading:

1. Moore, Brooke N., et al. *Critical thinking*. Dubuque: McGraw-Hill Companies, Inc, 2015, Ch 5.

Unit 4

Unit IV: CLEAR THINKING: KEYS FOR SOLUTION

1. Identification and analysis of the problem through case studies
2. Evaluating the Argument: Validity, Soundness and Strength; Reflecting upon the issue with Sensitivity and Fairness.
3. Evaluating Decision Options from Multiple Perspective.
4. Identifying Inconsistencies, Understanding Dilemma and Looking for Appropriate Solution within Limitations.

Recommended Reading:

1. Case Studies from both the recommended books
2. Moore, Brooke N., et al. *Critical thinking*. Dubuque: McGraw-Hill Companies, Inc, 2015, Ch.2-5.
3. Dewey, John. *How we think*. Mineola, N.Y: Dover Publications, 1997, Ch.7, Ch 8.

References

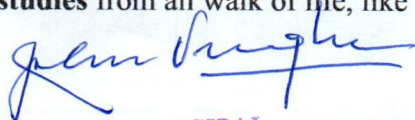
1. Moore, Brooke N., et al. *Critical thinking*. Dubuque: McGraw-Hill Companies, Inc, 2015, Ch1-4.
2. Dewey, John. *How we think*. Mineola, N.Y: Dover Publications, 1997, 68-14.

Additional Resources:

1. Watson, Jamie C. *Critical thinking : an introduction to reasoning well*. London/New York: Bloomsbury Academic, an imprint of Bloomsbury Publishing Plc, 2015.
2. Kallet, Mike. *Think smarter : critical thinking to improve problem-solving and decision-making skills*. Hoboken, New Jersey: Wiley, 2014.
3. Bloom, Benjamin S., David R. Krathwohl, and Bertram B. Masia. *Taxonomy of educational objectives : the classification of educational goals*. New York: David McKay Company, 1956.

Teaching Learning Process

With the class room teaching for basic conceptual clarity the whole syllabus should be based on **case studies** from all walk of life, like social, economical, political, religious, gender,


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environment, global perspective as well as the surrounding local issues. **Project works** need to be encouraged Audio visuals should also encouraged with projector for direct interactive sessions and peer understanding. **Logic games, e-learning methods, theme based movies and mock tests** may be conducted for better understanding and better application of the skill.

Lecture & Tutorials are essential

Assessment Methods

Same as university rule of 75% exam and 25% of internal assessment.
Presentations based on case history and creative modules should be the evaluative procedure.
Peer evaluation should be encouraged.
Objective questions to test reasoning skill should be encouraged.

Keywords

Beliefs, Claims, Arguments, Analysis and evaluation, Cognitive bias, Fallacy.

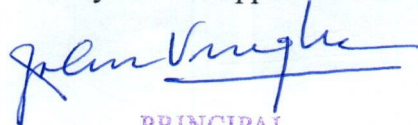
Feminism (GE (3)) Generic Elective - (GE) Credit:6

Course Objectives:

A course in Feminism is needed to sensitise students to a perspective of thought that acts as a filter—a lens through which all subjects must be studied. It seeks to create gender sensitization and develops a wholistic approach towards education. This course addresses the concerns of women in terms of debates on consciousness and soul, analyses their connect with nature and culture; and explains the development of feminist ideologies.

Course Learning Outcomes:

Study of Feminism arms the student with analytical skills to develop valid arguments to counter gender discrimination, sexism and patriarchal dominance. Feminist theory has a social agenda i.e. to initiate transformation in social structures, customs and practices. Thus the study of Feminism is not only an empowering tool against gender oppression but also against other systems of oppression such as race, class and colour.


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- Jetli & Prabhakar. *Logic*. India: Pearson, 2012.
-

Teaching Learning Process

The paper will be taught by way of lectures and doing problems on the blackboard with justifications and encouraging students to practice exercises after completion of each chapter in their tutorial classes.

Assessment Methods

Internal assessment for 25 marks out of which 10 marks for class test, 10 marks for project/group discussion/ assignment and 5 marks for attendance.

75 marks for University Examination.

Keywords

Logical Connectives, Truth Tables, Truth Functions, Variable and Constants, Truth Trees, Formal Proof, Quantification

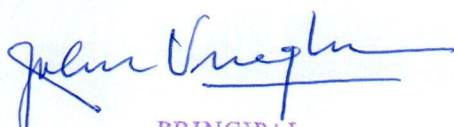
Art & Film Appreciation

(SEC (2))

Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

- The objective of the course is to enable a student to become an active and engaging viewer of art and cinema .
- To discern the aesthetic experience as different from art experience
- To enable a student to understand and appreciate films and other related art forms


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Course Learning Outcomes

It is a skill to develop and enhance philosophical analysis and contextualizing in terms of Rasa ,empathy and disinterestedness.

Unit 1 Art and Experience

1. Meaning and Analysis

References

Satre, J.P, "The Work of Art" in Aesthetics, Harold Osborne,(London: Oxford University Press, 1972).

Hospers, John (1969) *Introduction Readings in Aesthetics*, Free Press.

Gupta, Shamala. *Art, Beauty and creativity*. (DK Printworld New Delhi 1999).

Hiyanna, M. (1997) Art Experience, Indira Gandhi National Centre for the Arts Manohar. Chapter-1.

UNIT II: Film as an Art Form

Documentaries, Commercial, Parallel Cinema, Web series as new cinematic art form.

References

Christopher, Falzon, *Philosophy goes to the Movies*, Routledge.

Vijaya, Mishra. (2009) *Specters of Sensibility: The Bollywood Film*. Routledge.

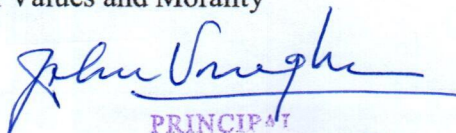
Arnheim, Rudolf, Film as Art, "Film and Reality" University of California Press.

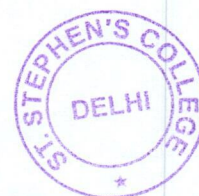
https://www.academia.edu/37948527/.The_Aesthetics_of_Digital_Art.pdf

<https://thirdcinema.wordpress.com/2015/10/27/indias-parallel-cinema/>

https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/Parallel_cinema.html

UNIT III: Art, Social Values and Morality


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1. Life art interface
2. Film and Cultural representation

References

Gupta, Shyamala. *Art, Beauty and creativity*. (DK Printworld New Delhi 1999).
Hiriyanna, M. *Art Experience*, Indira Gandhi National Centre for the Arts, Manohar.: Delhi, 1997, Chapter-7.
Clark, Kenneth. *The Nude: A Study in Ideal Form*. (Bollingen Series 35.2. New York: Pantheon Books, 1956).

Unit 4

UNIT IV: Art and Communication in and through Films

References

<https://thirdcinema.wordpress.com/2015/10/27/indias-parallel-cinema/>

https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/Parallel_cinema.html

Unit 5

References

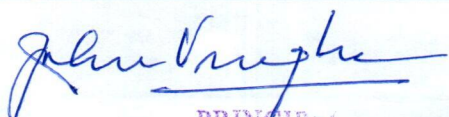
Recommended Readings

- Harold, Osborne (1976) *Aesthetics*, OUP.
- Hospers, John (1969) *Introduction Readings in Aesthetics*, Free Press.
- Christopher, Falzon, *Philosophy goes to the Movies*, Routledge.
- Vijaya, Mishra. (2009) *Specters of Sensibility: The Bollywood Film*. Routledge.
- Sussane Langer. (1953) *Feeling and Form*, Longman Publishing House.
- Arnheim, Rudolf, *Film as Art, "Film and Reality"* University of California Press

Additional Resources:

<https://thirdcinema.wordpress.com/2015/10/27/indias-parallel-cinema/>

https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/Parallel_cinema.html


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Teaching Learning Process

Lectures, Group Discussion, Film Screening and visit to Art Gallery

Assessment Methods

Internal Assessment by assignments and Test

Keywords

Rasa, disinterestedness, Coffee house cinema, commercial cinema, documentary, web series

**Bio-Ethics
(GE (5))
Generic Elective - (GE) Credit:6**

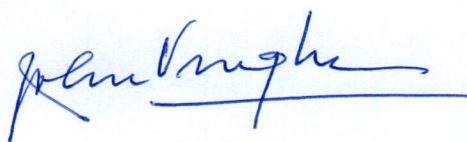
Course Objective(2-3)

Aim:

The course aims at ethical analysis of the topics within the realm of bio-medical sciences and legal studies.

Learning Outcome:

It is a career-oriented curriculum which enables students to develop competence in policy making and participation in ethics committee of various medical and care institutes. It sensitizes the minds towards the ongoing ethical dilemmas.



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AEEC-2
Reading skills in Brāhmī Scripts
(12133902)

Max. Marks : (75+ 25 = 100)

Credits : Lectures 24+ Tutorials 12

[A] Course Objectives:

Course of Epigraphy & script is an inter-disciplinary course within Sanskrit. The Brahmi script used in Indian inscriptions was developed into all modern Indian scripts like Tamil, Malayalam, Oriya, Bangali, Gurmukhi, among others. Study of inscriptions written mostly in Sanskrit languages, helps in preparation of ancient history.

It will provide introduction to the earlier forms of the Brahmi script, found in the Ashokan epigraphs, widely used all over India. Writing style, writing material and method of writing which led to variations and transformation in the Brahmi script will be studied to help students to interpret the causes that paved way to changes in it in different times and places. Students will acquaint with earlier examples of variations in the Brahmi script which developed into modern Indian scripts. More-over most of the South-East Asian countries also have a clear impact of the developed form of the Brahmi script, especially of the Grantha form of it.

[B] Course Learning Outcomes:

This course is helpful for students to investigate how actually Brahmi script developed and transformed into a wide variety at a time when mode and means of transport and communication were extremely slow. After acquiring knowledge of its variation, it will certainly be helpful in ascertaining to understand period of an inscription whose date is uncertain. This course is highly helpful for the students willing to adopt archaeology as their occupation with a background of Sanskrit.

[C] Contents:

Unit: I

Credits:04

Early Brāhmī alphabet - Aśokan period

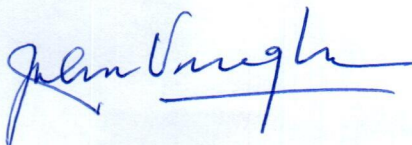
Unit: II

Credits : 04

Translation to variations - upto 4th century C.E.

Unit: III

Credits : 04


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North Indian

Unit: IV

Credits : 04

South Indian

Unit: V

Credits: 04

East Indian

Unit: VI

Credits : 04

West Indian, Vakatak Variety

[D] Suggested Books/Readings:

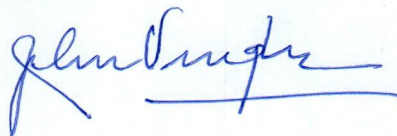
1. Dani, A.H. : Indian Paleography, 1963
2. Upasak, C.S. : History & Paleography of Mauryan Brāhmī Script, 1960
3. Verma, T.P. : Paleography of Brāhmī script in North India, 1971
4. ओझा, गौ. ही. : भारतीय प्राचीन लिपिमाला
5. पाण्डेय, राजबली : अशोक के अभिलेख, 1967

[E] Teaching Learning Process

1. Teachers are supposed to illustrate variations of the Brahmi script through different charts. These charts are easily available in the books written by Buhler and G.H.Ojha. Students should be taken to the museums, as such charts are available there.
2. The kutila variety may also be introduced to the students as it paved way for different styles especially in North India.
3. A variety of approaches to teaching-learning process, including lectures, seminars, tutorials, workshops, peer teaching and learning, practicum and project-based learning, field-based learning in this course. Problem-solving skills and higher-order skills of reasoning and analysis will be encouraged through teaching strategies. Lecture based Teaching Learning on the Sanskrit literature will be covered in this course.

[F] Weekly Plan

Week 1 – Unit 1
Week 2 – Unit 1
Week 3 – Unit 2
Week 4 – Unit 2
Week 5 – Unit 3



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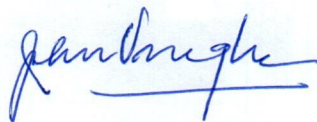
Week 6 – Unit 3
 Week 7 – Unit 4
 Week 8 – Unit 4
 Week 9 – Unit 5
 Week 10 – Unit 5
 Week 11 – Unit 6
 Week 12 – Unit 6

[G] Assessment :

II.	Basic Structure of Question Paper & Division of Marks	75
i	Long Questions -03 (All Units)	03x 10 = 30
ii.	Short notes- 05(All Units)	05 x 5 = 25
iii.	Short Answer Type Questions -13(Limit1-2Lines) (from all Units)	13x 1 = 13
iv.	Sanskrit Question-1	7
II	Internal Assessment (Project/Discussion/Assignment/ paper presentation/ Periodic tests etc.)	25

[H] Keywords :

sign, symbol, pictograph, ideo-pictography, hieroglyphics, boustrophen script. etc.


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AEEC-4
Evolution of Indian scripts
(12133904)

Max. Marks : (75+ 25 = 100)

Credits : Lectures 24 + Tutorials 12

[A] Course Objectives:

This course aims to acquaint students with the myth that Indians lacked knowledge of writing in ancient period. Available sources suggest that writing was mostly practiced on perishable material, so limited evidences are available to prove that practice of writing in India was widely known. Despite that Indians had relation with foreign countries there was a sleek chance that they borrowed any scripts from them.

A script develops from various types of symbols used to express writing. Indus valley script, a picto-ideographic script may have been developed as a grammatically perfect script in India. This section suggests to undergo research in linking proto Indian & ancient Indian Brahmi and Kharoshthi scripts.

Impact of time and space led the Brahmi to undergo variations. Their causes in changes in writing will be studied.

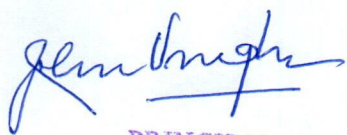
[B] Course Learning Outcomes:

Students willing to engage in archaeology can be enlightened about the importance and background of written material and utilize it in future.

Study of scripts are useful to evaluate and understand believes of prevailing contemporary multiple contents. After undergoing this course Students will be able utilize relevant information to develop capability to fix a date of an unknown writing, incidents, etc., with co-relating it to the available similar writing, and somewhat continuing incidents. Thus, it becomes helpful and useful for the students who are interested in pursuing advance study in archaeology.

[C] Contents:

Introduction to script		
Unit: I	• Antiquity of writing in India • Sign & symbols - pre-scripts	Credit : 06
Unit: II	• Early Brāhmī and Kharoshthi Scripts	Credits : 04
Unit: III	• Indus Valley script - Introduction	Credits : 04
Unit: IV	Types/Kinds of the Brāhmī script by 400 A.D.	Credits : 02


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Unit: V

- Transition to early modern Indian scripts
- Causes of variation in the Brāhmī script

Credits: 04**Credits : 04****[D] Suggested Books/Readings:****Compulsory Reading:**

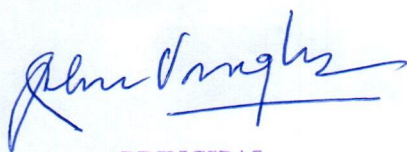
1. Buhler, G. : Indian Paleography, 1959
i. : On the origin of the Indian alphabet & numerals
2. Burnell, A.C. : Elements of South Indian Paleography, 1878.
3. Dani, A.H. : Indian Paleography, 1963
4. Verma, T.P. : Paleography of Brāhmī script in North India, 1971.

Additional Resources:.

1. गौ .ही .ओझा : भारतीय प्राचीन लिपिमाला
2. राजबली पाण्डेय : अशोक के अभिलेख, 1967
3. Diringer, David : The Alphabet (Reprint) 1962
4. Gelb, I. J. : A study of writing, 1963
5. Sircar, D.C. : Indian Epigraphy, 1965
6. Upasak, C.S. : History & Paleography of Mauryan Brāhmī script, 1960

[E] Teaching Learning Process

1. A variety of approaches to teaching-learning process, including lectures, seminars, tutorials, workshops, peer learning ,Group discussion, paper presentation, practicum and project-based learning, field-based learning in this course.
2. Visits to the museums for direct interaction with the script through charts will also be useful.
3. Teachers should explain terminology used and or related to the inscriptions. Merely translating language is unjust to the students and the subject. It is more useful to take students to the historically important sites, especially related to the inscriptions under-study.


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[F] Weekly Plan

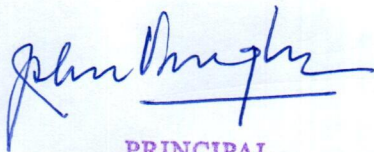
Week 1 – Unit 1
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 Week 4 – Unit 2
 Week 5 – Unit 3
 Week 6 – Unit 3
 Week 7 – Unit 4
 Week 8 – Unit 4
 Week 9 – Unit 5
 Week 10 – Unit 5
 Week 11 – Unit 6
 Week 12 – Unit 6

[G] Assessment :

I.	Basic Structure of Question Paper & Division of Marks	75
i	Long Questions -03 (All Units)	03x 10 = 30
ii.	Short notes- 05(All Units)	05 x 5 = 25
iii.	Short Answer Type Questions -13(Limit1-2Lines) (from all Units)	13x 1 = 13
iv.	Sanskrit Question-1	7
II	Internal Assessment (Project/Discussion/Assignment/ paper presentation/ Periodic tests etc.)	25

[H] Keywords :

Bāṇa, Kadambari, Śukanāsopadeśa, Daṇḍin, Dashakumarcharit, Viśrutacaritam, Subandhu, Ambikādatta, Hitopadeśa, Vetālapañcaviṃśatikā, Śimhāsanadvātrimśikā, Puruṣaparīkṣā, Śukasaptati etc.

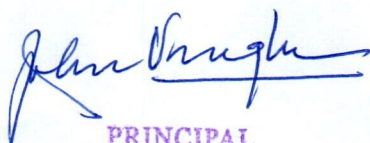

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B.Sc.(H) Chemistry

CC II Physical Chemistry - I States of Matter & Ionic Equilibrium

This paper involve study of three major states of matter i.e. solid, liquid and gas. Practical component of this paper involves surface tension measurements using Stalagmometer, viscosity measurement using Ostwald's viscometer and pHmetric titration. Students did projects in group of 3-4 students where they performed some activities using materials available at home and explain many concepts which we experience in daily life.


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3. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J.(1994),**Concepts and Models of Inorganic Chemistry**, John Wiley & Sons.
4. 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.

Practicals:

1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989),**Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.

Additional Resources:

1. Wulfsberg, G (2002),**Inorganic Chemistry**, Viva Books Private Limited.
2. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014),**Inorganic Chemistry**, 5th Edition, Pearson.

Teaching Learning Process:

- Conventional chalk and board teaching,
- Class interactions and discussions
- Power point presentation on important topics.

Assessment Methods:

- Presentations by Individual Student/ Group of Students
- Class Tests at Periodic Intervals.
- Written assignment(s)
- End semester University Theory and Practical Examination

Keywords:

Atomic Structure, Wave function, Quantum Numbers, Electronegativity, Ionic Bonding, Dipole Moment, VSEPR Theory, Covalent Bonding, Multiple Bonding, Molecular Orbitals, Bonding MO, Antibonding MO, Homonuclear, Heteronuclear, Metallic Bonding, Weak Chemical Forces.

Course Code: CHEMISTRY - C II: PHYSICAL CHEMISTRY - I

Course Title: States of Matter & Ionic Equilibrium

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

- To develop basic and advance concepts regarding the three states of matter.
- To derive the expressions for determining the physical properties of gases, liquids and solids.

- To study the concept of ionization in aqueous solution, pH, buffers and various applications of ionization.

Learning Outcomes:

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

- Derive mathematical expressions for different properties of gas, liquid and solids and understand their physical significance.
- Explain the crystal structure and calculate related properties of cubic systems.
- Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt.
- Apply the concepts of gas equations, pH and electrolytes while studying other chemistry courses and ever day life.

Unit 1:

Gaseous state: Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η ; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z , and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. Equation of states for real gases; van der Waals equation of state, its derivation and application in explaining real gas behaviour, Virial coefficients, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

(Lectures: 22)

Unit 2:

Liquid state: Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

(Lectures: 6)

Unit 3:

Solid state: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.

(Lectures: 12)

Unit 4:

Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

(Lectures: 20)

Practical:

(Credits: 2, Laboratory periods: 60)

1. Surface tension measurements using Stalagmometer.

- Determine the surface tension of aqueous solutions by (i) drop number (ii) drop weight method.
- Study the variation of surface tension with different concentration of detergent solutions. Determine CMC.

2. Viscosity measurement using Ostwald's viscometer.

- Determination of co-efficient of viscosity of an unknown aqueous solution.
- Study the variation of co-efficient of viscosity with different concentration of Poly Vinyl Alcohol (PVA) and determine molar mass of PVA.
- Study the variation of viscosity with different concentration of sugar solutions.

3. Determination of molecular weight of a volatile compound using Victor Meyer's method.

4. Solid State:

- Indexing of a given powder diffraction pattern of a cubic crystalline system.

4. pH-metry:

- Study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures.
- Preparation of buffer solutions of different pH values
 - Sodium acetate-acetic acid
 - Ammonium chloride-ammonium hydroxide

- iii. pH metric titration of (i) strong acid with strong base, (ii) weak acid with strong base and determination of dissociation constant of a weak acid.

References:

Theory:

1. Atkins, P.W.; Paula, J.de. (2014), **Atkin's Physical Chemistry Ed.**, 10th Edition, Oxford University Press.
2. Ball, D. W. (2017), **Physical Chemistry**, 2nd Edition, Cengage Learning, India.
3. Castellan, G. W. (2004), **Physical Chemistry**, 4th Edition, Narosa.
4. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 1, 6th Edition, McGraw Hill Education.

Practical:

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

Additional Resources:

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

Teaching Learning Process:

- Teaching Learning Process for the course is visualized as largely student-focused.
- Transaction through an intelligent mix of conventional and modern methods.
- Engaging students in cooperative learning.
- Learning through quiz design.
- Problem solving to enhance comprehension.

Assessment Methods:

- Graded assignments
- Conventional class tests
- Class seminars by students on course topics with a view to strengthening the content through width and depth
- Quizzes
- End semester university examination.

Keywords:

States of matter, ideal/real gases, critical constants, viscosity, surface tension, symmetry, Crystal lattice/Systems, X-ray diffraction, Bragg's law, ionic equilibria, solubility product, pH, indicator.

CCXII: Physical Chemistry- Quantum Chemistry & Spectroscopy

This paper introduces basic concept of Quantum Chemistry and Spectroscopy to students which form basis for all the characterization techniques. Students did projects where either they synthesized new compound and took their UV-Visible spectra or they studied the known compound under different conditions (different pH, temperature) and study their UV spectrum


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Keywords:

Amino acids, peptides, proteins, solid phase peptide synthesis, Killiani-Fischer synthesis, Amadori rearrangement, Lobry de Bruyn van Ekenstein rearrangement, Krebs cycle, Glycolysis, Enzymes, Inhibitors.

Course Code: CHEMISTRY - CXII: PHYSICAL CHEMISTRY-V

Course Title: Quantum Chemistry & Spectroscopy

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The aim of this course is to make students understand the limitations of classical mechanics and the need of quantum chemistry, familiarize them with postulates of quantum chemistry and apply the same to derive equations for various models and hydrogen atoms. Understand the basis of molecular spectroscopy and its applications.

Learning Outcomes:

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

- Learn about limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems.
- Develop an understanding of quantum mechanical operators, quantization, probability distribution, uncertainty principle and application of quantization to spectroscopy.
- Interpret various types of spectra and know about their application in structure elucidation

Unit 1:

Quantum Chemistry: Postulates of quantum mechanics, quantum mechanical operators and commutation rules, Schrödinger equation and its application to free particle and particle in a box (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy.

Angular momentum. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation in Cartesian and spherical polar coordinates (derivation not required). Separation of variables. Spherical harmonics. Discussion of solution (Qualitative).

(Lectures: 22)



Unit 2:

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part and quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

(Lectures: 8)

Unit 3:

Molecular Spectroscopy: Interaction of electromagnetic radiation with molecules and various types of spectra; Born Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies.

Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales (δ and τ), spin-spin coupling and high resolution spectra, interpretation of PMR spectra of simple organic molecules like methanol, ethanol, acetaldehyde, acetic acid and aromatic proton.

(Lectures:30)

Practical:

(Credits: 2, Laboratory periods: 60)

Colorimetry:

1. Verify Lambert-Beer's law and determine the concentration of $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ in a solution of unknown concentration.
2. Determine the concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in a mixture.
3. Study the kinetics of iodination of propanone in acidic medium.

4. Determine the amount of iron present in a sample using 1, 10-phenanthroline.
5. Determine the dissociation constant of an indicator (phenolphthalein).
6. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.

Spectrophotometry:

1. Study the 200-500 nm absorbance spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (kJ molecule^{-1} , kJ mol^{-1} , cm^{-1} , eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $\text{K}_2\text{Cr}_2\text{O}_7$.
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. Analysis of the given vibration-rotation spectrum of HCl (g)

References:

Theory:

1. Banwell, C.N.; McCash, E.M.(2006), **Fundamentals of Molecular Spectroscopy**, Tata McGraw-Hill.
2. Kapoor, K.L.(2015), **A Textbook of Physical Chemistry**, McGraw Hill Education, ,Vol 4, 5th Edition, McGraw Hill Education.
3. House, J.E.(2004), **Fundamentals of Quantum Chemistry**, 2nd Edition, Elsevier.
4. McQuarrie, D.A.(2016), **Quantum Chemistry**, Viva Books.
5. Chandra, A. K.(2001), **Introductory Quantum Chemistry**, Tata McGraw-Hill.
6. Kakkar, R. (2015), **Atomic & Molecular Spectroscopy**, Cambridge University Press.

Practical:

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

Additional Resources:

1. Engel, T.; Reid, P.(2013), **Quantum Chemistry and Spectroscopy**, Pearson.
2. Atkins, P.W.; Friedman, R. (2010), **Molecular Quantum Mechanics**, 5th Edition, Oxford University Press.

Teaching Learning Process:

- Teaching Learning Process for the course is visualized as largely student-focused.
- Transaction through an intelligent mix of conventional and modern methods.

- Engaging students in cooperative learning.
- Learning through quiz design.
- Problem solving to enhance comprehension.

Assessment Methods:

Students' evaluation will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Quantum mechanics, Operators, Schrodinger equation, Hydrogen like atoms, Approximation methods, Spectroscopy, Franck-Codon principle, Raman effect.

SEMESTER VI

Course Code: CHEMISTRY - CXIII: INORGANIC CHEMISTRY - IV

Course Title: Organometallic Chemistry & Bio-inorganic Chemistry

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The course introduces some important topics of Inorganic Chemistry in a compact way. Unit 1 of the course introduces students to the basic principles of qualitative inorganic analysis. The influence of solubility products and the common ion effect on the separation of cations is made clear. Interfering anions are identified and their removal is studied. Unit 2, an introduction to the very important area of organometallic chemistry including classification of organometallic compounds, the concept of hapticity and the 18-electron rule governing the stability of a wide variety of organometallic species. Specific organometallic compounds are studied in detail to further understand the basic concepts: metal carbonyls, metal alkyls, Zeise's salt and ferrocene. Unit 4 takes this a step further by covering catalysis, an important application of organometallic compounds. Under Unit 3, bioinorganic chemistry, the student learns the importance of inorganic chemical species, especially metals, in biological systems, through discussions on metal-containing enzymes, the sodium-potassium pump and the applications of iron in physiology, including iron transport and storage system.

Learning Outcomes:

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

- Understand and explain the basic principles of qualitative inorganic analysis

Assessment Methods:

- Graded assignments
- Conventional class tests
- Class seminars by students on course topics with a view to strengthening the content through width and depth
- Quizzes
- End semester university examination.

Keywords:

Green Chemistry, Twelve principles, Sustainable chemistry, Green energy, Marine antifoulant, Non toxic pigments.

Course Code: CHEMISTRY –SEC-9

Course Title: Pharmaceutical Chemistry

Total Credits: 04

(Credits: Theory-02, Practical-02)

(Total Lectures: Theory- 30, Practical-60)

Objectives:

The objective of this paper is to develop basic understanding of drugs discovery, design, development and their side effects. The course will cover synthesis of major drug classes including-analgesics, antipyretics, anti- inflammatory agents, antibacterial and antifungal agents, antiviral agents, central nervous system agents and drugs for HIV--AIDS. An overview of fermentation process and production of certain dietary supplements and certain common antibiotics will be discussed.

Learning Outcomes:

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

- Gain insight into retro-synthesis approach in relation to drug design and drug discovery.
- Learn synthetic pathways of major drug classes.
- Understand the fermentation process and production of ethanol, citric acids, antibiotics and some classes of vitamins.

Unit 1:

Introduction

Drug discovery, design and development: Sources of drugs: biological, marine, minerals and plant tissue culture, physio-chemical aspects (optical, geometric and bioisosterism) of drug molecules and biological action, drug receptor interaction, basic retro-synthetic approach for development of drug. Cause of side effect of drugs like ibuprofen, cetirizine, thalidomide. Difference between drug and poison.

(Lectures: 7)

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Unit 2:

Drugs and Pharmaceuticals

Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin and natural colours

Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazole, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), central nervous system agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antileprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

(Lectures:15)

Unit 3:

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B₂, Vitamin B₁₂ and Vitamin C.

(Lectures: 8)

Practical:

(Credits: 2, Laboratory periods: 60)

Chemistry Lab: Pharmaceutical chemistry

1. Preparation of aspirin and its analysis.
2. Preparation of paracetamol and its analysis.
3. Preparation of sulphacetamide of sulphonamide and its analysis.
4. Determination of alcohol contents in liquid drugs/galenical.
5. Determination of ascorbic acid in vitamin C tablets by iodometric or coulometric titrations.
6. Synthesis of ibuprofen.
7. Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry.

References:

Theory:

1. Patrick, G. (2017), **Introduction to Medicinal Chemistry**, Oxford University Press.
2. Singh H.; Kapoor V.K. (1996), **Medicinal and Pharmaceutical Chemistry**, Vallabh Prakashan.
3. Foye, W.O.; Lemke, T. L.; William, D.A. (1995), **Principles of Medicinal Chemistry**, B.I. Waverly Pvt. Ltd.

Practical:

1. Kjonaas, R.A.; Williams, P.E.; Counce, D.A.; Crawley, L.R. **Synthesis of Ibuprofen**. J. Chem. Educ., 2011, 88 (6), pp 825–828 DOI: 10.1021/ed100892p.
2. Marsh, D.G.; Jacobs, D.L.; Veening, H. **Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry**. J. Chem. Educ., 1973, 50 (9), p 626. DOI: 10.1021/ed050p626

Teaching Learning Process:

The teaching learning process will involve the traditional chalk and black board method. Certain topics like retro-synthetic approach and fermentation processes are taught through audio-visual aids. Students are encouraged to participate actively in the classroom through regular presentations on curriculum based topics.

Assessment Methods:

Assessment will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Retro-synthesis, Drug discovery, Design and synthesis, Side effects, Fermentation.

Course Code: CHEMISTRY –SEC-10

Course Title: Chemistry of Cosmetics and Perfumes

Total Credits: 04

(Credits: Theory-02, Practical-02)

(Total Lectures: Theory- 30, Practical-60)

Objectives:

Cosmetic plays an important role in our everyday lives as they make an individual's appearance more attractive and boost one's self-esteem and confidence. Keeping in view the tremendous potential which the cosmetic industry has today around the globe, this course will be useful for introducing students of Chemistry honours to the world of cosmetic chemistry. This has been designed to impart the theoretical and practical knowledge on basic principles of cosmetic chemistry, manufacture, formulation of various cosmetic products.

Learning outcomes:

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

- Learn basic of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products.
- Learn the use of safe, economic and body-friendly cosmetics
- Prepare new innovative formulations.

Practical:

1. Kjonaas, R.A.; Williams, P.E.; Counce, D.A.; Crawley, L.R. **Synthesis of Ibuprofen**. J. Chem. Educ., 2011, 88 (6), pp 825–828 DOI: 10.1021/ed100892p.
2. Marsh, D.G.; Jacobs, D.L.; Veening, H. **Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry**. J. Chem. Educ., 1973, 50 (9), p 626. DOI: 10.1021/ed050p626

Teaching Learning Process:

The teaching learning process will involve the traditional chalk and black board method. Certain topics like retro-synthetic approach and fermentation processes are taught through audio-visual aids. Students are encouraged to participate actively in the classroom through regular presentations on curriculum based topics.

Assessment Methods:

Assessment will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Retro-synthesis, Drug discovery, Design and synthesis, Side effects, Fermentation.

Course Code: CHEMISTRY –SEC-10

Course Title: Chemistry of Cosmetics and Perfumes

Total Credits: 04

(Credits: Theory-02, Practical-02)

(Total Lectures: Theory- 30, Practical-60)

Objectives:

Cosmetic plays an important role in our everyday lives as they make an individual's appearance more attractive and boost one's self-esteem and confidence. Keeping in view the tremendous potential which the cosmetic industry has today around the globe, this course will be useful for introducing students of Chemistry honours to the world of cosmetic chemistry. This has been designed to impart the theoretical and practical knowledge on basic principles of cosmetic chemistry, manufacture, formulation of various cosmetic products.

Learning outcomes:

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

- Learn basic of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products.
- Learn the use of safe, economic and body-friendly cosmetics
- Prepare new innovative formulations.

Unit 1:

Cosmetics- Definition, History, Classification, Ingredients, Nomenclature, Regulations.

(Lectures: 4)

Unit 2:

Face Preparation: Structure of skin, Face powder, Compact powder, Talcum powder.

(Lectures: 6)

Unit 3:

Skin Preparation: Face cream, vanishing cream, cold cream, suntan cream, lather shaving cream

(Lectures: 5)

Unit 4:

Hair preparation: Structure of hair, classification of hair, Hair dye- classification – temporary, semi-permanent, demi permanent, permanent, formulation, hair sprays, shampoo- types of shampoo, conditioners

(Lectures: 6)

Unit 5:

Colored preparation: Nail preparation Structure of nail, Nail lacquers, Nail polish remover Lipsticks

(Lectures: 4)

Unit 6:

Personal hygiene products: Antiperspirants and deodorants, oral hygiene products, flavours and essential oils

(Lectures: 5)

Practical:

(Credits: 02, Laboratory periods: 60)

Preparation of:

1. Talcum powder.
2. Shampoo.

3. Enamels.
4. Face cream.
5. Nail polish and nail polish remover.
6. Hand wash
7. Hand sanitizer
8. Body lotion
9. Soap
10. Tooth powder
11. Tooth paste

References:

1. Barel, A.O.; Paye, M.; Maibach, H.I.(2014),**Handbook of Cosmetic Science and Technology**, CRC Press.
2. Garud, A.; Sharma, P.K.; Garud, N. (2012),**Text Book of Cosmetics**, Pragati Prakashan.
3. Gupta, P.K.; Gupta, S.K.(2011),**Pharmaceutics and Cosmetics**, Pragati Prakashan
4. Butler, H. (2000),**Poucher's Perfumes, Cosmetic and Soap**, Springer
5. Kumari, R.(2018),**Chemistry of Cosmetics**, Prestige Publisher.

Additional Resources:

1. Flick, E.W.(1990),**Cosmetic and toiletry formulations**, Noyes Publications / William Andrew Publishing.
2. Natural Ingredients for Cosmetics; EU Survey 2005
3. Formulation Guide for cosmetics; The Nissin OilliO Group, Ltd.
4. Functional Ingredients & Formulated Products for Cosmetics & Pharmaceuticals; NOF Corporation

Teaching Learning Process:

- Conventional chalk and board teaching with power point presentation, you tube videos. and presentations from students on relevant topics.
- Theory coupled with preparation of cosmetic products in lab.

Assessment Methods:

Internal assessment through assignments and class test. End semester written and practical examination.

Keywords:

Cosmetic Products, Ingredients, Formulations, Raw materials, Lab. preparation, Ideal characteristics

- Quizzes
- End semester university examination.

Keywords:

Chemical Technology; Society; Energy; Polymer; Pollutants.

Course Code: CHEMISTRY –SEC-4

Course Title: Chemoinformatics

Total Credits: 04

(Credits: Theory-02, Practicals-02)

(Total Lectures: Theory- 30, Practicals-60)

Objectives:

The aim of the course is to introduce the students to computational drug design through structure-activity relationship, QSAR and combinatorial chemistry. The students will learn about the target analysis, virtual screening for lead discovery, structure based and ligand based design method and the use of computational techniques, library preparation and data handling.

Learning Outcomes:

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

- Have a comprehensive understanding of drug discovery process and techniques including structure-activity relationship, quantitative structure activity relationship and the use of chemoinformatics in this, including molecular modelling and docking studies.
- Appreciate role of modern computation techniques in the drug discovery process and perform their own modelling studies.

Unit 1:

Introduction to Chemoinformatics: History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular modelling and structure elucidation.

(Lectures: 2)

Unit 2:

Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification.

(Lectures: 2)

Unit 3:

Searching chemical structures: Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.

(Lectures: 6)

Unit 4:

Applications: Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity.

(Lectures: 6)

Unit 5:

Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra; Computer Assisted Structure elucidations; Computer Assisted Synthesis Design

(Lectures: 6)

Unit 6:

Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Chemoinformatics in Drug Design.

(Lectures: 8)

Practical:

(Credits: 2, Laboratory periods: 60)

1. Overview of Rational Drug Design, Ligands and Targets
2. In silico representation of chemical information
 - i. CIF IUCr Crystallographic Information Framework
 - ii. CML Chemical Markup Language
 - iii. SMILES -- Simplified Molecular Input Line Entry Specification
 - iv. InChi -- IUPAC International Chemical Identifier
 - v. Other representations
3. Chemical Databases and Data Mining
 - i. Cambridge Structural Database CCDC CSD
 - ii. Crystallographic Open Database COD
 - iii. Protein Data Bank PDB Ligand Explorer
 - iv. Chemspider
 - v. Other Data Bases

4. Molecular Drawing and Interactive Visualization

- i. ChemDraw
- ii. MarvinSketch
- iii. ORTEP
- iv. Chimera, RasMol, PyMol

5. Computer-Aided Drug Design Tools

- i. Molecular Modeling Tools
- ii. Structural Homology Modeling Tools
- iii. Docking Tools and Screening Tools
- iv. Other tools

6. Building a Ligand

- i. Building ab initio
- ii. Building from similar ligands
- iii. Building with a known macromolecular target
- iv. Building without a known macromolecular target
- v. Computational assessment of activity and toxicity and drugability.

References:

1. Leach, A. R.; Gillet, V. J. (2007), **An introduction to Chemoinformatics**, Springer.
2. Gasteiger, J.; Engel, T. (2003), **Chemoinformatics: A text-book**. Wiley-VCH.
3. Gupta, S. P. (2011), **QSAR & Molecular Modeling**. Anamaya Pub.
4. Gasteiger, J. **Handbook of cheminformatics: from data to knowledge in 4 volumes**, Wiley.

Additional Resources:

1. Jürgen, B. (2004), **Chemoinformatics Concepts, Methods, and Tools for Drug Discovery**, Springer

Teaching Learning Process:

The course aims to introduce students to different cheminformatics methods and its use in drug research through practicals. It is a rather new discipline of science. It concerns with the applications of computer to solving the chemistry problems related to drug designing and drug discovery.

The course will give emphasis on active learning in students through a combination of lectures, tutorials and practical sessions. The underlying principles will be explained in lectures and the practicals will establish the understanding of these principles through applications to drug research.

Assessment Methods:

- Formative assessment supporting student learning in Cheminformatics practicals
- Summative assessment
- Review of a case study
- Exercise based on SAR and QSAR-Report
- Practical exam of five hours

Assessment Methods:

Students' evaluation will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Solid State Chemistry, Nanomaterials, Solid electrolyte, Inorganic Pigments, Self-assembled, Composite Materials, Instrumentation, Polymers.

Course Code: CHEMISTRY –DSE-2

Course Title: Inorganic Materials of Industrial Importance

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The course introduces learners to the diverse roles of inorganic materials in the industry. It gives an insight into how these raw materials are converted into products used in day to day life. Students learn about silicates, fertilizers, surface coatings, batteries, engineering materials for mechanical construction as well as the emerging area of nano-sized materials. The course helps develop the interest of students in the frontier areas of inorganic and material chemistry.

Learning Outcomes:

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

- Learn the composition and applications of the different kinds of glass.
- Understand glazing of ceramics and the factors affecting their porosity.
- Give the composition of cement and discuss the mechanism of setting of cement.
- Explain the suitability of fertilizers for different kinds of crops and soil.
- Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings.
- Explain the principle, working and applications of different batteries.
- List and explain the properties of engineering materials for mechanical construction used in day to day life.
- Explain the synthesis and properties of nano-dimensional materials, various semiconductor and superconductor oxides.

Unit 1:

Silicate Industries

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead



glass, armoured glass, different types of safety glass, borosilicate glass, fluorosilicate glass, coloured glass, photosensitive glass, photochromic glass, glass wool and optical fibre.

Ceramics: Brief introduction to types of ceramics. glazing of ceramics.

Cement: Manufacture of Portland cement and the setting process, Different types of cements: quick setting cements, eco-friendly cement (slag cement), pozzolana cement.

(Lectures: 10)

Unit 2:

Fertilizers:

Different types of fertilizers (N, P and K). Importance of fertilizers, chemistry involved in the manufacture of the following fertilizers: urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, superphosphate of lime, potassium chloride and potassium nitrate.

(Lectures: 10)

Unit 3:

Surface Coatings:

Brief introduction to and classification of surface coatings, paints and pigments: formulation, composition and related properties, pigment volume concentration (PVC) and critical pigment volume concentration (CPVC), fillers, thinners, enamels and emulsifying agents. Special paints: heat retardant, fire retardant, eco-friendly paints, plastic paints, water and oil paints. Preliminary methods for surface preparation, metallic coatings (electrolytic and electroless with reference to chrome plating and nickel plating), metal spraying and anodizing.

Contemporary surface coating methods like physical vapor deposition, chemical vapor deposition, galvanising, carburizing, sherardising, boriding, nitriding and cementation.

(Lectures: 18)

Unit 4:

Batteries:

Primary and secondary batteries, characteristics of an Ideal Battery, principle, working, applications and comparison of the following batteries: Pb- acid battery, Li-metal batteries, Li-ion batteries, Li-polymer batteries, solid state electrolyte batteries, fuel cells, solar cells and polymer cells.

(Lectures: 8)

Unit 5:

Engineering materials for mechanical construction:

Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, superalloys, thermoplastics, thermosets and composite materials.

(Lectures: 8)

Unit 6:

Nano dimensional materials

Introduction to zero, one and two-dimensional nanomaterial: Synthesis, properties and applications of fullerenes, carbon nanotubes, carbon fibres, semiconducting and superconducting oxides.

(Lectures: 6)

Practical:

(Credits: 2, Laboratory periods: 60)

Chemistry Lab: Inorganic materials of industrial importance

4. Detection of constituents of Ammonium Sulphate fertilizer (Ammonium and Sulphate ions) by qualitative analysis and determine its free acidity.
5. Detection of constituents of CAN fertilizer (Calcium, Ammonium and Nitrate ions) fertilizer and estimation of Calcium content.
6. Detection of constituents of Superphosphate fertilizer (Calcium and Phosphate ions) and estimation of phosphoric acid content.
7. Detection of constituents of Dolomite (Calcium, Magnesium and carbonate ions) and determination of composition of Dolomite (Complexometric titration).
8. Analysis of (Cu, Ni) in alloy or synthetic samples (Multiple methods involving Complexometry, Gravimetry and Spectrophotometry).
9. Analysis of (Cu, Zn) in alloy or synthetic samples (Multiple methods involving Iodometry, Complexometry and Potentiometry).
10. Synthesis of pure ZnO and Cu doped ZnO nanoparticles.
11. Synthesis of silver nanoparticles by green and chemical approach methods and its characterization using UV-visible spectrophotometer.

References:

Theory:

1. West, A. R. (2014), **Solid State Chemistry and Its Application**, Wiley

2. Smart, L. E.; Moore, E. A. (2012), **Solid State Chemistry An Introduction**, CRC Press Taylor & Francis.
3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A.(2010), **Shriver and Atkins Inorganic Chemistry**, W. H. Freeman and Company.
4. Kent, J. A. (ed) (1997), **Riegel's Handbook of Industrial Chemistry**, CBS Publishers, New Delhi.
5. Poole Jr.; Charles P.; Owens, Frank J.(2003), **Introduction to Nanotechnology**, John Wiley and Sons.

Practical:

1. Svehla, G.(1996), **Vogel's Qualitative Inorganic Analysis**, Prentice Hall.
2. Banewicz, J. J.; Kenner, C.T. **Determination of Calcium and Magnesium in Limestones and Dolomites**, Anal. Chem., 1952, 24 (7), 1186–1187.
3. Ghorbani, H. R.; Mehr, F.P.; Pazoki, H.; Rahmani B. M. **Synthesis of ZnO Nanoparticles by Precipitation Method**. Orient J Chem 2015;31(2).
4. Orbaek, W.; McHale, M.M.; Barron, A.R. **Synthesis and characterization of silver nanoparticles for an undergraduate laboratory**, J. Chem. Educ. 2015, 92, 339–344.

Additional Resources:

1. Kingery, W. D.; Bowen H. K.; Uhlmann, D. R. (1976), **Introduction to Ceramics**, Wiley Publishers, New Delhi.
2. Gopalan, R. Venkappayya, D.; Nagarajan, S. (2004), **Engineering Chemistry**, Vikas Publications.

Teaching Learning Process:

- Teaching Learning Process for the course is visualized as largely student-focused.
- Transaction through an intelligent mix of conventional and modern methods.
- Engaging students in cooperative learning.
- Learning through quiz design.
- Problem solving to enhance comprehension.

Assessment Methods:

Assessment will be done based on regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Silicates, Ceramics, Cement, Fertilizers, Surface Coatings, Batteries, Engineering materials for mechanical construction, Nano dimensional materials.

4. Levie, R. de.(2001),**How to use Excel in analytical chemistry and in general scientific data analysis**, Cambridge University Press.
5. Le, C.T.; Eberly, L.E. (2016),**Introductory Biostatistics**, Wiley.

Additional Resources:

1. **Chemical safety matters IUPAC – IPCS**, Cambridge University Press, 1992.
2. **OSU safety manual 1.01**.

Teaching Learning Process

Lecture with conventional teaching aids, presentations, invited talks on thrusting areas, group discussions, literature survey and lab visit.

Assessment Methods

- Internal assessment through assignments and class test.
- Writing review on identified research problem
- Poster presentation
- End semester university examination

Keywords

Review of research papers, writing research papers, citation, and Laboratory safety.

Course Code: CHEMISTRY –DSE-8

Course Title: Green Chemistry

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

Today's society is moving towards becoming more and more environmentally conscious. There is rising concern of environmental pollution, depleting resources, climate change, ozone depletion, heaps and heaps of landfills piling up, legislation which is getting stringent with strict environmental laws, rising cost of waste deposits and so on. We are faced with a challenge to work towards sustainable practices. Green chemistry has arisen from these concerns. It is not a new branch of chemistry but the way chemistry should be practiced. Innovations and applications of green chemistry in education has helped companies not only gain environmental benefits but at the same time achieve economic and societal goals also. This is possible because these undergraduate students are ultimate scientific community of tomorrow.

Learning Outcomes:

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

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- Understand the twelve principles of green chemistry and will build the basic understanding of toxicity, hazard and risk of chemical substances.
- Understand stoichiometric calculations and relate them to green chemistry metrics. They will learn about atom economy and how it is different from percentage yield.
- Learn to design safer chemical products and processes that are less toxic than current alternatives. Hence, they will understand the meaning of inherently safer design for accident prevention and the principle "what you don't have can't harm you".
- Understand benefits of use of catalyst and bio catalyst, use of renewable feed stock which helps in energy efficiency and protection of the environment, renewable energy sources, importance led reactions in various green solvents.
- Appreciate the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems. Thus the students are able to realise that chemistry can be used to solve rather than cause environmental problems.
- Green chemistry is a way to boost profits, increase productivity and ensure sustainability with absolute zero waste. Success stories and real world cases also motivate them to practice green chemistry. These days customers are demanding to know about a product: Is it green? Does it contribute to global warming? Was it made from non depletable resources? Students have many career opportunities as "green" is the path to success.

Unit 1:

Introduction to Green Chemistry

What is Green Chemistry? Some important environmental laws, pollution prevention Act of 1990, emergence of green chemistry, Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

(Lectures:5)

Unit 2:

Principles of Green Chemistry and Designing a Chemical synthesis

Twelve principles of Green Chemistry and their explanation with examples

Special emphasis on the following:

- Prevention of Waste/ by products; maximum incorporation of the materials used in the process into the final products, Environmental impact factor, waste or pollution prevention hierarchy
- Green metrics to assess greenness of a reaction, e.g. Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.
- Prevention/ minimization of hazardous/ toxic products reducing toxicity
- Risk = (function) hazard x exposure
- Designing safer chemicals with minimum toxicity yet has the ability to perform the desired functions
- Green solvents: super critical fluids with special reference to carbon dioxide, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, solvents obtained from renewable resources and how to compare greenness of solvents
- Energy requirements for reactions – alternative sources of energy: use of microwaves, ultrasonic energy and photochemical energy
- Selection of starting materials; should be renewable rather than depleting, Illustrate with few examples such as biodiesel and polymers from renewable resources (such as green plastic)
- Avoidance of unnecessary derivatization – careful use of blocking/protecting groups
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.

- Design for degradation: A product should not persist after the commercial function is over e.g. soaps and detergents, pesticides and polymers
- Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.
- 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.

(Lectures:25)

Unit 3:

Examples of Green Synthesis/ Reactions

- Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis).
- Green Reagents: Non-phosgene Isocyanate Synthesis, Selective Methylation using dimethylcarbonate.
- Microwave assisted solvent free synthesis of copper phthalocyanine
- Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid and Decarboxylation reaction
- Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)

(Lectures:10)

Unit 4:

Real world case studies based on the Presidential green chemistry awards of EPA

- Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solvents with CO₂ for precision cleaning and dry cleaning of garments.
- A new generation of environmentally advanced wood preservatives: Getting the chromium and Arsenic out of pressure treated wood.
- An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.
- Healthier Fats and oils by Green Chemistry: Enzymatic Inter esterification for production of No Trans-Fats and Oils.
- Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting.
- Using a naturally occurring protein to stimulate plant growth, improve crop quality, increase yields, and suppress disease.

(Lectures:10)

Unit 5:

Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimcry and green chemistry, Biomimetic, Multifunctional Reagents; mechanochemical and solvent free synthesis of inorganic complexes; co crystal controlled solid state synthesis (C²S³); Green chemistry in sustainable development.

(Lectures:10)

Practical:

(Credits: 2, Laboratory periods: 60)

Chemistry Lab- Green chemistry

Characterization by m. pt., U.V.-Visible spectroscopy, IR spectroscopy, and any other specific method should be done (wherever applicable).

Safer starting materials

1. Preparation and characterization of nanoparticles of gold using tea leaves/silver nanoparticles using plant extracts.

Using renewable resources

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).

Use of enzymes as catalysts

3. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

Alternative green solvents

4. Extraction of D-limonene from orange peel using liquid CO₂ prepared from dry ice.
5. Mechanochemical solvent free, solid-solid synthesis of azomethine using p- toluidine and o-vanillin/p-vanillin (various other combinations of primary amine and aldehyde can also be tried).

Alternative sources of energy

6. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).
7. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reducing waste

8. Designing and conducting an experiment by utilizing the products and by products obtained in above preparations which become waste otherwise if not used. This is done by critical thinking and literature survey.

Some representative examples:

- Use of nanoparticles as catalyst for a reaction
- Benzoin converted into Benzil and Benzil into Benzilic acid by a green method
- Use of azomethine for complex formation
- Rearrangement reaction from Benzopinacol to Benzopinacolone
- Conversion of byproduct of biodiesel to a useful product
- Students should be taught to do spot tests for qualitative inorganic analysis for cations and anions, and qualitative organic analysis for preliminary test and functional group analysis.

References:

Theory:

1. Anastas, P.T.; Warner, J.C.(1998), **Green Chemistry, Theory and Practice**, Oxford University Press.
2. Lancaster, M.(2016), **Green Chemistry An Introductory Text**. 2nd 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.(2001), **Introduction to Green Chemistry**, Marcel Dekker.
5. Alhuwalia, V. K.; Kidwai, M.R.(2005), **New Trends in Green chemistry**, Anamalaya Publishers.

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.(2006), **Introduction to organic Laboratory Technique- A Microscale approach**, 4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.
4. Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. Indu Tucker Sidhwani et al. University of Delhi, Journal of Undergraduate Research and Innovation, Volume 1, Issue 1, February 2015, ISSN: 2395-2334.
5. Sidhwani, Tucker I.; Chowdhury, S. Greener alternatives to Qualitative Analysis for Cations without H₂S and other sulfur containing compounds, J. Chem. Educ. 2008, 85, 1099.
6. Sidhwani, Tucker I.; Chowdhury, S. et al., DU Journal of Undergraduate Research and Innovation, 2016, Volume 2, Issue 2, 70-79.
7. Dhingra, S., ; Angrish, C. Qualitative organic analysis: An efficient, safer, and economical approach to preliminary tests and functional group analysis. *Journal of Chemical Education*, 2011, 88(5), 649-651.

Additional References:

1. Cann, M. C.; Umile, T.P. (2008), **Real world cases in Green chemistry** Vol 11, American chemical Society, Washington.
2. Benyus, J. (1997), **Innovations Inspired by nature**, Harper collins.
3. Garay, A. L.; Pichon, A.; James, S.L. Chem Soc Rev, 2007, 36, 846-855.

Teaching Learning Process:

- Conventional chalk and board teaching
- Power point presentations
- Interactive sessions
- Literature survey and critical thinking to design to improve a traditional reaction and problem solving
- Visit to a green chemistry lab
- Some motivating short movies in green chemistry especially in bio mimicry

Assessment Methods:

- Presentation by students
- Class Test
- Written Assignment
- End Semester University Theory and Practical Exams

Keywords:

Green chemistry, Twelve principles of green chemistry, Atom economy, Waste minimization, Green metric, Green solvents, Solvent free, Catalyst, Bio-catalyst, Renewable energy sources, Hazardous, Renewable feedstock, Ionic liquids, Supercritical fluids, Inherent safer design, Green synthesis, Co-crystal controlled solid state synthesis, Sustainable development, Presidential green chemistry awards.

Course Code: CHEMISTRY –DSE-9

Course Title: Industrial Chemicals and Environment

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The objective of this course is to make students aware about the concepts of different 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 understand:

- 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.
- Different industrial effluents and their treatment methods.
- Different sources of energy.
- Generation of nuclear waste and its disposal.
- Use of biocatalyst in chemical industries.

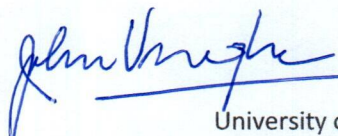
Unit 1:

Industrial Gases: Large scale production, uses storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, and sulphur dioxide.

(Lectures: 6)

Unit 2:

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Course Code: CHEMISTRY –DSE-4

Course Title: Analytical Methods in Chemistry

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The objective of this course is to make student aware of the concept of sampling, Accuracy, Precision, Statistical test data-F, Q and t test. The course exposes students to the laws of spectroscopy and selection rules governing the possible transitions in the different regions of the electromagnetic spectra. Thermal and electroanalytical methods of analysis are also dealt with. Students are exposed to important separation methods like solvent extraction and chromatography. The practicals expose students to latest instrumentation and they learn to detect analytes in a mixture.

Learning Outcomes:

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

- Perform experiment with accuracy and precision.
- Develop methods of analysis for different samples independently.
- Test contaminated water samples.
- Understand basic principle of instrument like Flame Photometer, UV-vis spectrophotometer.
- Learn separation of analytes by chromatography.
- Apply knowledge of geometrical isomers and keto-enol tautomers to analysis.
- Determine composition of soil.
- Estimate macronutrients using Flame photometry.

Unit 1:

Qualitative and quantitative aspects of analysis:

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression.

Normal law of distribution of indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

(Lectures: 5)

Unit 2:

Optical methods of analysis

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Transmittance. Absorbance and Beer-Lambert law

Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs). Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal, Techniques for the quantitative estimation of trace level of metal ions from water samples.

(Lectures: 25)

Unit 3:

Thermal methods of analysis:

Theory of thermogravimetry (TG) and basic principle of instrumentation of thermal analyser. Techniques for quantitative estimation of Ca and Mg from their mixture.

(Lectures: 5)

Unit 4:

Electroanalytical methods

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

(Lectures:10)

Unit 5:

Separation techniques

Solvent extraction: Classification, principle and efficiency of the technique.

Mechanism of extraction: extraction by solvation and chelation, Technique of extraction: batch, continuous and counter current extractions, Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique, Mechanism of separation: adsorption, partition & ion-exchange, Development of chromatograms: frontal, elution and displacement methods.

(Lectures:15)

Practical:

(Credits: 2, Laboratory periods: 60)

1. Separation of mixtures by paper chromatography and reporting the R_f values:
 - (i) Co^{2+} and Ni^{2+} .
 - (ii) Amino acids present in the given mixture.
2. Solvent Extractions
 - (i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+} DMG complex in chloroform, and determine its concentration by spectrophotometry.
3. Analysis of soil:
 - (i) Determination of pH of soil.
 - (ii) Total soluble salt
 - (iii) Estimation of calcium and magnesium
 - (iv) Qualitative detection of nitrate and phosphate
4. Ion exchange:
 - (i) Determination of exchange capacity of cation exchange resins and anion exchange resins.
 - (ii) Separation of amino acids from organic acids by ion exchange chromatography.
5. Spectrophotometry
 - (i) Verification of Lambert-Beer's law and determination of concentration of a coloured species (CuSO_4 , KMnO_4 , CoCl_2 , CoSO_4)
 - (ii) Determination of concentration of coloured species via following methods;
 - (a) Graphical method, (b) Epsilon method, (c) Ratio method, (iv) Standard addition method

References:

Theory:

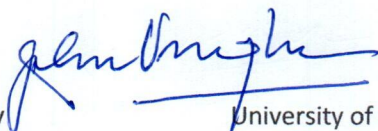
1. Willard, H.H.(1988),**Instrumental Methods of Analysis**, 7th Edition, Wardsworth Publishing Company.
2. Christian, G.D.(2004),**Analytical Chemistry**, 6th Edition, John Wiley & Sons, New York.
3. Harris, D. C.(2007),**Quantitative Chemical Analysis**,6th Edition, Freeman.
4. Khopkar, S.M. (2008), **Basic Concepts of Analytical Chemistry**, New Age International Publisher.
5. Skoog, D.A.; Holler F.J.; Nieman, T.A. (2005), **Principles of Instrumental Analysis**, Thomson Asia Pvt. Ltd.

Practical:

1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C.(1989),**Vogel's Textbook of Quantitative Chemical Analysis**,John Wiley and Sons.

Teaching Learning Process:

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- Teaching through audio-visual aids.
- Students are encouraged to participate actively in the classroom through regular presentations on curriculum based topics.
- As the best way to learn something is to do it yourself, practicals are planned in such a way so as to reinforce the topics covered in theory.

Assessment Methods:

- Presentations by individual student/ small group of students
- Class tests at periodic intervals.
- Written assignment(s)
- Objective type chemical quizzes based on contents of the paper.
- End semester university theory and practical examination.

Keywords:

Separation techniques, Solvent extraction, Ion-exchange, Optical methods, Flame Atomic Absorption and Emission Spectrometry, indeterminate errors, statistical test of data; F, Q and t tests. TGA.

Course Code: CHEMISTRY –DSE-5

Course Title: Molecular Modelling and Drug Design

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

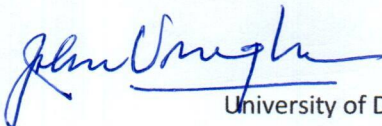
Objective of this course is to make students learn the theoretical background of principles of computational techniques in molecular modelling, evaluation and applications of different methods for various molecular systems, energy minimization techniques, analysis of Mulliken Charge & ESP Plots and elementary idea of drug design.

Learning Outcomes:

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

- Understand theoretical background of computational techniques and selective application to various molecular systems.
- Learn Energy minimization methods through use of different force fields.
- Learn ESP Plots by suitable soft wares, electron rich and electron deficient sites,
- Compare computational and experimental results and explain deviations.
- Carry out Molecular dynamics (MD) and Monte Carlo (MC) simulations on several molecules and polymers.
- Learn QSAR properties and their role in molecular modelling, cheminformatics and drug discovery.
- Perform Optimization of geometry parameters of a molecule (such as shape, bond length and bond angle) through use of software like Chem Sketch and Argus Lab in interesting hands-on exercises.

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2. Engel, T.; Reid, P.(2012), **Physical Chemistry**, Prentice-Hall. Chapter 26.

Teaching Learning Process:

Conventional methods of teaching i.e. lectures, PPTs, Hands on practice of molecule centric problems with maximum characterization parameters and recently designed lead drug molecules

Assessment Methods:

- Assignment based on Theoretical designing of small molecules of drug prospective
- Presentation on fundamentals of drug designing and molecular modelling
- Test
- Semester end examination

Keywords:

Molecular modelling, Quantum Mechanical Method, Cartesian Coordinates, Molecular Dynamics, Force Field, Software of Computational Chemistry.

Course Code: CHEMISTRY –DSE-6

Course Title: Polymer Chemistry

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The primary objective of this paper is to help the student to know about the synthesis, properties and applications of polymers.

Learning Outcomes:

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

- Know about history of polymeric materials and their classification
- Learn about different mechanisms of polymerization and polymerization techniques
- Evaluate kinetic chain length of polymers based on their mechanism
- Differentiate between polymers and copolymers
- Learn about different methods of finding out average molecular weight of polymers
- Differentiate between glass transition temperature (T_g) and crystalline melting point (T_m)
- Determine T_g and T_m
- Know about solid and solution properties of polymers
- Learn properties and applications of various useful polymers in our daily life.

This paper will give glimpse of polymer industry to the student and help them to choose their career in the field of polymer chemistry.

Unit 1:

Introduction and history of polymeric materials:

History of polymeric materials, Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization Bifunctional systems, Poly-functional systems

(Lectures: 12)

Unit 2:

Kinetics of Polymerization

Mechanism of step growth polymerization, kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic), Mechanism and kinetics of copolymerization, polymerization techniques

(Lectures: 8)

Unit 3:

Glass transition temperature (T_g) and determination of T_g , Free volume theory, WLF equation, Factors affecting glass transition temperature (T_g).

Crystallization and crystallinity: Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers-Structure Property relationships

(Lectures: 14)

Unit 4:

Determination of molecular weight of polymers (M_n , M_w , etc.) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index

Polymer Solution

Criteria for polymer solubility and Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy and free energy change of mixing of polymers solutions.

Polymer Degradation

Thermal, oxidative, hydrolytic and photodegradation

(Lectures: 16)

Unit 5:

Properties of Polymers

(Physical, thermal, Flow & Mechanical Properties) Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novolac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers: polyacetylene, polyaniline, poly(p-phenylene sulphide), polypyrrole, polythiophene

(Lectures: 10)

Practical:

(Credits: 2, Laboratory periods: 60)

Chemistry Lab: Polymer chemistry

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA)/MethylAcrylate (MA).
2. Preparation of nylon 6,6
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight of polyvinyl propylidene in water by viscometry:
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of head-to-head monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis of polymethacrylic acid.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method

2. IR studies of polymers
3. DSC (Differential Scanning Calorimetry) analysis of polymers
4. TG-DTA (Thermo-Gravimetry-Differential Thermal Analysis) of polymers

Suggested Additional Experiment:

1. Purification of monomer.
2. Emulsion polymerization of a monomer.

References:

Theory:

1. Carraher, C. E. Jr. (2013), **Seymour's Polymer Chemistry**, Marcel Dekker, Inc.
2. Odian, G. (2004), **Principles of Polymerization**, John Wiley.
3. Billmeyer, F.W. (1984), **Text Book of Polymer Science**, John Wiley.
4. Ghosh, P. (2001), **Polymer Science & Technology**, Tata McGraw-Hill.
5. Lenz, R.W. (1967), **Organic Chemistry of Synthetic High Polymers**, Interscience (Wiley).

Practical:

1. Allcock, H.R.; ; Lampe, F. W.; Mark, J. E. (2003), **Contemporary Polymer Chemistry**, Prentice-Hall.
2. Fried, J.R. (2003), **Polymer Science and Technology**, Prentice-Hall.
3. Munk, P.; Aminabhavi, T. M. (2002), **Introduction to Macromolecular Science**, John Wiley & Sons.
4. Sperling, L.H. (2005), **Introduction to Physical Polymer Science**, John Wiley & Sons.

Teaching-Learning Process:

- Teaching learning process for the course is visualized as largely student-focused.
- Transaction through an intelligent mix of conventional and modern methods.
- Engaging students in cooperative learning.
- Learning through quiz design.
- Problem solving to enhance comprehension.

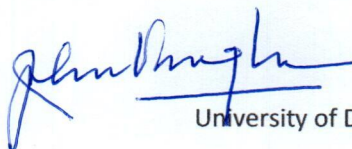
Assessment Methods:

Assessment will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Bonding, Texture, Polymerization, Degradation, Polymer solution, Crystallization, Properties, Applications.

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Keywords:

Green chemistry, Twelve principles of green chemistry, Atom economy, Waste minimization, Green metric, Green solvents, Solvent free, Catalyst, Bio-catalyst, Renewable energy sources, Hazardous, Renewable feedstock, Ionic liquids, Supercritical fluids, Inherent safer design, Green synthesis, Co-crystal controlled solid state synthesis, Sustainable development, Presidential green chemistry awards.

Course Code: CHEMISTRY –DSE-9

Course Title: Industrial Chemicals and Environment

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The objective of this course is to make students aware about the concepts of different 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 understand:

- 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.
- Different industrial effluents and their treatment methods.
- Different sources of energy.
- Generation of nuclear waste and its disposal.
- Use of biocatalyst in chemical industries.

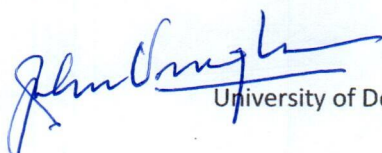
Unit 1:

Industrial Gases: Large scale production, uses storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, and sulphur dioxide.

(Lectures: 6)

Unit 2:

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Inorganic Chemicals: Manufacture, applications, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potassium dichromate and potassium permanganate

(Lectures: 10)

Unit 3:

Industrial Metallurgy: Preparation of ultrapure metals for semiconductor technology.

(Lectures: 4)

Unit 4:

Environment and its segments:

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere, chemical and photochemical reactions in atmosphere.

Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Major sources of air pollution, Pollution by SO₂, CO₂, CO, NO_x, H₂S and other foul smelling gases, methods of estimation of CO, NO_x, SO_x and control procedures, Effects of air pollution on living organisms and vegetation

Greenhouse effect and Global warming, Environmental effects of ozone, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and halogens, Air pollution control, Settling Chambers, Venturi Scrubbers, Cyclones, Electrostatic Precipitators (ESPs).

(Lectures:15)

Unit 5:

Water Pollution:

Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological cycle and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro fertilizer.

Sludge disposal. Industrial waste management, incineration of waste.

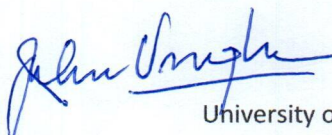
Water treatment and purification (reverse osmosis, electro dialysis, ion exchange).

Water quality parameters for wastewater, industrial water and domestic water.

(Lectures:15)

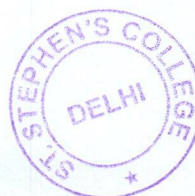
Unit 6:

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Energy & Environment: Sources of energy: Coal, petrol and natural gas. Nuclear fusion / fission, solar, hydrogen, geothermal, tidal and hydel.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis: Introduction to biocatalysis: Importance in green chemistry and chemical industry.

(Lectures: 10)

Practical:

(Credits: 2, Laboratory periods: 60)

Chemistry Lab: Industrial Chemicals & Environment

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD).
3. Determination of Biological Oxygen Demand (BOD).
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO_3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-} , HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2
8. Determination of hexavalent Chromium Cr(VI) concentration in tannery wastes/waste water sample using UV-Vis spectrophotometry technique.
9. Preparation of borax/ boric acid

References:

Theory

1. Manahan, S.E. (2017), **Environmental Chemistry**, CRC Press
2. Buchel, K.H.; Moretto, H.H.; Woditsch, P. (2003), **Industrial Inorganic Chemistry**, Wiley-VCH.
3. De, A.K. (2012), **Environmental Chemistry**, New Age International Pvt., Ltd.
4. Khopkar, S.M. (2010), **Environmental Pollution Analysis**, New Age International Publisher.

Practical

1. Vowles, P.D.; Connell, D.W. (1980), **Experiments in Environmental Chemistry: A Laboratory Manual**, Vol.4, Pergamon Series in Environmental Science.
2. Gopalan, R.; Anand, A.; Sugumar R.W. (2008), **A Laboratory Manual for Environmental Chemistry**, I. K. International.



Teaching Learning Process:

- Conventional chalk and board teaching,
- Visit to chemical industries to get information about the technologies, methods to check pollutants and its treatment.
- ICT enabled classes.
- Power point presentations.
- Interactive sessions.
- To get recent information through the internet.

Assessment Methods:

Assessment will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Air pollution, Biocatalysis, Environment, Green chemistry, Industrial gases, Inorganic chemicals, Metals, Ultrapure metals, Sources of energy, Water pollution.

Course Code: CHEMISTRY –DSE-10

Course Title: Instrumental Methods of Chemical Analysis

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

This course aims to provide knowledge on various spectroscopic techniques for chemical analysis along with the basic principles of instrumentation.

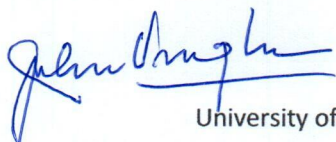
Learning Outcomes:

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

- Handle analytical data
- Understand basic components of IR, FTIR, UV-Visible and Mass spectrometer.
- Interpret of IR, FTIR, UV-visible spectra and their applications.
- Understand the use of single and double beam instruments.
- Learn separations techniques like Chromatography.
- Learn elemental analysis, NMR spectroscopy, Electroanalytical Methods, Radiochemical Methods, X-ray analysis and electron spectroscopy.

Unit 1:

B.Sc. Hons Chemistry



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- Teaching through audio-visual aids.
- Students are encouraged to participate actively in the classroom through regular presentations on curriculum based topics.
- As the best way to learn something is to do it yourself, practicals are planned in such a way so as to reinforce the topics covered in theory.

Assessment Methods:

- Presentations by individual student/ small group of students
- Class tests at periodic intervals.
- Written assignment(s)
- Objective type chemical quizzes based on contents of the paper.
- End semester university theory and practical examination.

Keywords:

Separation techniques, Solvent extraction, Ion-exchange, Optical methods, Flame Atomic Absorption and Emission Spectrometry, indeterminate errors, statistical test of data; F, Q and t tests. TGA.

Course Code: CHEMISTRY –DSE-5

Course Title: Molecular Modelling and Drug Design

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

Objective of this course is to make students learn the theoretical background of principles of computational techniques in molecular modelling, evaluation and applications of different methods for various molecular systems, energy minimization techniques, analysis of Mulliken Charge & ESP Plots and elementary idea of drug design.

Learning Outcomes:

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

- Understand theoretical background of computational techniques and selective application to various molecular systems.
- Learn Energy minimization methods through use of different force fields.
- Learn ESP Plots by suitable soft wares, electron rich and electron deficient sites,
- Compare computational and experimental results and explain deviations.
- Carry out Molecular dynamics (MD) and Monte Carlo (MC) simulations on several molecules and polymers.
- Learn QSAR properties and their role in molecular modelling, cheminformatics and drug discovery.
- Perform Optimization of geometry parameters of a molecule (such as shape, bond length and bond angle) through use of software like Chem Sketch and Argus Lab in interesting hands-on exercises.

Unit 1:

Introduction: Overview of Classical and Quantum Mechanical Methods (Ab initio, Semi-empirical, Molecular Mechanics, Molecular Dynamics and Monte Carlo) General considerations.

Coordinate systems: Cartesian and Internal Coordinates, Bond lengths, bond angles and torsion angles, Writing Z -matrix (ex: methane, ethane, ethene, ethyne, water, H₂O₂).

(Lectures: 8)

Unit 2:

Potential Energy Surfaces: Intrinsic Reaction Coordinates, Stationary points, Equilibrium points – Local and Global minima, concept of transition state with examples: Ethane, propane, butane, cyclohexane. Meaning of rigid and relaxed PES.

Applications of computational chemistry to determine reaction mechanisms.

Energy Minimization and Transition State Search: Geometry optimization, Methods of energy minimization: Multivariate Grid Search, Steepest Descent Method, Newton-Raphson method and Hessian matrix.

(Lectures: 12)

Unit 3:

Molecular Mechanics: Force Fields, Non-bonded interactions (van der Waals and electrostatic), how to handle torsions of flexible molecules, van der Waals interactions using Lennard-Jones potential, hydrogen bonding interactions, electrostatic term, Parameterization. Applications of MM, disadvantages, Software, Different variants of MM: MM1, MM2, MM3, MM4, MM+, AMBER, BIO+, OPLS.GUI.

(Lectures: 10)

Unit 4:

Molecular Dynamics: Radial distribution functions for solids, liquids and gases, intermolecular Potentials (Hard sphere, finite square well and Lennard-Jones potential), concept of periodic box, ensembles (microcanonical, canonical, isothermal – isobaric), Ergodic hypothesis. Integration of Newton's equations (Leapfrog and Verlet Algorithms), Rescaling, Simulation of Pure water – Radial distribution curves and interpretation, TIP & TIP3P, Typical MD simulation

Brief introduction to Langevin and Brownian dynamics

Monte Carlo Method: Metropolis algorithm.

(Lectures: 10)

Unit 5:

Huckel MO with examples: ethane, propenyl, cyclopropenyl systems, Properties calculated – energy, charges, dipole moments, bond order, electronic energies, resonance energies, Oxidation and reduction (cationic and anionic species of above systems)

Extension to Extended Huckel theory and PPP methods

Ab-initio methods: Writing the Hamiltonian of a system, Brief recap of H – atom solution, Units in quantum mechanical calculations, Born-Oppenheimer approximation (recap), Antisymmetry principle, Slater determinants, Coulomb and Exchange integrals,

Examples of He atom and hydrogen molecule, Hartree-Fock method

Basis sets, Basis functions, STOs and GTOs, diffuse and polarization functions. Minimal basis sets

Advantages of ab initio calculations, Koopman's theorem, Brief idea of Density Functional Theory

(Lectures: 12)

Unit 6:

Semi-empirical methods: Brief idea of CNDO, INDO, MINDO/3, MNDO, AM1, PM3 methods. Other file formats – PDB. Visualization of orbitals – HOMO, LUMO, ESP maps.

QSAR: Structure-activity relationships. Properties in QSAR (Partial atomic charges, polarizabilities, volume and surface area, log P, lipophilicity and Hammett equation and applications, hydration energies, refractivity). Biological activities (LD50, IC50, ED50.)

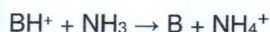
(Lectures: 8)

Practical:

(Credits: 2, Laboratory periods: 60)

1. Plotting a 3D graph depicting a saddle point in a spreadsheet software.
2. Determine the enthalpy of isomerization of cis and trans 2-butene.
3. Determine the heat of hydrogenation of ethylene.
4. Compare the optimized C-C bond lengths and Wiberg bond orders in ethane, ethene, ethyne and benzene using PM3. Is there any relationship between the bond lengths and bond orders? Visualize the highest occupied and lowest unoccupied molecular orbitals of ethane, ethene, ethyne, benzene and pyridine.
5. Perform a conformational analysis of butane.
6. Compare the basicities of the nitrogen atoms in ammonia, methylamine, dimethylamine and trimethylamine by comparison of their Mulliken charges and ESP maps.
7. Compare the gas phase basicities of the methylamines by comparing the enthalpies of the following reactions:





where B = CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$

8. Arrange 1-hexene, 2-methyl-2-pentene, (E)-3-methyl-2-pentene, (Z)-3-methyl-2-pentene, and 2,3-dimethyl-2-butene in order of increasing stability.
9. Compare the optimized bond angles H_2O , H_2S , H_2Se using PM3.
10. Compare the HAH bond angles for the second row hydrides (BeH_2 , CH_4 , NH_3 , H_2O) and compare with the results from qualitative MO theory.
11. (a) Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol. Note the dipole moment of each molecule. (b) Show how the shapes affect the trend in boiling points: (118 °C, 100 °C, 108 °C, 82 °C, respectively).
12. Compute the resonance energy of benzene by comparison of its enthalpy of hydrogenation with that of cyclohexene.
13. Plot the electrostatic potential mapped on electron density for benzene and use it to predict the type of stacking in the crystal structure of benzene dimer.
14. Predict the aromaticity of thiophene with respect to benzene by comparing the enthalpies of the following reactions:
 - (a) Hydrogenation of benzene to 1,3-cyclohexadiene and then 1,3-cyclohexadiene to cyclohexene.
 - (b)



15. Docking of Sulfonamide-type D-Glu inhibitor into MurD active site using Argus lab.

Note: Software: Argus Lab (www.planaria-software.com).

References:

Theory:

1. Lewars, E. (2003), **Computational Chemistry**, Kluwer academic Publisher.
2. Cramer, C.J.(2004),**Essentials of Computational Chemistry**, John Wiley & Sons.
3. Hinchcliffe, A. (1996),**Modelling Molecular Structures**, John Wiley & Sons.
4. Leach, A.R.(2001),**Molecular Modelling**, Prentice-Hall.

Practical:

1. Lewars, E. G. (2011),**Computational Chemistry**, Springer (India) Pvt. Ltd. Chapter 1 & 2.

2. Engel, T.; Reid, P.(2012),**Physical Chemistry**, Prentice-Hall. Chapter 26.

Teaching Learning Process:

Conventional methods of teaching i.e. lectures, PPTs, Hands on practice of molecule centric problems with maximum characterization parameters and recently designed lead drug molecules

Assessment Methods:

- Assignment based on Theoretical designing of small molecules of drug prospective
- Presentation on fundamentals of drug designing and molecular modelling
- Test
- Semester end examination

Keywords:

Molecular modelling, Quantum Mechanical Method, Cartesian Coordinates, Molecular Dynamics, Force Field, Software of Computational Chemistry.

Course Code: CHEMISTRY –DSE-6

Course Title: Polymer Chemistry

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The primary objective of this paper is to help the student to know about the synthesis, properties and applications of polymers.

Learning Outcomes:

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

- Know about history of polymeric materials and their classification
- Learn about different mechanisms of polymerization and polymerization techniques
- Evaluate kinetic chain length of polymers based on their mechanism
- Differentiate between polymers and copolymers
- Learn about different methods of finding out average molecular weight of polymers
- Differentiate between glass transition temperature (T_g) and crystalline melting point (T_m)
- Determine T_g and T_m
- Know about solid and solution properties of polymers
- Learn properties and applications of various useful polymers in our daily life.

BMATH204: Differential Equations

Total Marks: 150 (Theory: 75, Internal Assessment: 25 and Practical: 50)

Workload: 4 Lectures, 4 Practicals (per week) **Credits:** 6 (4+2)

Duration: 14 Weeks (56 Hrs. Theory + 56 Hrs. Practical) **Examination:** 3 Hrs.

Course Objectives: The main objective of this course is to introduce the students to the exciting world of differential equations, mathematical modeling and their applications.

Course Learning Outcomes: The course will enable the students to:

- i) Learn basics of differential equations and mathematical modeling.
- ii) Formulate differential equations for various mathematical models.
- iii) Solve first order non-linear differential equations and linear differential equations of higher order using various techniques.
- iv) Apply these techniques to solve and analyze various mathematical models.

Unit 1: Differential Equations and Mathematical Modeling

Differential equations and mathematical models, Order and degree of a differential equation, Exact differential equations and integrating factors of first order differential equations, Reducible second order differential equations, Applications of first order differential equations to acceleration-velocity model, Growth and decay model.

Unit 2: Population Growth Models

Introduction to compartmental models, Lake pollution model (with case study of Lake Burley Griffin), Drug assimilation into the blood (case of a single cold pill, case of a course of cold pills, case study of alcohol in the bloodstream), Exponential growth of population, Limited growth of population, Limited growth with harvesting.

Unit 3: Second and Higher Order Differential Equations

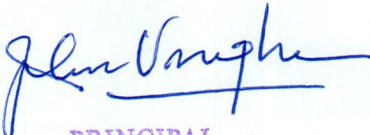
General solution of homogeneous equation of second order, Principle of superposition for a homogeneous equation; Wronskian, its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, Method of undetermined coefficients, Method of variation of parameters, Applications of second order differential equations to mechanical vibrations.

Unit 4: Analysis of Mathematical Models

Interacting population models, Epidemic model of influenza and its analysis, Predator-prey model and its analysis, Equilibrium points, Interpretation of the phase plane, Battle model and its analysis.

References:

1. Barnes, Belinda & Fulford, Glenn R. (2015). *Mathematical Modelling with Case Studies, Using Maple and MATLAB* (3rd ed.). CRC Press, Taylor & Francis Group.
2. Edwards, C. Henry, Penney, David E., & Calvis, David T. (2015). *Differential Equation and Boundary Value Problems: Computing and Modeling* (5th ed.). Pearson Education.
3. Ross, Shepley L. (2004). *Differential Equations* (3rd ed.). John Wiley & Sons. India


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Additional Reading:

- i. Ross, Clay C. (2004). *Differential Equations: An Introduction with Mathematica*[®] (2nd ed.). Springer.

Practical / Lab work to be performed in a Computer Lab:

Modeling of the following problems using Mathematica /MATLAB/Maple/Maxima/Scilab etc.

1. Plotting of second and third order respective solution family of differential equation.
2. Growth and decay model (exponential case only).
3. (i) Lake pollution model (with constant/seasonal flow and pollution concentration).
(ii) Case of single cold pill and a course of cold pills.
(iii) Limited growth of population (with and without harvesting).
4. (i) Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey one predator).
(ii) Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
(iii) Battle model (basic battle model, jungle warfare, long range weapons).
5. Plotting of recursive sequences, and study of the convergence.
6. Find a value $m \in \mathbb{N}$ that will make the following inequality holds for all $n > m$:
(i) $|\sqrt[n]{0.5} - 1| < 10^{-3}$, (ii) $|\sqrt[n]{n} - 1| < 10^{-3}$,
(iii) $(0.9)^n < 10^{-3}$, (iv) $\frac{2^n}{n!} < 10^{-7}$, etc.
7. Verify the Bolzano–Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
8. Study the convergence/divergence of infinite series of real numbers by plotting their sequences of partial sum.
9. Cauchy's root test by plotting n th roots.
10. D'Alembert's ratio test by plotting the ratio of n th and $(n+1)$ th term of the given series of positive terms.
11. For the following sequences $\{a_n\}$, given $\varepsilon = \frac{1}{2^k}$, $p = 10^j$, $k = 0, 1, 2, \dots$; $j = 1, 2, 3, \dots$

Find $m \in \mathbb{N}$ such that

$$(i) |a_{m+p} - a_m| < \varepsilon, \quad (ii) |a_{2m+p} - a_{2m}| < \varepsilon,$$

where a_n is given as:

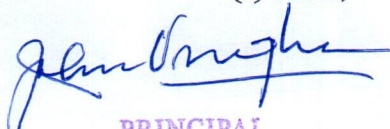
$$\begin{array}{lll} (a) \frac{n+1}{n}, & (b) \frac{1}{n}, & (c) 1 - \frac{1}{2} + \frac{1}{3} - \dots + \frac{(-1)^{n-1}}{n} \\ (d) \frac{(-1)^n}{n}, & (e) 2^{-n}n^2, & (f) 1 + \frac{1}{2!} + \dots + \frac{1}{n!}. \end{array}$$

12. For the following series $\sum a_n$, calculate

$$(i) \left| \frac{a_{n+1}}{a_n} \right|, \quad (ii) |a_n|^{\frac{1}{n}}, \text{ for } n = 10^j, j = 1, 2, 3, \dots,$$

and identify the convergent series, where a_n is given as:

$$\begin{array}{llll} (a) \left(\frac{1}{n}\right)^{1/n}, & (b) \frac{1}{n}, & (c) \frac{1}{n^2}, & (d) \left(1 + \frac{1}{\sqrt{n}}\right)^{-n^{3/2}}, \\ (e) \frac{n!}{n^n}, & (f) \frac{n^3 + 5}{3^n + 2}, & (g) \frac{1}{n^2 + n}, & (\square) \frac{1}{\sqrt{n+1}}, \\ (j) \cos n, & (j) \frac{1}{n \log n}, & (k) \frac{1}{n(\log n)^2}. \end{array}$$


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Teaching Plan (Theory of BMATH204: Differential Equations):

Weeks 1 and 2: Differential equations and mathematical models, Order and degree of a differential equation, Exact differential equations and integrating factors of first order differential equations, Reducible second order differential equations.

[2] Chapter 1 (Sections 1.1 and 1.6).

[3] Chapter 2.

Week 3: Application of first order differential equations to acceleration-velocity model, Growth and decay model.

[2] Chapter 1 (Section 1.4, Pages 35 to 38), and Chapter 2 (Section 2.3).

[3] Chapter 3 (Section 3.3, A and B with Examples 3.8, 3.9).

Week 4: Introduction to compartmental models, Lake pollution model (with case study of Lake Burley Griffin).

[1] Chapter 2 (Sections 2.1, 2.5 and 2.6).

Week 5: Drug assimilation into the blood (case of a single cold pill, case of a course of cold pills, Case study of alcohol in the bloodstream).

[1] Chapter 2 (Sections 2.7 and 2.8).

Week 6: Exponential growth of population, Density dependent growth, Limited growth with harvesting.

[1] Chapter 3 (Sections 3.1 to 3.3).

Weeks 7 to 9: General solution of homogeneous equation of second order, Principle of superposition for a homogeneous equation; Wronskian, its properties and applications; Linear homogeneous and non-homogeneous equations of higher order with constant coefficients; Euler's equation.

[2] Chapter 3 (Sections 3.1 to 3.3).

Weeks 10 and 11: Method of undetermined coefficients, Method of variation of parameters; Applications of second order differential equations to mechanical vibrations.

[2] Chapter 3 (Sections 3.4 (Pages 172 to 177) and 3.5).

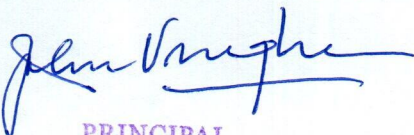
Weeks 12 to 14: Interacting population models, Epidemic model of influenza and its analysis, Predator-prey model and its analysis, Equilibrium points, Interpretation of the phase plane, Battle model and its analysis.

[1] Chapter 5 (Sections 5.1, 5.2, 5.4 and 5.9), and Chapter 6 (Sections 6.1 to 6.4).

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Learn basics of differential equations and mathematical modeling.	(i) Each topic to be explained with examples and illustrated on computers using Mathematica /MATLAB /Maple/Maxima/Scilab. (ii) Students to be involved in discussions and encouraged to ask questions. (iii) Students to be given homework/assignments. (iv) Students to be encouraged to give short presentations.	• Presentations and participation in discussions. • Assignments and class tests. • Mid-term examinations. • Practical and viva-voce examinations. • End-term examinations.
2.	Formulate differential equations for various mathematical models.		
3.	Solve first order non-linear differential equations and linear differential equations of higher order using various techniques.		
4.	Apply these techniques to solve and analyze various mathematical models.		

Keywords: Battle model, Epidemic model, Euler's equation, Exact differential equation, Integrating factor, Lake pollution model, Mechanical vibrations, Phase plane, Predator-prey model, Wronskian and its properties.


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DSE-2 (ii): Discrete Mathematics

Total Marks: 100 (Theory: 75 + Internal Assessment: 25)

Workload: 5 Lectures, 1 Tutorial (per week) **Credits:** 6 (5+1)

Duration: 14 Weeks (70 Hrs.) **Examination:** 3 Hrs.

Course Objectives: The course aims at introducing the concepts of ordered sets, lattices, sublattices and homomorphisms between lattices. It also includes introduction to modular and distributive lattices along with complemented lattices and Boolean algebra. Then some important applications of Boolean algebra are discussed in switching circuits. The second part of this course deals with introduction to graph theory, paths and circuits, Eulerian circuits, Hamiltonian graphs and finally some applications of graphs to shortest path algorithms.

Course Learning outcomes: After the course, the student will be able to:

- i) Understand the notion of ordered sets and maps between ordered sets.
- ii) Learn about lattices, modular and distributive lattices, sublattices and homomorphisms between lattices.
- iii) Become familiar with Boolean algebra, Boolean homomorphism, Karnaugh diagrams, switching circuits and their applications.
- iv) Learn about basics of graph theory, including Eulerian graphs, Hamiltonian graphs.
- v) Learn about the applications of graph theory in the study of shortest path algorithms.

Unit 1: Ordered Sets

Definitions, Examples and basic properties of ordered sets, Order isomorphism, Hasse diagrams, Dual of an ordered set, Duality principle, Maximal and minimal elements, Building new ordered sets, Maps between ordered sets.

Unit 2: Lattices

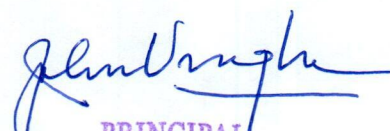
Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products and homomorphisms; Definitions, Examples and properties of modular and distributive lattices, The $M_3 - N_5$ theorem with applications, Complemented lattice, Relatively complemented lattice, Sectionally complemented lattice.

Unit 3: Boolean Algebras and Switching Circuits

Boolean algebras, De Morgan's laws, Boolean homomorphism, Representation theorem; Boolean polynomials, Boolean polynomial functions, Disjunctive normal form and conjunctive normal form, Minimal forms of Boolean polynomial, Quine-McCluskey method, Karnaugh diagrams, Switching circuits and applications of switching circuits.

Unit 4: Graph Theory

Introduction to graphs, Königsberg bridge problem, Instant insanity game; Definition, examples and basic properties of graphs, Subgraphs, Pseudographs, Complete graphs, Bipartite graphs, Isomorphism of graphs, Paths and circuits, Eulerian circuits, Hamiltonian cycles, Adjacency matrix, Weighted graph, Travelling salesman problem, Shortest path, Dijkstra's algorithm.


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References:

1. Davey, B. A., & Priestley, H. A. (2002). *Introduction to Lattices and Order* (2nd ed.). Cambridge University press, Cambridge.
2. Goodaire, Edgar G., & Parmenter, Michael M. (2011). *Discrete Mathematics with Graph Theory* (3rd ed.). Pearson Education (Singapore) Pvt. Ltd. Indian Reprint.
3. Lidl, Rudolf & Pilz, Gunter. (2004). *Applied Abstract Algebra* (2nd ed.), Undergraduate Texts in Mathematics. Springer (SIE). Indian Reprint.

Additional Reading:

- i. Rosen, Kenneth H. (2012). *Discrete Mathematics and its Applications, with Combinatorics and Graph Theory*. (7th ed.). McGraw-Hill Education. Indian Reprint.

Teaching Plan (DSE-2 (ii): Discrete Mathematics):

Weeks 1 and 2: Definitions, Examples and basic properties of ordered sets, Order isomorphism, Hasse diagrams, dual of an ordered set, Duality principle, Maximal and minimal elements, Building new ordered sets, Maps between ordered sets.

[1] Chapter 1 (Sections 1.1 to 1.5, Sections 1.14 to 1.26, and Sections 1.34 to 1.36).

[3] Chapter 1 [Section 1 (1.1 to 1.3)].

Weeks 3 and 4: Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products and homomorphisms.

[1] Chapter 2 (Sections 2.1 to 2.19).

[3] Chapter 1 [Section 1 (1.5 to 1.20)].

Week 5: Definitions, Examples and properties of Modular and distributive lattices.

[1] Chapter 4 (Sections 4.1 to 4.9).

[3] Chapter 1 [Section 2 (2.1 to 2.6)].

Week 6: $M_3 - N_5$ theorem with applications, Complemented lattice, Relatively complemented lattice, Sectionally complemented lattice.

[1] Chapter 4 (Sections 4.10 and 4.11).

[3] Chapter 1 [Section 2 (2.7 to 2.14)].

Weeks 7 and 8: Boolean algebras, De Morgan's laws, Boolean homomorphism, representation theorem, Boolean polynomials, Boolean polynomial functions, Disjunctive normal form and conjunctive normal form.

[3] Chapter 1 (Sections 3 and 4).

Week 9: Minimal forms of Boolean polynomial, Quine–McCluskey method, Karnaugh diagrams.

[3] Chapter 1 (Section 6).

Week 10: Switching circuits and applications of switching circuits.

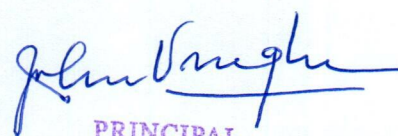
[3] Chapter 2 (Sections 7 and 8).

Weeks 11 and 12: Introduction to graphs, Königsberg bridge problem, Instant insanity game. Definition, Examples and basic properties of graphs, Subgraphs, Pseudographs, Complete graphs, Bipartite graphs, Isomorphism of graphs.

[2] Chapter 9 [Sections 9.1, 9.2 (9.2.1, 9.2.7) and 9.3].

Weeks 13 and 14: Paths and circuits, Eulerian circuits, Hamiltonian cycles, Adjacency matrix, Weighted graph, Travelling salesman problem, shortest path, Dijkstra's algorithm.

[2] Chapter 10 [Sections 10.1 to 10.4 (10.4.1 to 10.4.3)].

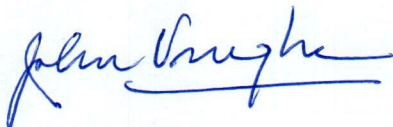

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Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Understand the notion of ordered sets and maps between ordered sets.	(i) Each topic to be explained with examples.	• Presentations and participation in discussions. • Assignments and class tests. • Mid-term examinations. • End-term examinations.
2.	Learn about lattices, modular and distributive lattices, sublattices and homomorphisms between lattices.	(ii) Students to be involved in discussions and encouraged to ask questions.	
3.	Become familiar with Boolean algebra, Boolean homomorphism, Karnaugh diagrams, switching circuits and their applications.	(iii) Students to be given homework/assignments.	
4.	Learn about basics of graph theory, including Eulerian graphs, Hamiltonian graphs. Learn about the applications of graph theory in the study of shortest path algorithms.	(iv) Students to be encouraged to give short presentations.	

Keywords: Boolean algebra, Lattices, Graphs, Modularity, Ordered sets, Paths and circuits, Shortest path algorithms, Switching circuits.



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DSE-4 (ii) Linear Programming and Theory of Games

Total Marks: 100

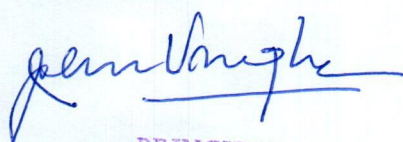
Theory: 75

Internal Assessment: 25

5 Lectures, 1 Tutorial (per week per student)

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

[1]: Chapter 3 (Sections 3.2-3.3, 3.5-3.8), Chapter 4 (Sections 4.1-4.4).


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Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

[1]: Chapter 6 (Sections 6.1- 6.3).

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

[3]: Chapter 5 (Sections 5.1, 5.3-5.4).

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

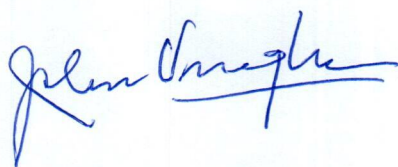
[2]: Chapter 14.

REFERENCES:

1. **Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali**, *Linear Programming and Network Flows* (2nd edition), John Wiley and Sons, India, 2004.
2. **F. S. Hillier and G. J. Lieberman**, *Introduction to Operations Research- Concepts and Cases* (9th Edition), Tata McGraw Hill, 2010.
3. **Hamdy A. Taha**, *Operations Research, An Introduction* (9th edition), Prentice-Hall, 2010.

SUGGESTED READING:

1. **G. Hadley**, *Linear Programming*, Narosa Publishing House, New Delhi, 2002.



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Skill Enhancement Paper

SEC-1: LaTeX and HTML

Total Marks: 100 (Theory: 38, Internal Assessment: 12, and Practical: 50)

Workload: 2 Lectures, 4 Practicals (per week) Credits: 4 (2+2)

Duration: 14 Weeks (28 Hrs. Theory + 56 Hrs. Practical) Examination: 2 Hrs.

Course Objectives: The purpose of this course is to acquaint students with the latest typesetting skills, which shall enable them to prepare high quality typesetting, beamer presentation and webpages.

Course Learning Outcomes: After studying this course the student will be able to:

- i) Create and typeset a LaTeX document.
- ii) Typeset a mathematical document using LaTeX.
- iii) Learn about pictures and graphics in LaTeX.
- iv) Create beamer presentations.
- v) Create web page using HTML.

Unit 1: Getting Started with LaTeX

Introduction to TeX and LaTeX, Typesetting a simple document, Adding basic information to a document, Environments, Footnotes, Sectioning and displayed material.

Unit 2: Mathematical Typesetting with LaTeX

Accents and symbols, Mathematical typesetting (elementary and advanced): Subscript/ Superscript, Fractions, Roots, Ellipsis, Mathematical Symbols, Arrays, Delimiters, Multiline formulas, Spacing and changing style in math mode.

Unit 3: Graphics and Beamer Presentation in LaTeX

Graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions, Beamer presentation.

Unit 4: HTML

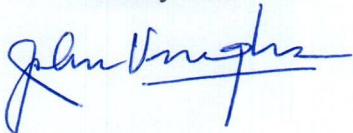
HTML basics, Creating simple web pages, Images and links, Design of web pages.

References:

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Lamport, Leslie (1994). *LaTeX: A Document Preparation System, User's Guide and Reference Manual* (2nd ed.). Pearson Education. Indian Reprint.

Additional Readings:

- i. Dongen, M. R. C. van (2012). *LaTeX and Friends*. Springer-Verlag.
- ii. Robbins, J. N. (2018). *Learning Web Design: A Beginner's Guide to HTML* (5th ed.). O'Reilly Media Inc.



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Practical / Lab work to be performed in Computer Lab.

- [1] Chapter 9 (Exercises 4 to 10), Chapter 10 (Exercises 1 to 4 and 6 to 9),
Chapter 11 (Exercises 1, 3, 4, and 5), and Chapter 15 (Exercises 5, 6 and 8 to 11).

Teaching Plan (Theory of SEC-1: LaTeX and HTML):

Weeks 1 to 3: Introduction to TeX and LaTeX, Typesetting a simple document, Adding basic information to a document, Environments, Footnotes, Sectioning and displayed material.

[1] Chapter 9 (9.1 to 9.5).

[2] Chapter 2 (2.1 to 2.5).

Weeks 4 to 6: Accents of symbols, Mathematical typesetting (elementary and advanced): Subscript/Superscript, Fractions, Roots, Ellipsis, Mathematical symbols, Arrays, Delimiters, Multiline formulas, Spacing and changing style in math mode.

[1] Chapter 9 (9.6 and 9.7).

[2] Chapter 3 (3.1 to 3.3).

Weeks 7 and 8: Graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions.

[1] Chapter 9 (Section 9.8). Chapter 10 (10.1 to 10.3).

[2] Chapter 7 (7.1 and 7.2).

Weeks 9 and 10: Beamer presentation.

[1] Chapter 11 (Sections 11.1 to 11.4).

Weeks 11 and 12: HTML basics, Creating simple web pages.

[1] Chapter 15 (Sections 15.1 and 15.2).

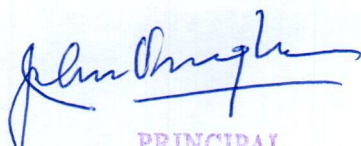
Weeks 13 and 14: Adding images and links, Design of web pages.

[1] Chapter 15 (Sections 15.3 to 15.5).

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Create and typeset a LaTeX document.	(i) Each topic to be explained with illustrations on computers. (ii) Students be given homework/ assignments. (iii) Students be encouraged to create simple webpages.	• Presentations and class discussions. • Assignments and class tests. • Mid-term examinations. • End-term examinations.
2.	Typeset a mathematical document using LaTeX.		
3.	Learn about pictures and graphics in LaTeX. Create beamer presentations.		
4.	Create web page using HTML.		

Keywords: LaTeX, Mathematical typesetting, PSTricks, Beamer, HTML.


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Skill Enhancement Paper

SEC-2: Computer Algebra Systems and Related Software

Total Marks: 100 (Theory: 38, Internal Assessment: 12, and Practical: 50)

Workload: 2 Lectures, 4 Practicals (per week) **Credits:** 4 (2+2)

Duration: 14 Weeks (28 Hrs. Theory + 56 Hrs. Practical) **Examination:** 2 Hrs.

Course Objectives: This course aims at familiarizing students with the usage of computer algebra systems (/Mathematica/MATLAB/Maxima/Maple) and the statistical software **R**. The basic emphasis is on plotting and working with matrices using CAS. Data entry and summary commands will be studied in **R**. Graphical representation of data shall also be explored.

Course Learning Outcomes: This course will enable the students to:

- i) Use of computer algebra systems (Mathematica/MATLAB/Maxima/Maple etc.) as a calculator, for plotting functions and animations
- ii) Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigenvectors.
- iii) Understand the use of the statistical software **R** as calculator and learn to read and get data into **R**.
- iv) Learn the use of **R** in summary calculation, pictorial representation of data and exploring relationship between data.
- v) Analyze, test, and interpret technical arguments on the basis of geometry.

Unit 1: Introduction to CAS and Applications

Computer Algebra System (CAS), Use of a CAS as a calculator, Computing and plotting functions in 2D, Plotting functions of two variables using Plot3D and ContourPlot, Plotting parametric curves surfaces, Customizing plots, Animating plots, Producing tables of values, working with piecewise defined functions, Combining graphics.

Unit 2: Working with Matrices

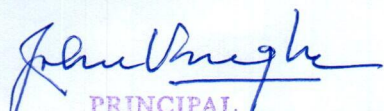
Simple programming in a CAS, Working with matrices, Performing Gauss elimination, operations (transpose, determinant, inverse), Minors and cofactors, Working with large matrices, Solving system of linear equations, Rank and nullity of a matrix, Eigenvalue, eigenvector and diagonalization.

Unit 3: **R** - The Statistical Programming Language

R as a calculator, Explore data and relationships in **R**. Reading and getting data into **R**: Combine and scan commands, Types and structure of data items with their properties, Manipulating vectors, Data frames, Matrices and lists, Viewing objects within objects, Constructing data objects and conversions.

Unit 4: Data Analysis with **R**

Summary commands: Summary statistics for vectors, Data frames, Matrices and lists, Summary tables, Stem and leaf plot, Histograms, Plotting in **R**: Box-whisker plots, Scatter plots, Pairs plots, Line charts, Pie charts, Cleveland dot charts and bar charts, Copy and save graphics to other applications.


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References:

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Torrence, Bruce F., & Torrence, Eve A. (2009). *The Student's Introduction to Mathematica®: A Handbook for Precalculus, Calculus, and Linear Algebra* (2nd ed.). Cambridge University Press.
3. Gardener, M. (2012). *Beginning R: The Statistical Programming Language*, Wiley.

Additional Reading:

- i. Verzani, John (2014). *Using R for Introductory Statistics* (2nd ed.). CRC Press, Taylor & Francis Group.

Note: Theoretical and Practical demonstration should be carried out only in **one** of the CAS: Mathematica/MATLAB/Maxima/Scilab or any other.

Practical / Lab work to be performed in Computer Lab.

- [1] Chapter 12 (Exercises 1 to 4 and 8 to 12), Chapter 14 (Exercises 1 to 3)
[2] Chapter 3 [Exercises 3.2(1 and 2), 3.3(1, 2 and 4), 3.4(1 and 2), 3.5(1 to 4), 3.6(2 and 3)].
[2] Chapter 6 (Exercises 6.2 and 6.3) and Chapter 7 [Exercises 7.1(1), 7.2, 7.3(2), 7.4(1) and 7.6].

Note: Relevant exercises of [3] Chapters 2 to 5 and 7 (The practical may be done on the database to be downloaded from <http://data.gov.in/>).

Teaching Plan (Theory of SEC-1: Computer Algebra Systems and Related Software):

Weeks 1 to 3: Computer Algebra System (CAS), Use of a CAS as a calculator, Computing and plotting functions in 2D, Producing tables of values, Working with piecewise defined functions, Combining graphics. Simple programming in a CAS.

[1] Chapter 12 (Sections 12.1 to 12.5).

[2] Chapter 1, and Chapter 3 (Sections 3.1 to 3.6 and 3.8).

Weeks 4 and 5: Plotting functions of two variables using Plot3D and contour plot, Plotting parametric curves surfaces, Customizing plots, Animating plots.

[2] Chapter 6 (Sections 6.2 and 6.3).

Weeks 6 to 8: Working with matrices, Performing Gauss elimination, Operations (Transpose, Determinant, Inverse), Minors and cofactors, Working with large matrices, Solving system of linear equations, Rank and nullity of a matrix, Eigenvalue, Eigenvector and diagonalization.

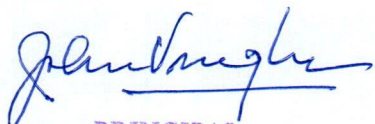
[2] Chapter 7 (Sections 7.1 to 7.8).

Weeks 9 to 11: R as a calculator, Explore data and relationships in R. Reading and getting data into R: Combine and scan commands, Types and structure of data items with their properties. Manipulating vectors, Data frames, Matrices and lists. Viewing objects within objects. Constructing data objects and conversions.

[1] Chapter 14 (Sections 14.1 to 14.4).

[3] Chapter 2, and Chapter 3.

Weeks 12 to 14: Summary commands: Summary statistics for vectors, Data frames, Matrices and lists. Summary tables. Stem and leaf plot, histograms. Plotting in R: Box-whisker plots, Scatter plots, Pairs plots, Line charts, Pie charts, Cleveland dot charts and Bar charts. Copy and save graphics to other applications.


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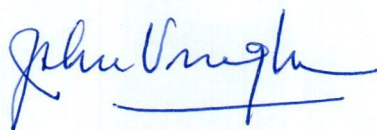
[1] Chapter 14 (Section 14.7).

[3] Chapter 5 (up to Page 157), and Chapter 7.

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Use of computer algebra systems (Mathematica/MATLAB/Maxima/Maple etc.) as a calculator, for plotting functions and animations	(i) Each topic to be explained with illustrations using CAS or R .	• Presentations and class discussions.
2.	Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigenvectors.	(ii) Students to be given homework/ assignments.	• Assignments and class tests.
3.	Understand the use of the statistical software R as calculator and learn to read and get data into R .	(iii) Students to be encouraged to do look for new applications.	• Mid-term examinations.
4.	Learn the use of R in summary calculation, pictorial representation of data and exploring relationship between data. Analyze, test, and interpret technical arguments on the basis of geometry.		• End-term examinations.

Keywords: Plot3D, ContourPlot, Calculator, Summary commands, Histograms.



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2. Mathematical Physics (1995), A.K. Ghatak, IC Goyal and S.J. Chua, Macmillan India, New Delhi.
3. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
4. Differential Equations, George F. Simmons, 2007, McGraw Hill.
5. Introduction to Vector Analysis, H.F. Davis and A. D. Snider, Wm. C. Brown Publishers; 6th edition (1991).
6. Statistics – A Guide to the Use of Statistical Methods in the Physical Sciences, R.J. Barlow, Wiley (1993).

References for Laboratory Work:

1. Schaum's Outline of Programming with C++', J. Hubbard, 2000, McGraw-Hill Education.
2. C++ How to Program', Paul J. Deitel and Harvey Deitel, Pearson (2016).
3. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
4. Computational Physics, Darren Walker, 1st Edn., Scientific International Pvt. Ltd (2015).
5. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.

CC-II: Mechanics (32221102)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

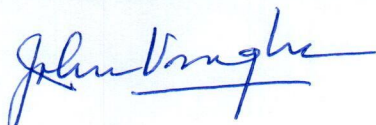
Course Objective

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity. Students will also appreciate the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations. The students will be able to apply the concepts learnt to several real world problems.

Course Learning Outcomes

Upon completion of this course, students are expected to

- Understand laws of motion and their application to various dynamical situations.


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- Learn the concept of inertial reference frames and Galilean transformations. Also, the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.
- Understand translational and rotational dynamics of a system of particles.
- Apply Kepler's laws to describe the motion of planets and satellite in circular orbit.
- Understand concept of Geosynchronous orbits
- Explain the phenomenon of simple harmonic motion.
- Understand special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object.
- In the laboratory course, the student shall perform experiments related to mechanics: compound pendulum, rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity), fluid dynamics, estimation of random errors in the observations etc.

Unit 1

Fundamentals of Dynamics: Reference frames, Inertial frames, Galilean transformations, Galilean invariance, Review of Newton's Laws of Motion. Momentum of variable mass system: motion of rocket. Dynamics of a system of particles. Principle of conservation of momentum. Impulse. Determination of Centre of Mass of discrete and continuous objects having cylindrical and spherical symmetry (1-D, 2-D & 3-D).

(5 Lectures)

Unit 2

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable, unstable and neutral equilibrium. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

(5 Lectures)

Collisions: Elastic (1-D and 2-D) and inelastic collisions. Centre of Mass and Laboratory frames.

(4 Lectures)

Unit 3

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of inertia, theorem of parallel and perpendicular axes. Determination of moment of inertia of discrete and continuous objects [1-D, 2-D & 3-D (rectangular, cylindrical and spherical)]. Kinetic energy of rotation. Motion involving both translation and rotation.

(10 Lectures)

Unit 4

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere.

John Douglas

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(2 Lectures)

Motion of a particle under a central force field: Two-body problem, its reduction to one-body problem and its solution. Reduction of angular momentum, kinetic energy and total energy. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit, Geosynchronous orbits.

(7 Lectures)

Unit 5

Oscillations: Idea of SHM. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Compound pendulum. Damped oscillation. Forced oscillations: Transient and steady states, sharpness of resonance and Quality Factor.

(5 Lectures)

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications.

(7 Lectures)

Unit 6

Special Theory of Relativity: Outcomes of Michelson-Morley Experiment. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity, Length contraction, Time dilation. Relativistic transformation of velocity, acceleration, frequency and wave number. Mass of relativistic particle. Mass-less Particles. Mass-energy Equivalence. Relativistic Doppler effect (transverse and longitudinal). Relativistic Kinematics (decay problems, inelastic collisions and Compton effect). Transformation of Energy and Momentum.

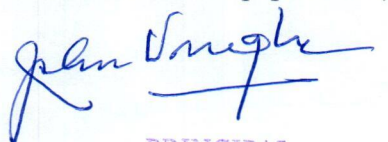
(15 Lectures)

Practical : 60 Hours

Demonstration cum laboratory sessions on the construction and use of Vernier callipers, screw gauge and travelling microscope, and necessary precautions during their use.

Sessions and exercises on the least count errors, their propagation and recording in final result up to correct significant digits, linearization of data and the use of slope and intercept to determine unknown quantities.

Session on the writing of scientific laboratory reports, which may include theoretical and practical significance of the experiment performed, apparatus description, relevant theory, necessary precautions to be taken during the experiment, proper recording of observations, data analysis, estimation of the error and explanation of its sources, correct recording of the result of the experiment, and proper referencing of the material taken from other sources (books, websites, research papers, etc.)


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At least 06 experiments from the following

1. Measurements of length (or diameter) using Vernier Calliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the motion of the spring and calculate (a) Spring constant and, (b) g.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine g and velocity for a freely falling body using Digital Timing Technique.
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.

References for Theory:

Essential Readings:

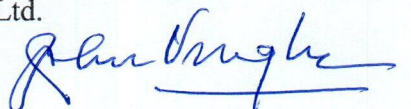
1. An Introduction to Mechanics (2/e), Daniel Kleppner & Robert Kolenkow, 2014, Cambridge University Press.
2. Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education.
3. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education.
4. Intermediate Dynamics, Patrick Hamill, 2010, Jones and Bartlett Publishers.
5. Analytical Mechanics, G. R. Fowles and G. L. Cassiday, 2005, Cengage Learning.

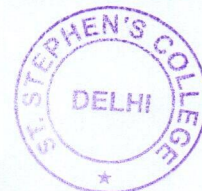
Additional Readings:

1. Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
2. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
3. University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
4. Fundamentals of Physics, Resnick, Halliday & Walker 10/e, 2013, Wiley.
5. Engineering Mechanics, Basudeb Bhattacharya, 2/e, 2015, Oxford University Press.
6. Physics for Scientists and Engineers, R. A. Serway, J. W. Jewett, Jr, 9/e, 2014, Cengage Learning.
7. Mechanics, D. S. Mathur, P. S. Hemne, 2012, S. Chand.

References for Laboratory Work:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.


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3. Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11/e, 2011, Kitab Mahal.

CC-III: Electricity and Magnetism (32221201)

Credit: 06 (Theory-04, Practical-02)

Theory: 60 Hours

Practical: 60 Hours

Course Objective

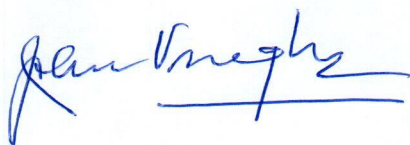
This course reviews the concepts of electromagnetism learnt at school from a more advanced perspective and goes on to build new concepts. The course covers static and dynamic electric and magnetic fields, and the principles of electromagnetic induction. It also includes analysis of electrical circuits and introduction of network theorems. The students will be able to apply the concepts learnt to several real world problems.

Course Learning Outcomes

At the end of this course the student will be able to

- Demonstrate the application of Coulomb's law for the electric field, and also apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- Demonstrate an understanding of the relation between electric field and potential, exploit the potential to solve a variety of problems, and relate it to the potential energy of a charge distribution.
- Apply Gauss's law of electrostatics to solve a variety of problems.
- Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws)
- Understand the concepts of induction and self-induction, to solve problems using Faraday's and Lenz's laws.
- Understand the basics of electrical circuits and analyze circuits using Network Theorems.
- In the laboratory course the student will get an opportunity to verify network theorems and study different circuits such as RC circuit, LCR circuit. Also, different methods to measure low and high resistance, capacitance, self-inductance, mutual inductance, strength of a magnetic field and its variation in space will be learnt.

Unit 1



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3. Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11/e, 2011, Kitab Mahal.

CC-III: Electricity and Magnetism (32221201)

Credit: 06 (Theory-04, Practical-02)

Theory: 60 Hours

Practical: 60 Hours

Course Objective

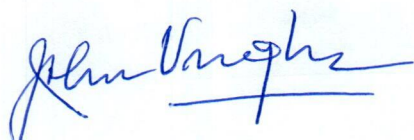
This course reviews the concepts of electromagnetism learnt at school from a more advanced perspective and goes on to build new concepts. The course covers static and dynamic electric and magnetic fields, and the principles of electromagnetic induction. It also includes analysis of electrical circuits and introduction of network theorems. The students will be able to apply the concepts learnt to several real world problems.

Course Learning Outcomes

At the end of this course the student will be able to

- Demonstrate the application of Coulomb's law for the electric field, and also apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- Demonstrate an understanding of the relation between electric field and potential, exploit the potential to solve a variety of problems, and relate it to the potential energy of a charge distribution.
- Apply Gauss's law of electrostatics to solve a variety of problems.
- Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws)
- Understand the concepts of induction and self-induction, to solve problems using Faraday's and Lenz's laws.
- Understand the basics of electrical circuits and analyze circuits using Network Theorems.
- In the laboratory course the student will get an opportunity to verify network theorems and study different circuits such as RC circuit, LCR circuit. Also, different methods to measure low and high resistance, capacitance, self-inductance, mutual inductance, strength of a magnetic field and its variation in space will be learnt.

Unit 1



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Electric Field and Electric Potential: Electric field: Electric field lines. Electric flux. Gauss Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

(6 Lectures)

Conservative nature of Electrostatic Field: Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.

(6 Lectures)

Electrostatic energy of system of charge: Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

(10 Lectures)

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics.

(8 Lectures)

Unit 2

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

(9 Lectures)

Magnetic Properties of Matter: Magnetization vector (**M**). Magnetic Intensity (**H**). Magnetic Susceptibility and permeability. Relation between **B**, **H**, **M**. Ferromagnetism. B-H curve and hysteresis.

(4 Lectures)

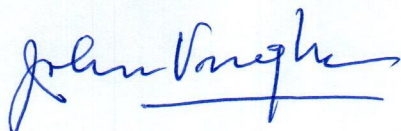
Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

(6 Lectures)

Unit 3

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

(5 Lectures)



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Network theorems: Ideal constant-voltage and constant-current Sources. Review of Kirchhoff's Current Law & Kirchhoff's Voltage Law. Mesh & Node Analysis. Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem. Applications to dc circuits.

(6 Lectures)

Practical : 60 Hours

Dedicated demonstration cum laboratory sessions on the construction, functioning and uses of different electrical bridge circuits, and electrical devices like the ballistic galvanometer.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.

Sessions on least square fitting and computer programme to find slope and intercept of straight-line graphs of experimental data. Application to the specific experiments done in the lab.

At least 6 experiments from the following:

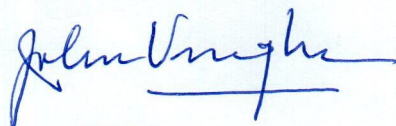
1. To study the characteristics of a series RC Circuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Foster's Bridge.
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton theorems.
7. To verify the Superposition, and Maximum power transfer theorems.
8. To determine self inductance of a coil by Anderson's bridge.
9. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
10. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
11. Measurement of charge sensitivity, current sensitivity and CDR of Ballistic Galvanometer
12. Determine a high resistance by leakage method using Ballistic Galvanometer.
13. To determine self-inductance of a coil by Rayleigh's method.
14. To determine the mutual inductance of two coils by Absolute method.

References for Theory:

Essential Readings:

1. Fundamentals of Electricity and Magnetism, Arthur F. Kip, 2nd Edn. 1981, McGraw-Hill.
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
5. Network, Lines and Fields, John D. Ryder, 2nd Edn., 2015, Pearson.

Additional Readings:



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1. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
2. Electricity, Magnetism & Electromagnetic Theory, S.Mahajanand Choudhury, 2012, Tata McGraw
3. Electricity and Magnetism, J.H.Fewkes& J.Yarwood. Vol.I, 1991, Oxford Univ. Press.
4. Problems and Solutions in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan & Ravi Varshney.
5. Schaum's Outline of Electric Circuits, J. Edminister & M. Nahvi, 3rd Edn., 1995, McGraw Hill.

References for Laboratory Work:

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

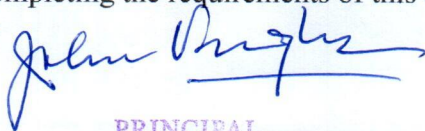
CC-IV: Waves and Optics (32221202) Credit : 06 (Theory-04, Practical-02) Theory : 60 Hours Practical : 60 Hours

Course Objective

This course reviews the concepts of waves and optics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with explaining ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. The course also provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.

Course Learning Outcomes

On successfully completing the requirements of this course, the students will have the skill and knowledge to:



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1. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
2. Electricity, Magnetism & Electromagnetic Theory, S.Mahajanand Choudhury, 2012, Tata McGraw
3. Electricity and Magnetism, J.H.Fewkes& J.Yarwood. Vol.I, 1991, Oxford Univ. Press.
4. Problems and Solutions in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan & Ravi Varshney.
5. Schaum's Outline of Electric Circuits, J. Edminister & M. Nahvi, 3rd Edn., 1995, McGraw Hill.

References for Laboratory Work:

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

CC-IV: Waves and Optics (32221202)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

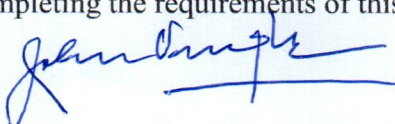
Practical : 60 Hours

Course Objective

This course reviews the concepts of waves and optics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with explaining ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. The course also provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.

Course Learning Outcomes

On successfully completing the requirements of this course, the students will have the skill and knowledge to:


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- Understand Simple harmonic oscillation and superposition principle.
- Understand different types of waves and their velocities: Plane, Spherical, Transverse, Longitudinal.
- Understand Concept of normal modes in transverse and longitudinal waves: their frequencies and configurations.
- Understand Interference as superposition of waves from coherent sources derived from same parent source.
- Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture, understand Fraunhofer and Fresnel Diffraction.
- In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt first hand. The motion of coupled oscillators, study of Lissajous figures and behaviour of transverse, longitudinal waves can be learnt in this laboratory course.

Unit 1

Superposition of Collinear Harmonic oscillations: Simple harmonic motion (SHM). Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

(6 Lectures)

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies and their uses.

(2 Lectures)

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

(4 Lectures)

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

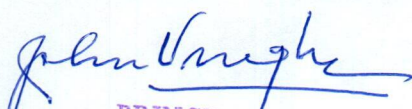
(8 Lectures)

Unit 2

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

(4 Lectures)

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination


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(Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

(10 Lectures)

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

(6 Lectures)

Unit 3

Diffraction:

Fraunhofer diffraction: Single slit. Rectangular and Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

(10 Lectures)

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Cornu's spiral and its applications. Straight edge, a slit and a wire.

(10 Lectures)

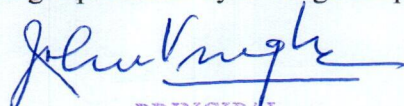
Practical: 60 Hours

Dedicated demonstration cum laboratory session on the construction, and use of spectrometer and lasers, and necessary precautions during their use.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab.

At least 06 experiments from the following:

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2-T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster's focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.


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11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

References for Theory:

Essential Readings:

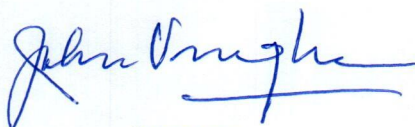
1. Vibrations and Waves, A.P. French, 1stEdn., 2003, CRC press.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
4. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
5. Optics, Eugene Hecht, 4thEdn., 2014, Pearson Education.

Additional Readings:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. Optics, (2017), 6th Edition, Ajoy Ghatak, McGraw-Hill Education, New Delhi
4. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications

References for Laboratory Work:

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press



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CC-V: Mathematical Physics-II (32221301)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

Course Objective

The emphasis of course is to equip students with the mathematical tools required in solving problems interest to physicists and expose them to fundamental computational physics skills thus enabling them to solve a wide range of physics problems. This course will aim at introducing the concepts of Fourier series, special functions, linear partial differential equations by separation of variable method.

Course Learning Outcomes

On successfully completing this course, the students will be able to

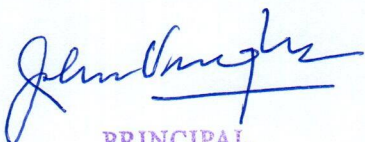
- Represent a periodic function by a sum of harmonics using Fourier series and their applications in physical problems such as vibrating strings etc.
- Obtain power series solution of differential equation of second order with variable coefficient using Frobenius method.
- Understand properties and applications of special functions like Legendre polynomials, Bessel functions and their differential equations and apply these to various physical problems such as in quantum mechanics.
- Learn about gamma and beta functions and their applications.
- Solve linear partial differential equations of second order with separation of variable method.
- In the laboratory course, the students will learn the basics of the Scilab software/Python interpreter and apply appropriate numerical method to solve selected physics problems both using user defined and inbuilt functions from Scilab/Python. They will also learn to generate and plot Legendre polynomials and Bessel functions and verify their recurrence relation.

Unit 1

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Even and odd functions and their Fourier expansions (Fourier Cosine Series and Fourier Sine Series). Application. Summing of Infinite Series. Parseval's Identity and its application to summation of infinite series.

(17 Lectures)

Unit 2


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Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations: Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions ($J_0(x)$ and $J_1(x)$) and Orthogonality.

(24 Lectures)

Unit 3

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions.

(4 Lectures)

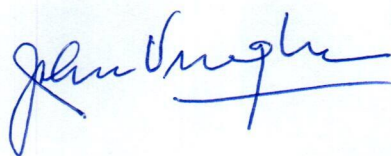
Unit 4

Partial Differential Equations: Solutions to partial differential equations (2 or 3 independent variables) using separation of variables: Laplace's Equation in problems of rectangular geometry. Solution of wave equation for vibrational modes of a stretched string, rectangular and circular membranes. Solution of 1D heat flow equation. (Wave/Heat equation not to be derived).

(15 Lectures)

Practical : 60 Hours

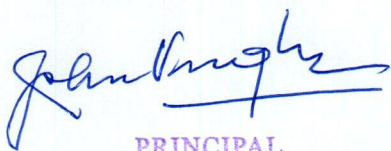
The aim of this Lab is to use the computational methods to solve physical problems. The course will consist of practical sessions and lectures on the related theoretical aspects. The recommended group size for the lab is not more than 15 students. Evaluation done not only on the basis of programming but also on the basis of formulating the problem. Minimum 12 programs must be attempted taking at least one from each programming section. The instructor may choose to use Python in place of Scilab covering all features as mentioned.

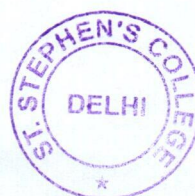


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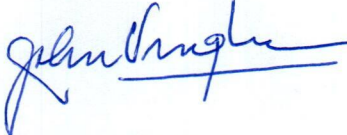


Topics	Description with Applications
Introduction to Numerical computation software using Scilab or Python	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initializing variables in Scilab, Multidimensional arrays, Sub-array, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting, Branching Statements and program design, Relational and logical operators, the while loop, for loop, details of loop operations, break and continue statements, nested loops, logical arrays and vectorization. User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program.
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation. Lagrange Interpolation.	Evaluation of trigonometric functions e.g. $\sin(x)$, $\cos(x)$, $\tan(x)$ etc – Given the values at n points in a tabulated form, evaluate the value at an intermediate point.
Numerical Integration: Newton Cotes Integration methods (Trapezoidal and Simpson rules) for definite integrals	Given acceleration with equidistant time data calculate position and velocity and plot them. Application to other mathematical and physical problems
Solution of Linear system of equations: Solve system of linear equations using Gauss elimination method and Gauss Seidal method. Inverse of a matrix (by Gauss elimination)	Application to Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)


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Generation of Special functions using user defined functions and compare with Scilab built in functions	Generating and plotting Legendre Polynomials Generating and plotting Bessel functions Verification of recurrence relation Use the data obtained above for Legendre polynomials or Bessel's function at N points and find its value at an intermediate point using Lagrange interpolation.
Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods	First order differential equation (Initial value problems) Radioactive decay Current in RC, LC circuits with DC source Newton's law of cooling Classical equations of motion
System of First order Differential Equations	Attempt following problems using RK 4 order method: - Solve the coupled differential equations $dx/dt=y+x-x^3/3$; $dy/dt= -x$ for four initial conditions : $x(0) = 0$, $y(0) = -1, -2, -3, -4$. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$ - Application to linear electric networks


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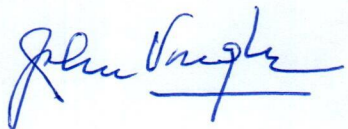


Second order differential equation (Euler and RK Methods)	Second Order Differential Equations: Harmonic oscillator (no friction) Damped Harmonic oscillator (Overdamped, Critically damped and Oscillatory behavior) Forced Harmonic oscillator (Transient and Steady state solution) Apply above to LCR circuits also The differential equation describing the motion of a pendulum is $\frac{d^2\theta}{dt^2} = -\sin\theta$. The pendulum is released from rest at an angular displacement α, i.e. $\theta(0) = \alpha$ and $\dot{\theta}(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot $\theta, \frac{d\theta}{dt}$ as a function of time in the range $0 \leq t \leq 8\pi$. Also plot the analytic solution valid for small θ ($\sin\theta \approx \theta$) Solve $x^2 \frac{d^2y}{dx^2} - 4x(1+x) \frac{dy}{dx} + 2(1+x)y = x^3$ with the initial conditions at $x = 1$ as $y(1) = \frac{1}{2}e^2, \frac{dy}{dx}(x=1) = \frac{-3}{2}e^2 - 0.5,$ in the range $1 < x < 3$. Plot y and $\frac{dy}{dx}$ against x in the given range on the same graph.
Using Scicos/xcos	Generating sine wave, square wave, sawtooth wave Solution of harmonic oscillator Phase space plots

References for Theory:

Essential Readings :

1. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India .
2. Advanced Mathematics for Engineers and Scientists: Schaum Outline Series, M. R Spiegel, McGraw Hill Education (2009).
3. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
4. Mathematical Methods for Physicists, Arfken, Weber and Harris, Elsevier
5. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Harvill, Dover Publications (2014).


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Additional Readings:

1. Mathematical methods for Scientists & Engineers, D.A. Mc Quarrie, 2003, Viva Books
2. Mathematical Methods for Physics and Engineers, K.F. Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
3. Mathematical Physics, A.K. Ghatak, I.C. Goyal and S.J. Chua, Laxmi Publications Private Limited (2017)
4. Partial Differential Equations for Scientists and Engineers, S.J. Farlow, Dover Publications (1993).
5. Fourier Analysis with Applications to Boundary Value Problems: Schaum Outline Series, M. R. Spiegel, McGraw Hill Education (1974).

References for Laboratory Work:

1. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896.
2. Documentation at the Scilab homepage: <https://www.scilab.org/> and the Python home page <https://docs.python.org/3/>
3. Computational Physics, Darren Walker, Scientific International Pvt. Ltd (2015).
4. Applied numerical analysis, Cutis F. Gerald and P.O. Wheatley, Pearson Education, India (2007).
5. An Introduction to Computational Physics, T. Pang, Cambridge University Press (2010).

CC-VI: Thermal Physics (32221302)**Credit : 06 (Theory-04, Practical-02)****Theory : 60 Hours****Practical : 60 Hours****Course Objective**

This course deals with the relationship between the macroscopic properties of physical systems in equilibrium. It reviews the concepts of thermodynamics learnt at school from a more advanced perspective and develops them further. The primary goal is to understand the fundamental laws of thermodynamics and their applications to various systems and processes. In addition, it will also give exposure to students about the Kinetic theory of gases, transport phenomena involved in ideal gases, phase transitions and behavior of real gases.



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Additional Readings:

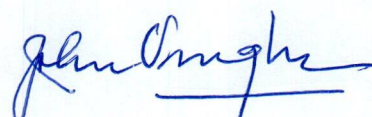
1. Mathematical methods for Scientists & Engineers, D.A. Mc Quarrie, 2003, Viva Books
2. Mathematical Methods for Physics and Engineers, K.F. Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
3. Mathematical Physics, A.K. Ghatak, I.C. Goyal and S.J. Chua, Laxmi Publications Private Limited (2017)
4. Partial Differential Equations for Scientists and Engineers, S.J. Farlow, Dover Publications (1993).
5. Fourier Analysis with Applications to Boundary Value Problems: Schaum Outline Series, M. R. Spiegel, McGraw Hill Education (1974).

References for Laboratory Work:

1. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896.
2. Documentation at the Scilab homepage: <https://www.scilab.org/> and the Python homepage <https://docs.python.org/3/>
3. Computational Physics, Darren Walker, Scientific International Pvt. Ltd (2015).
4. Applied numerical analysis, Cutis F. Gerald and P.O. Wheatley, Pearson Education, India (2007).
5. An Introduction to Computational Physics, T. Pang, Cambridge University Press (2010).

CC-VI: Thermal Physics (32221302)**Credit : 06 (Theory-04, Practical-02)****Theory : 60 Hours****Practical : 60 Hours****Course Objective**

This course deals with the relationship between the macroscopic properties of physical systems in equilibrium. It reviews the concepts of thermodynamics learnt at school from a more advanced perspective and develops them further. The primary goal is to understand the fundamental laws of thermodynamics and their applications to various systems and processes. In addition, it will also give exposure to students about the Kinetic theory of gases, transport phenomena involved in ideal gases, phase transitions and behavior of real gases.


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Course Learning Outcomes

At the end of the course, students will be able to:

- Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics.
- Understand the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.
- Know about reversible and Irreversible processes.
- Learn about Maxwell's relations and use them for solving many problems in Thermodynamics
- Understand the concept and behavior of ideal and real gases.
- Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equitation of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.
- In the laboratory course, the students are expected to do some basic experiments in thermal Physics, viz., determination of Mechanical Equivalent of Heat (J), coefficient of thermal conductivity of good and bad conductor, temperature coefficient of resistance, variation of thermo-emf of a thermocouple with temperature difference at its two junctions and calibration of a thermocouple.

Unit 1

Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.

(8 Lectures)

Unit 2

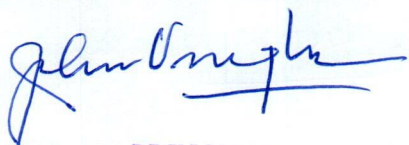
Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

(10 lectures)

Unit 3

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature-Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

(7 lectures)



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Unit 4

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations.

Maxwell's Thermodynamic Relations: Derivation of Maxwell's thermodynamic Relations and their applications, Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Value of $C_p - C_v$, (3) Tds Equations, (4) Energy equations.

(14 lectures)

Unit 5

Kinetic Theory of Gases Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

Molecular Collisions: Mean Free Path. Collision Probability. Estimation of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

(11 lectures)

Unit 6

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. Andrew's Experiments on CO₂ Gas. Virial Equation. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. p-V Diagrams. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and vander Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.

(10 lectures)

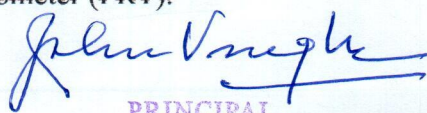
Practical: 60 Hours

Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the thermal physics lab, including necessary precautions.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab.

At least six experiments should be performed in the lab:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).


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6. To study the variation of Thermo-emf of a Thermocouple with Difference of Temperature of its Two Junctions using a null method. And also calibrate the Thermocouple in a specified temperature range.
7. To calibrate a thermocouple to measure temperature in a specified Range using Op-Amp difference amplifier and to determine Neutral Temperature.

References for Theory:

Essential Readings:

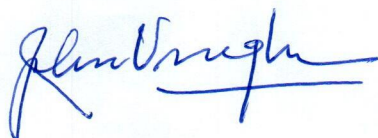
1. Heat and Thermodynamics: M.W. Zemansky and R.Dittman, (Tata McGraw-Hill.)
2. A Treatise on Heat :M.N.Saha and B.N.Srivastava, 1958 (Indian Press.)
3. Thermal Physics: S. C.Garg, R. M. Bansal and C. K. Ghosh (Tata McGraw-Hill.)
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics :Sears and Salinger (Narosa).
5. Concepts in Thermal Physics: Blundell and Blundell (Oxford Univ. press)

Additional Readings:

1. An Introduction to Thermal Physics: D. Schroeder (Pearson)
2. Thermal Physics :C. Kittel and H. Kroemer (W. H. Freeman)

References for Laboratory work:

1. Advanced Practical Physics for students: B. L. Flint and H.T.Worsnop (Little Hampton Book)
2. A Text Book of Practical Physics : InduPrakash& Ramakrishna(KitabMahal)
3. Advanced level Practical Physics: Nelkon and Ogborn (Heinemann Educational Publ.)
4. An Advanced Course in Practical Physics: D. Chattopadhyay& P. C. Rakshit, (New Central Book Agency)
5. Practical Physics: G.L. Squires (Cambridge University Press)



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5. Digital Design, Morris Mano, 5th Ed. Pearson.

Additional Readings :

1. Digital Electronics G K Kharate ,2010, Oxford University Press
2. Logic circuit design, Shimon P. Vingron, 2012, Springer
3. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning. Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill

References for Laboratory Work :

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill
2. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, McGraw Hill.
3. Microprocessor 8085: Architecture, Programming and interfacing, A.Wadhwa,2010, PHI Learning

CC-VIII: Mathematical Physics III (32221401)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

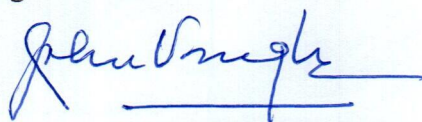
Course Objective

The emphasis of the course is on applications in solving problems of interest to physicists. Students will be examined on the basis of problems, seen and unseen. The course will develop understanding of the basic concepts underlying complex analysis and complex integration and enable student to use Fourier and Laplace Transform to solve real world problems.

Course Learning Outcomes

After completing this course, student will be able to

- Determine continuity, differentiability and analyticity of a complex function, find the derivative of a function and understand the properties of elementary complex functions.
- Work with multi-valued functions (logarithmic, complex power, inverse trigonometric function) and determine branches of these functions
- Evaluate a contour integral using parametrization, fundamental theorem of calculus and Cauchy's integral formula.


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- Find the Taylor series of a function and determine its radius of convergence.
- Determine the Laurent series expansion of a function in different regions, find the residues and use the residue theory to evaluate a contour integral and real integral.
- Understand the properties of Fourier and Laplace transforms and use these to solve boundary value problems.
- In the laboratory course, the students will learn the basics of the Scilab software/Python interpreter and apply appropriate numerical method to solve selected physics problems both using user defined and inbuilt functions from Scilab/Python.

Unit 1

Complex Analysis

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De-Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Equations. Examples of analytic functions. Singularities: poles, removable singularity, essential singularity, branch points, branch cut. Integration of a function of a complex variable. Cauchy-Goursat Theorem, Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application of Contour Integration in solving Definite Integrals.

(30 Lectures)

Unit 2

Integrals Transforms

Fourier Transforms: Fourier Integral theorem (Statement only). Fourier Transform (FT). Examples: FT of single pulse, trigonometric, exponential and Gaussian functions. FT of derivatives, Inverse FT, Convolution theorem. Properties of FT s (translation, change of scale, complex conjugation, etc.). Solution of one dimensional Wave Equation using FT. Fourier Sine Transform (FST) and Fourier Cosine Transform (FCT).

(12 Lectures)

Unit 3

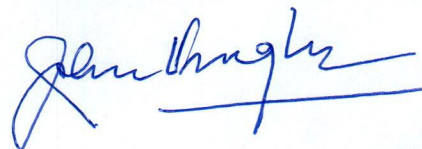
Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations, Coupled differential equations of 1st order. Solution of 1-D heat equation (semi-infinite bar) using LT.

(15 Lectures)

Unit 4

Dirac delta function: Definition and properties. Representation of Dirac delta function as a Fourier Integral. Laplace and Fourier Transform of Dirac delta function.

(3 Lectures)



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Practical: 60 Hours

The aim of this Lab is to use the computational methods to solve physical problems. The course will consist of practical sessions and lectures on the related theoretical aspects of the Laboratory course. Evaluation done not only on the basis of programming but also on the basis of formulating the problem. **At least ten** programs must be attempted taking at least one from each programming section. The program list is only suggestive and students should be encouraged to do more problems.

C++/C/Scilab/Python based simulations experiments on Mathematical Physics problems like

1. Boundary Value Problems :
 - A. Solution to Ordinary Differential equation (Boundary Value Problems using finite Difference and shooting methods) :
 - i. Solve $y''(x) + y(x) = 0$ with $y(0) = 1$, $y(\pi/2) = 1$ for $0 < x < \pi$.
 - ii. Solve for the steady state concentration profile $y(x)$ in the reaction-diffusion problem given by Solve $y''(x) - y(x) = 0$ with $y(0) = 1$, $y'(1) = 0$.
 - B. Solution to Partial Differential equation: Finite Difference and Crank-Nicholson methods to solve Laplace equation, wave equation, and Heat Equation.
2. Gauss Quadrature Integration Method : Gauss Legendre, Gauss Laguerre and Gauss Hermite. :
 - i. Verification of Orthogonality of Legendre Polynomials.
$$\int_{-1}^{+1} P_n(\mu) P_m(\mu) d\mu = \frac{2}{(2n+1)} \delta_{n,m}$$
 - ii. Complex analysis: Integrate $\int_0^{\infty} \frac{1}{(x^2+2)} dx$ numerically using Gauss Laguerre method and check with contour integration.
3. Dirac Delta Function: representations of Dirac delta function as a limiting sequence of functions. Verify the properties of Dirac Delta function. e.g. Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}} \int \exp\left(\frac{-(x-2)^2}{2\sigma^2}\right) (x+3) dx$, for $\sigma = 1, 0.1, 0.01$ and show that it tends to 5. Use Hermite Gauss quadrature method and also Simpson method with appropriate limits.
4. Fourier Series:

Evaluate the Fourier coefficients of a given periodic function (e.g. square wave, triangle wave, half wave and full wave rectifier etc.)
5. Weighted Least square fitting of given data (x,y) with known error/uncertainty-values using user defined function.
6. Integral transform:
 - i. Discrete and Fast Fourier Transform of given function in tabulated or mathematical form e.g function $\exp(-x^2)$.
 - ii. Perform circuit analysis of a general LCR circuit using Laplace's transform.

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References for Theory:

Essential Readings:

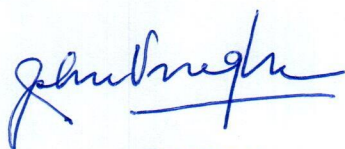
1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Complex Variables and Applications, J.W.Brown & R.V.Churchill, 7th Ed. 2003, Tata McGraw-Hill.
3. Laplace Transform: Schaum's Outline, M.R> Spiegel, McGraw Hill Education.
4. Complex Variables: Schaum's Outline, McGraw Hill Education (2009).
5. Fourier Analysis and Its Applications (Wadsworth and Brooks/Cole Mathematics Series), Gerald B. Folland, Thomson Brooks/Cole (1992).

Additional Readings:

1. Mathematics for Physicists, P.Dennery and A.Krzywicki, 1967, Dover Publications.
2. Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press.
3. Mathematical Physics with Applications, Problems and Solutions, V. Balakrishnan, Ane Books (2017).
4. Fourier Analysis with Applications to Boundary Value Problems: : Schaum Outline Series, M. R Spiegel, McGraw Hill Education (1974).
5. Fourier Transform and its Applications, 2nd Ed., Ronald New Bold Bracewell, McGraw Hill (1978).

References for Laboratory Work:

1. An introduction to computational Physics, T.Pang, 2nd Edn., 2006, Cambridge Univ. Press
2. Applied numerical analysis, Cutis F. Gerald and P.O. Wheatley, Pearson Education, India (2007).
3. Friendly Introduction to Numerical Analysis, Brian Bradie, Pearson Education (2007).
4. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., PHI Learning Pvt. Ltd. (2012).
5. Partial Differential Equations for Scientists and Engineers, S.J. Farlow, Dover Publications (1993).



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CC-IX: Elements of Modern Physics (32221402)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

Course Objective

The objective of this course is to teach the physical and mathematical foundations necessary for learning various topics in modern physics which are crucial for understanding atoms, molecules, photons, nuclei and elementary particles. These concepts are also important to understand phenomena in laser physics, condensed matter physics and astrophysics.

Course Learning Outcomes

After getting exposure to this course, the following topics would be learnt:

- Main aspects of the inadequacies of classical mechanics as well as understanding of the historical development of quantum mechanics.
- Formulation of Schrodinger equation and the idea of probability interpretation associated with wave-functions.
- The spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in details. Basic lasing
- The properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.
- Decay rates and lifetime of radioactive decays like alpha, beta, gamma decay. Neutrino, its properties and its role in theory of beta decay.
- Fission and fusion: Nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.
- In the laboratory course, the students will get opportunity to measure Planck's constant, verify photoelectric effect, determine e/m of electron, Ionization potential of atoms, study emission and absorption line spectra. They will also find wavelength of Laser sources by single and Double slit experiment, wavelength and angular spread of He-Ne Laser using plane diffraction grating.

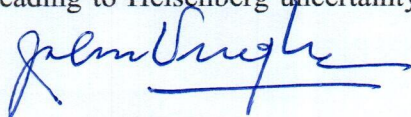
Unit 1

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Double-slit experiment with electrons. Probability. Wave amplitude and wave functions.

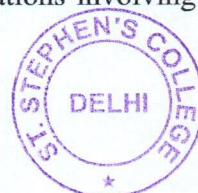
(12 Lectures)

Unit 2

Position measurement : gamma ray microscope thought experiment; Wave-particle duality leading to Heisenberg uncertainty principle; Uncertainty relations involving canonical pair



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of variables: Derivation from Wave Packets; Impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle: origin of natural width of emission lines as well as estimation of the mass of the virtual particle that mediates a force from the observed range of the force

(7 Lectures)

Unit 3

Two-slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

(10 Lectures)

Unit 4

One dimensional infinitely rigid box : energy eigenvalues, eigenfunctions and their normalization; Quantum dot as an example; Quantum mechanical scattering and tunneling in one dimension : across a step potential & across a rectangular potential barrier.

Lasers: Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion.

(14 Lectures)

Unit 5

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, N-Z graph, Liquid Drop model: semi-empirical mass formula and binding energy.

(6 Lectures)

Unit 6

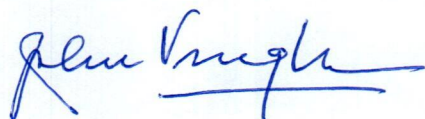
Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay: energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus. Fission and fusion: mass deficit, relativity and generation of energy; Fission : nature of fragments and emission of neutrons. Fusion and thermonuclear reactions driving stellar evolution (brief qualitative discussions).

(11 Lectures)

Practical: 60 Hours

Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the modern physics lab, including necessary precautions.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab.



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At least 05 experiments from the following:

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine angular spread of He-Ne laser using plane diffraction grating

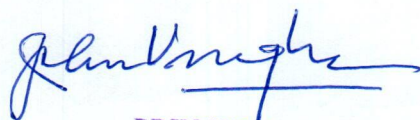
Reference for Theory:

Essential Readings

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Modern Physics by R A Serway, C J Moses and C A Moyer, 3rd edition, Thomson Brooks Cole, 2012.
3. Modern Physics for Scientists and Engineers by S T Thornton and A Rex, 4th edition, Cengage Learning, 2013.
4. Concepts of Nuclear Physics by B L Cohen, Tata McGraw Hill Publication, 1974.
5. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.

Additional Readings:

1. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A. Moore, 2003, McGraw Hill.
2. Thirty years that shook physics: the story of quantum theory, George Gamow, Garden City, NY: Doubleday, 1966.
3. New Physics, ed. Paul Davies, Cambridge University Press (1989).
4. Quantum Theory, David Bohm, Dover Publications, 1979.
5. Lectures on Quantum Mechanics: Fundamentals and Applications, eds. A. Pathak and Ajoy Ghatak, Viva Books Pvt. Ltd., 2019
6. Quantum Mechanics: Theory and Applications, (2019), (Extensively revised 6th Edition), Ajoy Ghatak and S. Lokanathan, Laxmi Publications, New Delhi
7. Basic ideas and concepts in Nuclear Physics: An introductory approach by K Heyde, third edition, IOP Publication, 1999.


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Reference for Laboratory

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

CC-X: Analog Systems and Applications (32221403)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

Course Objective

This course introduces the concept of semiconductor devices and their applications. It also emphasizes on understanding of amplifiers, oscillators, operational amplifier and their applications.

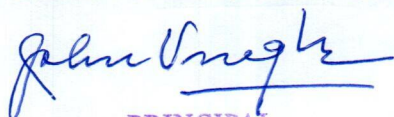
Course Learning Outcomes

At the end of this course, the following concepts will be learnt

- Characteristics and working of pn junction.
- Two terminal devices: Rectifier diodes, Zener diode, photodiode etc
- NPN and PNP transistors: Characteristics of different configurations, biasing, stabilization and their applications.
- CE and two stage RC coupled transistor amplifier using h-parameter model of the transistor.
- Designing of different types of oscillators and their stabilities.
- Ideal and practical op-amps: Characteristics and applications.
- In the laboratory course, the students will be able to study characteristics of various diodes and BJT. They will be able to design amplifiers, oscillators and DACs. Also different applications using Op-Amp will be designed.

Unit 1

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Barrier


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Reference for Laboratory

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

CC-X: Analog Systems and Applications (32221403)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

Course Objective

This course introduces the concept of semiconductor devices and their applications. It also emphasizes on understanding of amplifiers, oscillators, operational amplifier and their applications.

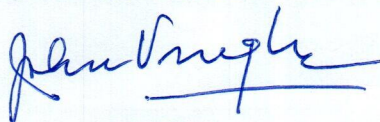
Course Learning Outcomes

At the end of this course, the following concepts will be learnt

- Characteristics and working of pn junction.
- Two terminal devices: Rectifier diodes, Zener diode, photodiode etc
- NPN and PNP transistors: Characteristics of different configurations, biasing, stabilization and their applications.
- CE and two stage RC coupled transistor amplifier using h-parameter model of the transistor.
- Designing of different types of oscillators and their stabilities.
- Ideal and practical op-amps: Characteristics and applications.
- In the laboratory course, the students will be able to study characteristics of various diodes and BJT. They will be able to design amplifiers, oscillators and DACs. Also different applications using Op-Amp will be designed.

Unit 1

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Barrier



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Width and Current for abrupt Junction. Equation of continuity, Current Flow Mechanism in Forward and Reverse Biased Diode.

(9 Lectures)

Unit 2

Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter, (2) Zener Diode and Voltage Regulation. Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell, Qualitative idea of Schottky diode and Tunnel diode.

(7 Lectures)

Unit 3

Bipolar Junction transistors: n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains α and β . Relations between α and β . Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow.

(6 Lectures)

Unit 4

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.

(10 Lectures)

Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response.

(4 Lectures)

Unit 5

Feedback in Amplifiers: Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

(4 Lectures)

Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.

(4 Lectures)

Unit 6

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.

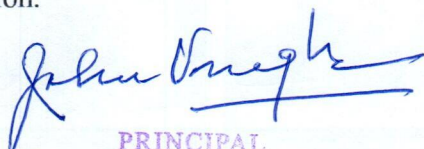
(4 Lectures)

Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Comparator and Zero crossing detector (8) Wein bridge oscillator.

(9 Lectures)

Conversion: D/A Resistive networks (Weighted and R-2R Ladder). Accuracy and Resolution.

(3 Lectures)


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Practical : 60 Hours

Session on the construction and use of specific analogue devices and experimental apparatuses used in the lab, including necessary precautions.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab.

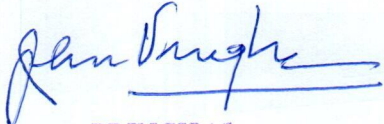
At least 08 experiments from the following:

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
4. To study the various biasing configurations of BJT for normal class A operation.
5. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6. To study the frequency response of voltage gain of a two stage RC-coupled transistor amplifier.
7. To design a Wien bridge oscillator for given frequency using an op-amp.
8. To design a phase shift oscillator of given specifications using BJT.
9. To design a digital to analog converter (DAC) of given specifications.
10. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
11. (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response
(b) To design non-inverting amplifier using Op-amp (741,351) and study frequency response
12. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode
(b) To study the zero-crossing detector and comparator.
13. To design a precision Differential amplifier of given I/O specification using Op-amp.
14. To investigate the use of an op-amp as an Integrator.
15. To investigate the use of an op-amp as a Differentiator.
16. To design a circuit to simulate the solution of simultaneous equation and 1st/2nd order differential equation.

References for Theory:

Essential Readings :

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
4. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
5. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
6. Electronic Principles, A. Malvino, D.J. Bates, 7th Edition, 2018, Tata Mc-Graw Hill Education.
7. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson


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Additional Readings:

1. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI
2. Learning Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill OP-Amps
3. Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning
4. Microelectronic Devices & Circuits, David A.Bell, 5th Edn.,2015, Oxford University Press
5. Basic Electronics: Principles and Applications, C.Saha, A.Halder, D.Ganguli, 1st Edition, 2018, Cambridge University Press

References for Laboratory Work:

1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, Mc-Graw Hill. OP-Amps

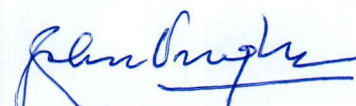
CC-XI: Quantum Mechanics & Applications (32221501)**Credit : 06 (Theory-04, Practical-02)****Theory : 60 Hours****Practical : 60 Hours****Course Objective**

After learning the elements of modern physics, in this course students would be exposed to more advanced concepts in quantum physics and their applications to problems of the sub atomic world.

Course Learning Outcomes

The Students will be able to learn the following from this course:

- Methods to solve time-dependent and time-independent Schrodinger equation.
- Quantum mechanics of simple harmonic oscillator.
- Non-relativistic hydrogen atom: spectrum and eigenfunctions.


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- Angular momentum: Orbital angular momentum and spin angular momentum.
- Bosons and fermions - symmetric and anti-symmetric wave functions.
- Application to atomic systems
- In the laboratory course, with the exposure in computational programming in the computer lab, the student will be in a position to solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one-dimensional and three dimensional potentials.

Unit 1

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function: Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

(12 Lectures)

Unit 2

Time independent Schrodinger equation: Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle.

(12 Lectures)

Unit 3

General discussion of bound states in an arbitrary potential: continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator: energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.

(10 Lectures)

Unit 4

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground and first excited states; Orbital angular momentum quantum numbers l and m ; s, p, d shells.

(10 Lectures)

Unit 5

Atoms in Electric and Magnetic Fields: Electron angular momentum. Angular momentum quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin


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Magnetic Moment. Stern-Gerlach Experiment. Normal Zeeman Effect: Electron Magnetic Moment and Magnetic Energy.

(8 Lectures)

Unit 6

Many electron atoms: Pauli's Exclusion Principle. Symmetric and Anti-symmetric Wave Functions. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Spin-orbit coupling in atoms-L-S and J-J couplings.

(8 Lectures)

Practical : 60 Hours

Use C/C++/Scilab/Python for solving the following problems based on Quantum Mechanics like:

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$$\frac{d^2 y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2} [V(r) - E] \text{ where } V(r) = \frac{-e^2}{r}$$

where m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take $e = 3.795$ (eVÅ)^{1/2}, $\hbar c = 1973$ (eVÅ) and $m = 0.511 \times 10^6$ eV/c².

2. Solve the s-wave radial Schrodinger equation for an atom:

$$\frac{d^2 y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2} [V(r) - E]$$

where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

$$V(r) = \frac{-e^2}{r} e^{-r/a}$$

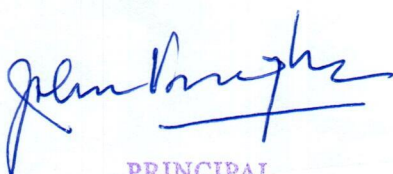
Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take $e = 3.795$ (eVÅ)^{1/2}, $m = 0.511 \times 10^6$ eV/c², and $a = 3$ Å, 5 Å, 7 Å. In these units $\hbar c = 1973$ (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$$\frac{d^2 y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2} [V(r) - E]$$

For an harmonic oscillator potential

$$V(r) = \frac{1}{2} k r^2 + \frac{1}{3} b r^3$$



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for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $m = 940 \text{ MeV}/c^2$, $k = 100 \text{ MeV fm}^{-2}$, $b = 0, 10, 30 \text{ MeV fm}^{-3}$. In these units, $\hbar c = 197.3 \text{ MeV fm}$. The ground state energy is expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

$$\frac{d^2 y}{dr^2} = A(r)u(r), A(r) = \frac{2\mu}{\hbar^2} [V(r) - E]$$

Where μ is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D(e^{-2\alpha r} - e^{-\alpha r}), r = \frac{r - r_0}{r_0}$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take: $m = 940 \times 10^6 \text{ eV}/c^2$, $D = 0.755501 \text{ eV}$, $\alpha = 1.44$, $r_0 = 0.131349 \text{ \AA}$

Where μ is the reduced mass of the two-atom system for the Morse potential

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take: $m = 940 \times 10^6 \text{ eV}/c^2$, $D = 0.755501 \text{ eV}$, $\alpha = 1.44$, $r_0 = 0.131349 \text{ \AA}$

Laboratory based experiments (Optional):

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. Quantum efficiency of CCD

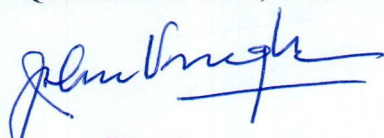
References for Theory

Essential Readings

1. Quantum Mechanics, B. H. Bransden and C. J. Joachain; 2nd Ed., Prentice Hall, 2000.
2. A Text book of Quantum Mechanics, P.M. Mathews and K. Venkatesan, 2nd Ed., 2010, McGraw Hill.
3. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press.
4. Quantum Mechanics: Theory and Applications, (2019), (Extensively revised 6th Edition), Ajoy Ghatak and S. Lokanathan, Laxmi Publications, New Delhi.
5. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education.

Additional Readings

1. Introduction to Quantum Mechanics, R. H. Dicke and J. P. Wittke, Addison-Wesley Publications, 1966.
2. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
3. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.


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4. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
5. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer.
6. Introductory Quantum Mechanics, R. L. Liboff; 4th Ed., Addison Wesley, 2003.
7. Quantum Mechanics: Concepts and Applications, 2nd Edition, Nouredine Zettili, A John Wiley and Sons, Ltd., Publication

References for Laboratory Work:

1. Schaum's outline of Programming with C++. J. Hubbard, 2000, McGraw- Hill Publication
2. An introduction to computational Physics, T. Pang, 2nd Edn., 2006, Cambridge Univ. Press
3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer.
4. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press.

CC-XII: Solid State Physics (32221502)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

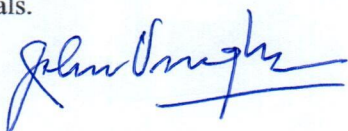
Course Objective

This course introduces the basic concepts and principles required to understand the various properties exhibited by condensed matter, especially solids. It enables the students to appreciate how the interesting and wonderful properties exhibited by matter depend upon its atomic and molecular constituents. The gained knowledge helps to solve problems in solid state physics using relevant mathematical tools. It also communicates the importance of solid state physics in modern society.

Course Learning Outcomes

On successful completion of the module students should be able to

- Elucidate the concept of lattice, crystals and symmetry operations.
- Understand the elementary lattice dynamics and its influence on the properties of materials.



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4. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
5. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer.
6. Introductory Quantum Mechanics, R. L. Liboff, 4th Ed., Addison Wesley, 2003.
7. Quantum Mechanics: Concepts and Applications, 2nd Edition, Nouredine Zettili, A John Wiley and Sons, Ltd., Publication

References for Laboratory Work:

1. Schaum's outline of Programming with C++. J. Hubbard, 2000, McGraw- Hill Publication
2. An introduction to computational Physics, T. Pang, 2nd Edn., 2006, Cambridge Univ. Press
3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer.
4. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press.

CC-XII: Solid State Physics (32221502)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

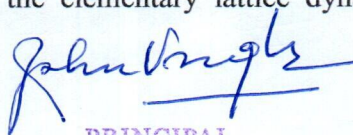
Course Objective

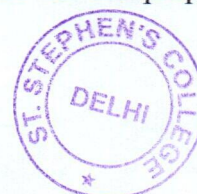
This course introduces the basic concepts and principles required to understand the various properties exhibited by condensed matter, especially solids. It enables the students to appreciate how the interesting and wonderful properties exhibited by matter depend upon its atomic and molecular constituents. The gained knowledge helps to solve problems in solid state physics using relevant mathematical tools. It also communicates the importance of solid state physics in modern society.

Course Learning Outcomes

On successful completion of the module students should be able to

- Elucidate the concept of lattice, crystals and symmetry operations.
- Understand the elementary lattice dynamics and its influence on the properties of materials.


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- Describe the main features of the physics of electrons in solids: origin of energy bands, and their influence electronic behavior.
- Explain the origin of dia-, para-, and ferro-magnetic properties of solids.
- Explain the origin of the dielectric properties exhibited by solids and the concept of polarizability.
- Understand the basics of phase transitions and the preliminary concept and experiments related to superconductivity in solid.
- In the laboratory students will carry out experiments based on the theory that they have learned to measure the magnetic susceptibility, dielectric constant, trace hysteresis loop. They will also employ to four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.

Unit 1

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Types of Lattices. Unit Cell, Symmetry and Symmetry Elements. Miller Indices. Reciprocal Lattice. Brillouin Zones. Diffraction of X-rays: single crystal and powder method. Bragg's Law, Laue Condition. Ewalds' construction. Atomic and Geometrical Factor. Simple numerical problem on SC, BCC, FCC.

(14 Lectures)

Unit 2

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law.

(10 Lectures)

Unit 3

Electrons in Solids: Electrons in metals- Introduction to Drude Model, Density of states (1-D, 2-D, 3-D) (basic idea), Elementary band theory: Kronig Penney model. Band Gap, direct and indirect bandgap. Effective mass, mobility, Hall Effect (Metal and Semiconductor).

(10 Lectures)

Unit 4

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia- and Para- magnetism. Hunds's rule. Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Curie's law. B-H Curve. soft and hard material and Energy Loss Hysteresis.

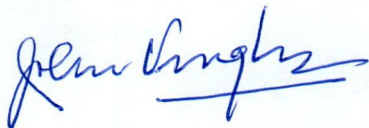
(9 Lectures)

Unit 5

Dielectric Properties of Materials: Polarization. Local Electric Field in solids. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mossotti Equation. Classical Theory of Electric Polarizability. AC polarizability, Normal and Anomalous Dispersion. Complex Dielectric Constant. Langevin-Debye equation.

(9 Lectures)

Unit 6



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Introduction to basics of phase transitions: Landau theory for ferromagnetic materials (No derivation).

(3 Lectures)

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation).

(5 Lectures)

Practical : 60 Hours

Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the solid state physics lab, including necessary precautions.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab.

At least 06 experiments from the following:

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method).
2. To measure the Magnetic susceptibility of solids.
3. To determine the Coupling Coefficient of a piezoelectric crystal.
4. To study the dielectric response of materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of a metal using Surface Plasmon Resonance (SPR) technique.
6. To determine the refractive index of a dielectric material using SPR technique.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Iron (Fe) using solenoid & determine the energy loss from Hysteresis loop.
9. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150°C) by four-probe method and determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.
11. Analysis of X-Ray diffraction data in terms of unit cell parameters and estimation of particle size.
12. Measurement of change in resistance of a semiconductor with magnetic field.

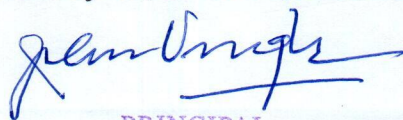
References for Theory:

Essential Readings:

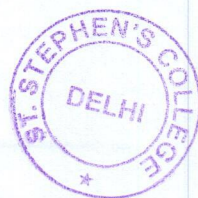
1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill.
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning.
5. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer.

Additional Readings

1. Elementary Solid State Physics, M.Ali Omar, 2006, Pearson
2. Solid State Physics, Rita John, 2014, McGraw Hill



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3. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.

References for Practical:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

CC-XIII: Electromagnetic Theory (32221601)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

Course Objective

This core course develops further the concepts learnt in the electricity and magnetism course to understand the properties of electromagnetic waves in vacuum and different media.

Course Learning Outcomes

At the end of this course the student will be able to:

- Apply Maxwell's equations to deduce wave equation, electromagnetic field energy, momentum and angular momentum density.
- Understand electromagnetic wave propagation in unbounded media: Vacuum, dielectric medium, conducting medium, plasma.
- Understand electromagnetic wave propagation in bounded media: reflection and transmission coefficients at plane interface in bounded media.
- Understand polarization of Electromagnetic Waves: Linear, Circular and Elliptical Polarization. Production as well as detection of waves in laboratory.
- Learn the features of planar optical wave guide.
- Understand the fundamentals of propagation of electromagnetic waves through optical fibres.


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3. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.

References for Practical:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
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5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

CC-XIII: Electromagnetic Theory (32221601)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

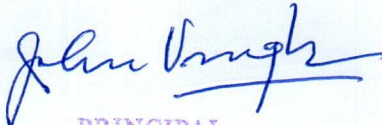
Course Objective

This core course develops further the concepts learnt in the electricity and magnetism course to understand the properties of electromagnetic waves in vacuum and different media.

Course Learning Outcomes

At the end of this course the student will be able to:

- Apply Maxwell's equations to deduce wave equation, electromagnetic field energy, momentum and angular momentum density.
- Understand electromagnetic wave propagation in unbounded media: Vacuum, dielectric medium, conducting medium, plasma.
- Understand electromagnetic wave propagation in bounded media: reflection and transmission coefficients at plane interface in bounded media.
- Understand polarization of Electromagnetic Waves: Linear, Circular and Elliptical Polarization. Production as well as detection of waves in laboratory.
- Learn the features of planar optical wave guide.
- Understand the fundamentals of propagation of electromagnetic waves through optical fibres.


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- In the laboratory course, the student get an opportunity to perform experiments with Polarimeter, Babinet Compensator, Ultrasonic grating, simple dipole antenna. Also, to study phenomena of interference, refraction, diffraction and polarization.

Unit 1

Maxwell Equations: Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Poynting's Theorem and Poynting's Vector. Electromagnetic (em) Energy Density. Physical Concept of Electromagnetic Field Energy Density. Momentum Density and Angular Momentum Density.

(12 Lectures)

Unit 2

EM Wave Propagation in Unbounded Media: Plane em waves through vacuum and isotropic dielectric medium: transverse nature, refractive index, dielectric constant, wave impedance. Plane em waves through conducting medium: relaxation time, skin depth, attenuation constant. Wave propagation through dilute plasma: electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth.

(10 Lectures)

Unit 3

EM Waves in Bounded Media: Boundary conditions at a plane interface between two media. Reflection & Refraction of plane em waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence)

(10 Lectures)

Unit 4

Polarization of EM Waves: Propagation of em waves in an Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Description of Linear, Circular and Elliptical Polarization. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light

(12 Lectures)

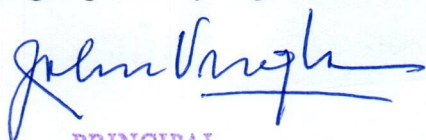
Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.

(5 Lectures)

Unit 5

Wave Guides: Planar optical wave guides. Planar dielectric wave guide ($-d/2 < x < d/2$). Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.

(8 Lectures)



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Optical Fibres: Acceptance Angle, Numerical Aperture. Step and Graded Index fibres (Definitions Only). Single and Multiple Mode Fibres.

(3 Lectures)

Practical: 60 Hours

Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the lab, including necessary precautions.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab.

At least 06 experiments from the following

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan's law of radiation and to determine Stefan's constant.
12. To determine Boltzmann constant using V-I characteristics of PN junction diode.
13. To find Numerical Aperture of an Optical Fibre.
14. To verify Brewster's Law and to find the Brewster's angle.

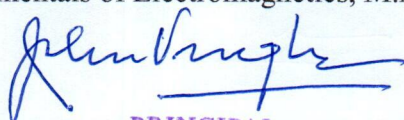
References for Theory:

Essential Readings:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Electromagnetic Field and Waves, P. Lorrain and D. Corson, 2nd Ed., 2003, CBS Publisher.
3. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 2010, Wiley
4. Principle of Optics, M. Born and E. Wolf, 6th Edn., 1980, Pergamon Press
5. Optics, (2017), 6th Edition, Ajoy Ghatak, McGraw-Hill Education, New Delhi

Additional Readings:

1. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
2. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill


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3. Problems and solution in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan & Ravi Varshney.
4. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
5. Engineering Electromagnetic, William H. Hayt, 8th Edition, 2012, McGraw Hill.
6. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.

References for Laboratory Work:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
3. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.

CC-XIV: Statistical Mechanics (32221602)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

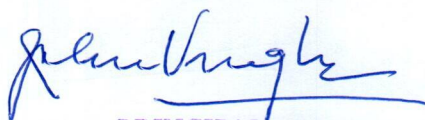
Course Objective

Statistical Mechanics deals with the derivation of the macroscopic parameters (internal energy, pressure, specific heat etc.) of a physical system consisting of large number of particles (solid, liquid or gas) from knowledge of the underlying microscopic behavior of atoms and molecules that comprises it. The main objective of this course work is to introduce the techniques of Statistical Mechanics which has applications in various fields including Astrophysics, Semiconductors, Plasma Physics, Bio-Physics etc. and in many other directions.

Course Learning Outcomes

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

- Understand the concepts of microstate, macrostate, phase space, thermodynamic probability and partition function.
- Understand the use of Thermodynamic probability and Partition function for calculation of thermodynamic variables for physical system (Ideal gas, finite level system).


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3. Problems and solution in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan & Ravi Varshney.
4. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
5. Engineering Electromagnetic, William H. Hayt, 8th Edition, 2012, McGraw Hill.
6. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.

References for Laboratory Work:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
3. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.

CC-XIV: Statistical Mechanics (32221602)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

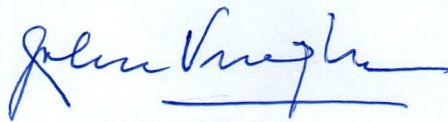
Course Objective

Statistical Mechanics deals with the derivation of the macroscopic parameters (internal energy, pressure, specific heat etc.) of a physical system consisting of large number of particles (solid, liquid or gas) from knowledge of the underlying microscopic behavior of atoms and molecules that comprises it. The main objective of this course work is to introduce the techniques of Statistical Mechanics which has applications in various fields including Astrophysics, Semiconductors, Plasma Physics, Bio-Physics etc. and in many other directions.

Course Learning Outcomes

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

- Understand the concepts of microstate, macrostate, phase space, thermodynamic probability and partition function.
- Understand the use of Thermodynamic probability and Partition function for calculation of thermodynamic variables for physical system (Ideal gas, finite level system).


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- Difference between the classical and quantum statistics
- Understand the properties and Laws associated with thermal radiation.
- Apply the Fermi-Dirac distribution to model problems such as electrons in solids and white dwarf stars
- Apply the Bose-Einstein distribution to model problems such as blackbody radiation and Helium gas.
- In the laboratory course, with the exposure in computer programming and computational techniques, the student will be in a position to perform numerical simulations for solving the problems based on Statistical Mechanics.

Unit 1

Classical

Statistics: Macrostates and Microstates, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur-Tetrode equation. Saha's Ionization Formula. Law of Equipartition of Energy (with proof)—Applications to Specific Heat of gas and solids and its Limitations, Thermodynamic Functions of a Finite Level System, Negative Temperature.

(24 Lectures)

Unit 2

Bose-Einstein Statistics: B-E Distribution law, Thermodynamic functions of a strongly degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law.

(12 Lectures)

Unit 3

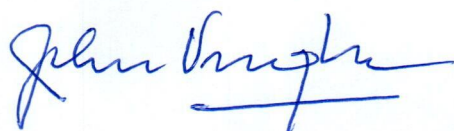
Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly degenerate Fermi Gas, Fermi Energy Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.

(12 Lectures)

Unit 4

Theory of Radiation: Properties of Thermal Radiation and Radiation Pressure. Blackbody Radiation and its spectral distribution. Kirchhoff law. Stefan-Boltzmann law and its Thermodynamic proof. Wien's Displacement law. Wien's Distribution Law. Rayleigh-Jean's Law. Ultraviolet Catastrophe. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation Deduction of Wien's Distribution Law, Rayleigh-Jeans Law, Stefan-Boltzmann Law and Wien's Displacement law from Planck's law.

(12 Lectures)



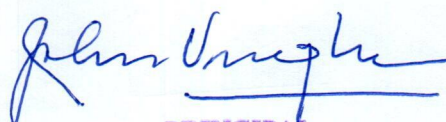
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Practical: 60 Hours

Use C/C++/Scilab/Python/other numerical simulations for solving the problems based on Statistical Mechanics like:

1. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
 - a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations
 - b) Study of transient behavior of the system (approach to equilibrium)
 - c) Relationship of large N and the arrow of time
 - d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution.
2. Plot the probability of various macrostates in coin-tossing experiment (two level system) versus number of heads with 4, 8, 16 coins etc.
3. Computation of the partition function $Z(b)$ for the systems with a finite number of single particle levels (e.g., 2 level, 3 level etc.) and finite number of non-interacting particles N under Maxwell-Boltzmann/ Fermi-Dirac/Bose Einstein statistics:
 - a) Study the behavior of $Z(b)$, average energy, C_v , and entropy and its dependence upon the temperature, total number of particles N and the spectrum of single particle energy states.
 - b) Plot the probability of occupancy of all the states w.r.t. temperature.
4. Plot the Maxwell speed distribution function at different temperatures in a 3-dimension system. Calculate the average speed, root mean square and most probable speed
5. Plot Specific Heat of Solids w.r.t temperature
 - a) Dulong-Petit law,
 - b) Einstein distribution function
 - c) Debye distribution function
6. Plot the following functions with energy at different temperatures
 - a) Maxwell-Boltzmann distribution
 - b) Fermi-Dirac distribution
 - c) Bose-Einstein distribution
7. Plot the distribution of particles w.r.t. energy (dN/de versus e) in 3 Dimensions for
 - a) Relativistic and non-relativistic bosons both at high and low temperature.
 - b) Relativistic and non-relativistic fermions both at high and low temperature.
8. Plot Planck's law of Black body radiation w.r.t. wavelength/frequency at different temperatures. Compare it with Rayleigh-Jeans Law and Wien's distribution law for a given temperature.


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References for Theory:

Essential Readings:

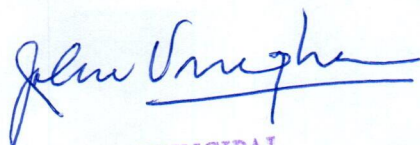
1. Statistical Mechanics: R.K. Pathria and P. D. Beale(Academic Press)
2. Introductory Statistical Mechanics: R. Bowley and M. Sanchez (Oxford Univ.Press)
3. Statistical Physics: F. Mandl (Wiley)
4. A treatise on Heat : M.N. Saha and B.N. Srivastava (Indian Press)
5. Problems and Solutions on Thermodynamics andStatistical Mechanics : Lim Yung-Kou (Sarat Book House)

Additional Readings:

- 1.Statistical Physics: Berkeley Physics Course, F. Reif, (McGraw-Hill)
- 2.An Introduction to Statistical Physics: W.G.V. Rosser(Wiley)
3. An Introduction to Thermal Physics: D. Schroeder (Pearson)
4. Concepts in Thermal Physics: Blundell and Blundell (Oxford Univ. press)
5. Statistical and Thermal Physics:Loknathan and Gambhir (PHI)

References for Laboratory work:

1. Elementary Numerical Analysis: K.E. Atkinson (Wiley)
2. Introduction to Modern Statistical Mechanics: D. Chandler (Oxford University Press)
3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics : F . W. Sears and G. L. Salinger (Narosa)
4. Modern Thermodynamics with Statistical Mechanics: Carl S. Helrich(Springer)
5. Statistical and Thermal Physics with Computer Applications : H. Gould and J.Tobochnik(Princeton University Press)



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SEC: Computational Physics Skills (32223902)

Credit:04 (Theory-02, Practical-02)

Theory: 30 Hours

Practical : 60 Hours

Course Objectives

This course is intended to give an insight to computer hardware and computer applications. Students will familiarize with use of computer to solve physics problems. They will learn a programming language namely fortran and data visualization using GNU plot. Further they will also learn to prepare long formatted document using latex.

Course Learning Outcomes

Students will be able to

- Use computers for solving problems in Physics.
- Prepare algorithms and flowcharts for solving a problem.
- Use Linux commands on terminal
- Use an unformatted editor to write sources codes.
- Learn “Scientific Word Processing”, in particular, using LaTeX for preparing articles, papers etc. which include mathematical equations, picture and tables.
- Learn the basic commands of Gnuplot.

Unit 1

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor.

Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of $\sin(x)$ as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

(4 Lectures)

Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.


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(5 Lectures)

Unit 2

Control Statements: Types of Logic(Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO- CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems Programming:

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using $\exp(x)$ series evaluated at $x=1$

(6 Lectures)

Unit 3

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

(6 Lectures)

Unit 4

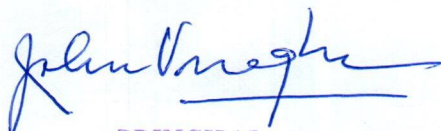
Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot.importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

(9 Lectures)

Practicals/Hands on exercises:

PRACTICALS-SEC LAB: Computational Physics Skills Lab

Teacher may give long duration project based on this paper.



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1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

References

1. Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
2. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
3. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010).
4. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
5. Elementary Numerical Analysis, K.E.Atkinson,3rd Edn., 2007, Wiley India Edition.

SEC: Electrical circuits and Network Skills (32223903)

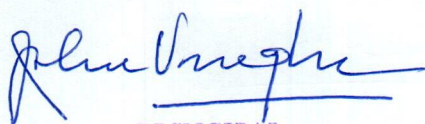
Credit:04 (Theory-02, Practical-02)

Theory: 30 Hours

Practical : 60 Hours

Course Objectives

To develop an understanding of basic principles of electricity and its household applications. To impart basic knowledge of solid state devices and their applications, understanding of electrical wiring and installation.



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- Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.
 - Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rd Edn., 2012, Oxford University Press.
 - Renewable Energy, 3rd Edition,
 - Solar Energy: Resource Assessment Handbook, P Jayakumar, 2009
 - J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
 - http://en.wikipedia.org/wiki/Renewable_energy
-

TECHNICAL DRAWING

Theory: 30 Lectures

Introduction: Drafting Instruments and their uses. lettering: construction and uses of various scales: dimensioning as per I.S.I. 696-1972. Engineering Curves: Parabola: hyperbola: ellipse: cycloids, involute: spiral: helix and loci of points of simple moving mechanism. 2D geometrical construction. Representation of 3D objects. Principles of projections. (4 Lectures)

Projections: Straight lines, planes and solids. Development of surfaces of right and oblique solids. Section of solids. (6 Lectures)

Object Projections: Orthographic projection. Interpenetration and intersection of solids. Isometric and oblique parallel projection of solids. (4 Lectures)

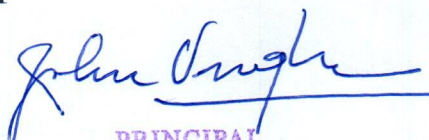
CAD Drawing: Introduction to CAD and Auto CAD, precision drawing and drawing aids, Geometric shapes, Demonstrating CAD- specific skills (graphical user interface. Create, retrieve, edit, and use symbol libraries. Use inquiry commands to extract drawing data). Control entity properties. Demonstrating basic skills to produce 2-D and 3-D drawings. 3D modeling with Auto CAD (surfaces and solids), 3D modeling with sketch up, annotating in Auto CAD with text and hatching, layers, templates & design center, advanced plotting (layouts, viewports), office standards, dimensioning, internet and collaboration, Blocks, Drafting symbols, attributes, extracting data. basic printing, editing tools, Plot/Print drawing to appropriate scale. (16 Lectures)

Reference Books:

- Engineering Drawing, N.S. Parthasarathy and Vele Murali, 1st Edition, 2015, Oxford University Press
 - Engineering Graphic, K. Venugopal, and V. Raja Prabhu, New Age International
 - AutoCAD 2014 & AutoCAD 2014/Donnie Gladfelter/Sybex/ISBN:978-1-118-57510-9
 - Architectural Design with Sketchup/Alexander Schreyer/John Wiley & Sons/ISBN: 978-1-118-12309-6
-

RADIATION SAFETY

Theory: 30 Lectures


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DSE: Advanced Mathematical Physics - I (32227502)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

Course Objective

The course is intended to impart the concept of generalized mathematical constructs in terms of Algebraic Structures (mainly Vector Spaces) and Tensors to have in-depth analysis of our physical system.

Course Learning Outcomes

At the end of this course, students will be able to

- Understand algebraic structures in n-dimension and basic properties of the linear vector spaces.
- Represent Linear Transformations as matrices and understand basic properties of matrices.
- Apply vector spaces and matrices in the quantum world.
- Learn basic properties of Cartesian and general tensors with physical examples such as moment of inertia tensor, energy momentum tensor, stress tensor, strain tensor etc.
- Learn how to express the mathematical equations for the Laws of Physics in their co-variant forms.
- In the laboratory course, the students are expected to solve the problems using the Scilab/C++/Python computer language: Eigenvalues and Eigenvectors of given matrix, determination of wave functions for stationary states as eigenfunctions, eigen energy values of Hermitian differential operators, Lagrangian formulation in classical dynamics etc.

Unit 1

Linear Vector Spaces Abstract Systems: Binary Operations and Relations. Introduction to Groups and Fields.

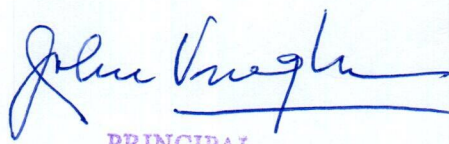
Vector Spaces and Subspaces. Linear Independence and Dependence of Vectors. Basis and Dimensions of a Vector Space. Change of basis. Homomorphism and Isomorphism of Vector Spaces. Linear Transformations. Algebra of Linear Transformations. Non-singular Transformations. Representation of Linear Transformations by Matrices.

(12 Lectures)

Unit 2

Matrices, Addition and Multiplication of Matrices: Null Matrices. Diagonal, Scalar and Unit Matrices. Upper- Triangular and Lower-Triangular Matrices. Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew-Hermitian Matrices. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices. Similar Matrices. Trace of a Matrix. Inner Product.

(8 Lectures)


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Unit 3

Eigen-values and Eigenvectors: Finding Eigen – values and Eigen vectors of a Matrix. Diagonalization of Matrices. Properties of Eigen-values and Eigen Vectors of Orthogonal, Hermitian and Unitary Matrices. Cayley-Hamilton Theorem (Statement only). Finding inverse of a matrix using Cayley-Hamilton Theorem. Use of Matrices in Solving ordinary second order differential equations and Coupled Linear Ordinary Differential Equations of first order. Functions of a Matrix.

(10 Lectures)

Unit 4

Cartesian Tensors: Transformation of Co-ordinates and fundamentals of Tensors. Einstein's Summation Convention. Relation between Direction Cosines. Algebra of Tensors: Sum, Difference and Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Invariant Tensors: Kronecker and Alternating Tensors. Association of Anti-symmetric Tensor of Order Two and Vectors.

(8 lectures)

Unit 5

Applications of Cartesian Tensors: Vector Calculus using Cartesian Tensors: Scalar and Vector Products of 2, 3, 4 vectors. Gradient, Divergence and Curl of Tensor Fields. Tensor notation of Laplacian operator. Proof of Vector Identities involving scalar and vector products and vector identities involving Del operator using Tensor notation. Isotropic Tensors (Definition only). Tensorial Character of Physical Quantities. Moment of Inertia Tensor. Stress and Strain Tensors: Symmetric Nature. Elasticity Tensor. Generalized Hooke's Law.

(12 lectures)

Unit 6

General Tensors: Transformation of Co-ordinates. Contravariant & Covariant Vectors. Contravariant, Covariant and Mixed Tensors. Kronecker Delta and Permutation Tensors. Algebra of Tensors. Sum, Difference & Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti- symmetric Tensors. Metric Tensor in cartesian, cylindrical, spherical coordinates.

(10 Lectures)

Practical: 60 Hours

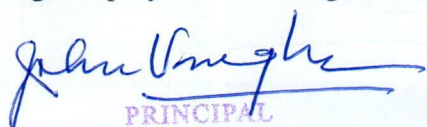
PRACTICAL- DSE LAB: Advanced Mathematical Physics-I

Scilab/C++/Python based simulations experiments based on Mathematical Physics problems like (at least 06 experiments)

1. Linear algebra: Power and Inverse Power methods for finding largest and smallest Eigenvalue and eigenvectors of matrices. QR method e.g.

$$\begin{pmatrix} 2 & 1 & 1 \\ 1 & 3 & 2 \\ 3 & 1 & 4 \end{pmatrix}; \begin{pmatrix} 1 & -i & 3+4i \\ +i & 2 & 4 \\ 3-4i & 4 & 3 \end{pmatrix}; \begin{pmatrix} 2 & -i & 2i \\ +i & 4 & 3 \\ -2i & 3 & 5 \end{pmatrix}$$

2. Orthogonal polynomials as eigenfunctions of Hermitian differential operators.


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3. Determination of the principal axes of moment of inertia through diagonalization (Matrix can be generated for a given distribution of discrete masses).
4. Study of geodesics in Euclidean and other spaces (surface of a sphere, etc): Using variational principal to find the shortest curve between two points. Suggested Physics problem: problem of refraction.
5. Application to solve differential equations for a bound system – Eigen value problem.
6. Application to computer graphics:
Write operators for shear, strain, two dimensional rotational problems, Reflection, Translation etc. Plot old and new coordinates.
7. Lagrangian formulation in classical mechanics with constraints.
8. Vector space of wave functions in Quantum Mechanics: Position and Momentum differential operators and their commutator, wave functions for stationary states as eigenfunction

Note: Students opting for Linear algebra and Tensor analysis as one option in DSE cannot opt Advanced mathematical physics-I course as second option.

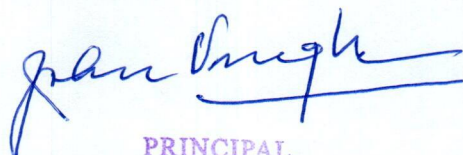
References for Theory:

Essential Readings:

1. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications
2. Theory and Problems of Linear Algebra, Seymour Lipschutz, 1987, McGraco-Hill Inc.
3. Theory and Problems of Vector Analysis and an introduction to Tensor Analysis, Murray R. Spiegel, 1974, McGraw Hill, Inc.
4. Introduction to Matrices & Linear Transformations, D.T.Finkbeiner, 1978, Dover Pub.
5. Matrices and tensors in Physics: A.W. Joshi, New Age International Pvt. Ltd (2017).

Additional Readings:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber and F.E.Harris, 1970, Elsevier.
2. Elementary Linear Algebra, Applications Version, Howard Anton and Chris Rorres, Wiley Student edition.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole
4. Introduction to Vectors and Tensors, Ray M Bowen, C -C Wang, Dover Publications (2009)
5. An Introduction to Linear Algebra and Tensors, M A Akivis, V V Goldberg, Richard and Silverman, Dover Publications (2012)
6. Vector Analysis and Cartesian Tensors, D.E. Bourne and P.C. Kendall, CRC Press (1992).
7. Cartesian Tensors, Harold Jeffreys, Cambridge University Press (1931).


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References for Laboratory Work:

1. Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444
2. Learning Scientific Programming with Python, Christian Hill, Cambridge University Press (2016)
3. Computational Problems for Physics: With Guided Solutions Using Python, Rubin H. Landau, Manuel José Páez, CRC Press (2018).
4. Numerical Recipes in C⁺⁺: The Art of Scientific Computing, W.H. Press et.al., 2ndEdn., Cambridge University Press (2013).
5. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.

DSE: Nuclear and Particle Physics (32227504)

Credit : 06 (Theory-05, Tutorial-01)

Theory : 75 Hours

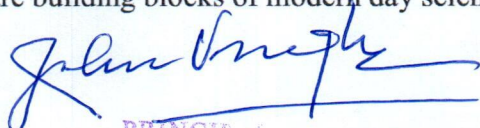
Tutorial : 15 Hours

Course Objective

The objective of the course is to impart the understanding of the sub atomic particles and their properties. It will emphasize to gain knowledge about the different nuclear techniques and their applications in different branches Physics and societal application. The course will focus on the developments of problem based skills.

Course Learning Outcomes

- To be able to understand the basic properties of nuclei as well as knowledge of experimental determination of the same, the concept of binding energy, its various dependent parameters, N-Z curves and their significance
- To appreciate the formulations and contrasts between different nuclear models such as Liquid drop model, Fermi gas model and Shell Model and evidences in support.
- Knowledge of radioactivity and decay laws. A detailed analysis, comparison and energy kinematics of alpha, beta and gamma decays.
- Familiarization with different types of nuclear reactions, Q- values, compound and direct reactions.
- To know about energy losses due to ionizing radiations, energy losses of electrons, gamma ray interactions through matter and neutron interaction with matter. Through the section on accelerators students will acquire knowledge about Accelerator facilities in India along with a comparative study of a range of detectors and accelerators which are building blocks of modern day science.


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References for Laboratory Work:

1. Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444
2. Learning Scientific Programming with Python, Christian Hill, Cambridge University Press (2016)
3. Computational Problems for Physics: With Guided Solutions Using Python, Rubin H. Landau, Manuel José Páez, CRC Press (2018).
4. Numerical Recipes in C⁺⁺: The Art of Scientific Computing, W.H. Press et.al., 2ndEdn., Cambridge University Press (2013).
5. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.

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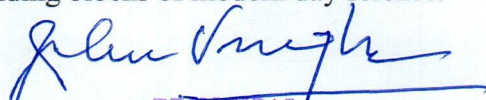
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- Familiarization with different types of nuclear reactions, Q- values, compound and direct reactions.
- To know about energy losses due to ionizing radiations, energy losses of electrons, gamma ray interactions through matter and neutron interaction with matter. Through the section on accelerators students will acquire knowledge about Accelerator facilities in India along with a comparative study of a range of detectors and accelerators which are building blocks of modern day science.


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- It will acquaint students with the nature and magnitude of different forces, particle interactions, families of sub-atomic particles with the different conservation laws, concept of quark model.
- The acquired knowledge can be applied in the areas of nuclear medicine, medical physics, archaeology, geology and other interdisciplinary fields of Physics and Chemistry. It will enhance the special skills required for these fields.

Unit 1

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density, matter density (experimental determination of each), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/Z plot, angular momentum, parity, magnetic moment, electric moments.

(10 Lectures)

Unit 2

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, nucleon separation energies (up to two nucleons), Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure and the basic assumptions of shell model.

(11 Lectures)

Unit 3

Radioactivity decay: Decay rate and equilibrium (Secular and Transient) (a) Alpha decay: basics of α -decay processes, theory of α -emission, Gamow factor, Geiger Nuttall law, α -decay spectroscopy, decay Chains. (b) β -decay: energy kinematics for β -decay, β -spectrum, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission from the excited state of the nucleus & kinematics, internal conversion.

(10 Lectures)

Unit 4

Nuclear Reactions: Types of Reactions, units of related physical quantities, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

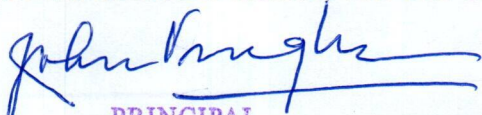
(8 Lectures)

Unit 5

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter (photoelectric effect, Compton scattering, pair production), neutron interaction with matter.

(9 Lectures)

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle for ionization chamber and GM Counter. Basic principle of Scintillation Detectors


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and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

(9 Lectures)

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons (Principal, construction, working, advantages and disadvantages).

(7 Lectures)

Unit 6

Particle physics: Particle interactions (concept of different types of forces), basic features, Cosmic Rays, types of particles and its families, Conservation Laws (energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness) concept of quark model, color quantum number and gluons.

(11 Lectures)

References for Theory :

Essential Readings:

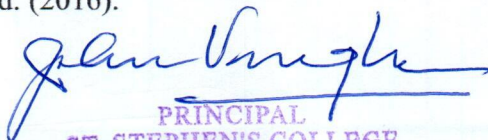
1. Basic ideas and concepts in Nuclear Physics: An introductory approach by K Heyde, third edition, IOP Publication, 1999.
2. Nuclear Physics by S N Ghoshal, First edition, S. Chand Publication, 2010.
3. Introductory Nuclear Physics by K S Krane, Wiley-India Publication, 2008.
4. Nuclear Physics: principles and applications by J Lilley, Wiley Publication, 2006.
5. Radiation detection and measurement, G F Knoll, John Wiley & Sons, 2010.
6. Introduction to elementary particles by D J Griffiths, Wiley, 2008.

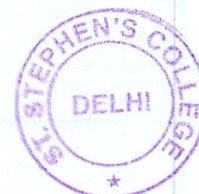
Additional Readings:

1. Concepts of Nuclear Physics by B L Cohen, Tata McGraw Hill Publication, 1974.
2. Physics and Engineering of Radiation Detection by S N Ahmed, Academic Press Elsevier, 2007.
3. Techniques for Nuclear and Particle Physics experiments by WR Leo, Springer, 1994.
4. Modern Physics by R A Serway, C J Moses and C A Moyer, 3rd edition, Thomson Brooks Cole, 2012.
5. Modern Physics for Scientists and Engineers by S T Thornton and A Rex, 4th edition, Cengage Learning, 2013.
6. Modern Physics by R A Serway, C J Moses and C A Moyer, 3rd edition, Thomson Brooks Cole, 2012.
7. Concepts of Modern Physics by Arthur Beiser, McGraw Hill Education, 2009.

References for Tutorial:

1. Schaum's Outline of Modern Physics, McGraw-Hill, 1999.
2. Schaum's Outline of College Physics, by E. Hecht, 11th edition, McGraw Hill, 2009.
3. Modern Physics by K Sivaprasath and R Murugesan, S Chand Publication, 2010.
4. Nuclear Physics "Problem-based Approach" Including MATLAB by Hari M. Aggarwal, PHI Learning Pvt. Ltd. (2016).


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DSE: Astronomy and Astrophysics (32227506)

Credit : 06 (Theory-05, Tutorial-01)

Theory : 75 Hours

Tutorial : 15 Hours

Course Objective

This course is designed to provide students with the basic knowledge about the theory and techniques of observational astronomy and physics of the astrophysical phenomenon. It applies theoretical concepts and mathematical techniques students have learnt in their earlier courses to astronomical and astrophysical phenomenon.

Course Learning Outcomes

Students completing this course will gain an understanding of

- Different types of telescopes, diurnal and yearly motion of astronomical objects, and astronomical coordinate systems and their transformations.
- Brightness scale for stars, types of stars, their structure and evolution on HR diagram.
- Components of Solar System and its evolution
- The large scale structure of the Universe and its history
- Distribution of chemical compounds in the interstellar medium and astrophysical conditions necessary for the emergence and existence of life.

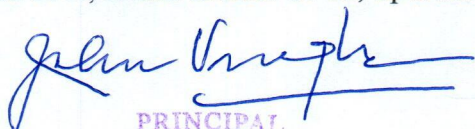
Unit 1

Introduction to Astronomy and Astronomical Scales: Overview of the Night Sky, Diurnal and Yearly motions of the Sun, Stars and Constellations. Size, Mass, Density and Temperature of Astronomical Objects. Basic concepts of Positional Astronomy: Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Horizon System, Equatorial System, Conversion of Coordinates. Rising and Setting Times, Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Astronomical Time Systems (LMT, UT, UTC).

(16 Lectures)

Unit 2

Basic Parameters of Stars: Determination of Distance by Parallax Method; Proper Motion, Brightness, Radiant Flux and Luminosity, Apparent and Absolute Magnitude Scales, Distance Modulus, Extinction, Determination of Temperature and Radius of a star; Stellar Spectra, Atomic Spectra Revisited, Introduction to Boltzmann and Saha Equations, Balmer Lines of H, H and K lines of Ca, Spectral Types and Their Temperature Dependence, Black


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Body Approximation, Luminosity Classification, H R Diagram and Relations Between Stellar Parameters.

(16 Lectures)

Unit 3

Observational Tools and Physical Principles: Observing through the atmosphere (Scintillation, Seeing, Atmospheric Windows and Extinction) Basic Optical Definitions for Telescopes: Magnification, Light Gathering Power, Limiting magnitude, Resolving Power, Diffraction Limit. Optical and Radio Telescopes, Current Indian Observatories. Virial theorem for N particle systems, applications in astrophysics. Systems in Thermodynamic Equilibrium, Equations for Hydrostatic equilibrium, Mean Molecular Weight of stellar gas, Stellar Energy Sources.

(16 Lectures)

Unit 4

Sun and the Milky Way: Solar Parameters, Sun's Internal Structure, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Solar Magneto-Hydrodynamics, Alfvén's Theorem. Basic Structure and Properties of the Milky Way, Nature of rotation of the Milky Way (Differential rotation of the Galaxy and Oort Constants, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Properties of and Around the Galactic Nucleus.

(15 Lectures)

Unit 5

Cosmology: Standard Candles (Cepheids and SNe Type Ia), Cosmic Distance Ladder, Olbers Paradox, Hubble Expansion, Cosmological Principle, Newtonian Cosmology and Friedmann Models

(12 Lectures)

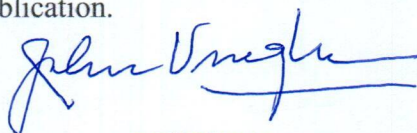
References for Theory :

Essential Readings :

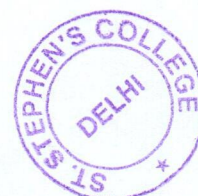
1. Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer
2. Astrophysics Stars and Galaxies K D Abhyankar, Universities Press
3. Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
4. Baidyanath Basu, An introduction to Astrophysics, Second printing, Prentice - Hall of India Private limited, New Delhi, 2001.
5. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing.

Additional Readings:

1. Explorations: Introduction to Astronomy, Thomas Arny and Stephen Schneider, 2014, 7th edition, McGraw Hill
2. Principles of Stellar Dynamics, S Chandrasekhar, Dover Books
3. The Physical Universe: An Introduction to Astronomy, F H Shu, University Science Books
4. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication.



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References

Essential Readings:

1. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications
2. Theory and Problems of Linear Algebra, Seymour Lipschutz, 1987, McGraw-Hill Inc.
3. Theory and Problems of Vector Analysis and an introduction to Tensor Analysis, Murray R. Spiegel, 1974, McGraw Hill, Inc.
4. Introduction to Matrices & Linear Transformations, D.T.Finkbeiner, 1978, Dover Pub.
5. Matrices and tensors in Physics: A.W. Joshi, New Age International Pvt. Ltd (2017).

Additional Readings:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber and F.E.Harris, 1970, Elsevier.
2. Elementary Linear Algebra, Applications Version, Howard Anton and Chris Rorres, Wiley Student edition.
3. Modern Mathematical Methods for Physicists and Engineers, C.D. Cantrell, 2011, Cambridge University Press.
4. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole
5. Introduction to Vectors and Tensors, Ray M Bowen, C -C Wang, Dover Publications (2009)
6. An Introduction to Linear Algebra and Tensors, M A Aklonis, V V Goldberg, Richard and Silverman, Dover Publications (2012)
7. Vector Analysis and Cartesian Tensors, D.E. Bourne and P.C. Kendall, CRC Press (1992).

DSE: Nano Materials and Applications (32227612)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

Practical : 60 Hours

Course Objective

The syllabus introduces the basic concepts and principles to understand nanomaterial. Various nanomaterial synthesis/growth methods and characterizations techniques are discussed to explore the field in detail. The effect of dimensional confinement of charge carries on the electrical, optical and structural properties are discussed. The concept of micro- and nano- electro mechanical systems (MEMS and NEMS) and important applications areas of nanomaterials are discussed.


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Course Learning Outcomes

On successful completion of the module students should be able to

- Explain the difference between nanomaterials and bulk materials and their properties.
- Explain the role of confinement on the density of state function and so on the various properties exhibited by nanomaterials compared to bulk materials.
- Explain various methods for the synthesis/growth of nanomaterials including top down and bottom up approaches.
- Analyze the data obtained from the various characterization techniques
- Explain the concept of Quasi-particles such as excitons and how they influence the optical properties.
- Explain the Interger Quantum Hall Effect and the concept of Landau Levels, and edge states in conductance quantization.
- Explain the conductance quantization in 1D structure and its difference from the 2DEG system.
- Explain various applications of nano particles, quantum dots, nano wires etc
- Explain why nanomaterials exhibit properties which are sometimes very opposite, like magnetic, to their bulk counterparts.
- In the Lab course students will synthesize nanoparticles by different chemical routes and characterize them in the laboratory using the different techniques, learnt in the theory. They will also carry out thin film preparation and prepare capacitors and evaluate its performance. They will fabricate a PN diode and study its I-V characteristics.

Unit 1

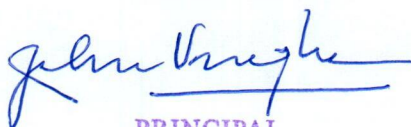
NANOSCALE SYSTEMS: Density of states (3D, 2D, 1D,0D),Length scales in physics, Nanostructures: 1D, 2D and 3D confined nanostructures (thin films, nanowires, nanorods, nanodots), Schrodinger equation- Infinite potential well, potential step, potential box,Band structure and density of states of materials at nanoscale (Quantitative for 3D, 2D, 1D, 0D), Size Effects in nano systems, Applications of quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences on electronic and optical properties. Numerical problems based on above topics.

(14 Lectures)

Unit 2

SYNTHESIS OF NANOSTRUCTURE MATERIALS (Qualitative): Top down and Bottom up approach, Photolithography. Ball milling. Spin coating, Vacuum deposition: Physical vapor deposition (PVD): Thermal evaporation, Sputtering, Pulsed Laser Deposition (PLD), electric arc deposition for CNT, C₆₀, grapheme, Chemical vapor deposition (CVD). Preparation through colloidal methods (Metals, Metal Oxide nanoparticles), Molecular Beam Epitaxy (MBE) growth of quantum dots.

(5 Lectures)



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Unit 3

CHARACTERIZATION: Structure and Surface morphology: X-Ray Diffraction (XRD). Scanning Electron Microscopy (SEM). Transmission Electron Microscopy (TEM). Atomic Force Microscopy (AFM). Scanning Tunneling Microscopy (STM).

Spectroscopy: Working principle of UV-Vis spectroscopy, IR Spectroscopy, Raman and Photoluminescence Spectroscopy and study the size dependent properties using these techniques.

(11 Lectures)

Unit 4

OPTICAL PROPERTIES: Quasi-particles and collective excitations (Qualitative idea). Quantitative treatment of excitons, Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of nanoparticles as a function of size, defects and impurities: deep level and surface defects. Numerical problems based on above topics.

(10 Lectures)

Unit 5

ELECTRON TRANSPORT: time and length scales of electrons in solids, Carrier transport in nanostructures: diffusive and ballistic transport, Charging effect, Coulomb blockade effect. Single electron transfer devices (no derivation). Conductance quantization: 2DEG in GaAs and integer quantum hall effect (Quantitative), conductance quantization in 1D structures using split gate in 2DEG (no derivation). Numerical problems based on above topics.

(14 Lectures)

Unit 6

APPLICATIONS (Qualitative): Applications of nanoparticles, quantum dots, nanowires and thinfilms for photonic devices (LED, solar cells). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots-magnetic data storage. Micro Electromechanical Systems (MEMS), NanoElectromechanical Systems (NEMS).

(6 Lectures)

Practical : 60 Hours

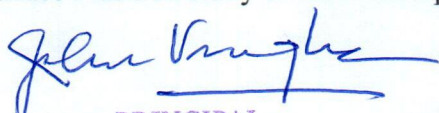
PRACTICALS- DSE LAB: Nano Material and Applications Lab

Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the nano physics lab, including necessary precautions.

Sessions on the review of experimental data analysis and its application to the specific experiments done in the lab.

At least 06 experiments from the following:

1. Synthesis of metal (Au/Ag) nanoparticles by chemical route and study its optical absorption properties.
2. Synthesis of semiconductor (CdS/ZnO/TiO₂/Fe₂O₃etc) nanoparticles and study its XRD and optical absorption properties as a function of time.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.


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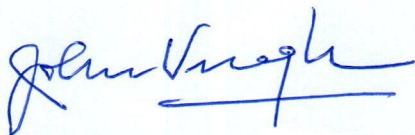
4. Analysis of XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on the color of nanomaterials.
 - (i) To prepare composite of CNTs with other materials.
 - (ii) Growth of quantum dots by thermal evaporation.
 - (iii) Prepare a disc of ceramic of a compound and study its XRD.
 - (iv) Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study its XRD and transmittance spectra in UV-Visible region.
 - (v) Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.
 - (vi) Fabricate a PN junction diode by diffusing Al over the surface of N-type Si/Ge and study its V-I characteristic.
 - (vii) Fabricate thin films (polymer, metal oxide) using electro-deposition
 - (viii) To study variation of resistivity or sheet resistance with temperature of the fabricated thin films using four probe method.

References for Theory:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology 1st edition (2003) Wiley India Pvt.Ltd..
2. S.K. Kulkarni, Nanotechnology: Principles & Practices 2nd edition (2011) (Capital Publishing Company)
3. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (2009) (PHI Learning Private Limited).
4. Introduction to Nanoelectronics, V.V. Mitin, V.A. Kochelap and M.A. Stroscio, 2011, Cambridge University Press.
5. Richard Booker, Earl Boysen, Nanotechnology for Dummies (2005) (Wiley Publishing Inc.).
6. Introductory Nanoscience by Masaru Kuno, (2012) Garland science Taylor and Francis Group
7. Solid State Physics by J. R. Hall and H. E. Hall, 2nd edition (2014) Wiley.
8. Electronic transport in mesoscopic systems by Supriyo Datta (1997) Cambridge University Press.
9. Fundamentals of molecular spectroscopy by C. N. Banwell and E. M. McCASH, 4th edition, McGrawHill. Reference Books for Practicals:
10. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology 1st edition (2003) Wiley India Pvt.Ltd..
11. S.K. Kulkarni, Nanotechnology: Principles & Practices 2nd edition (2011) (Capital Publishing Company)
12. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (2009) (PHI Learning Private Limited).

Additional Resources:

1. Quantum Transport in semiconductor nanostructures by Carla Beenakker and Henk Van Houten (1991) (available at arXiv: cond-mat/0412664) open source
2. Sara Cronewett Ph.D. thesis (2001).


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DSE: Advanced Mathematical Physics-II (32227625)

Credit : 06 (Theory-05, Tutorial-01)

Theory : 75 Hours

Tutorial : 15 Hours

Course Objective

The course is intended to develop new mathematical tools in terms of Calculus of Variation, Group Theory and Theory of Probability in the repertoire of the students to apply in Theoretical and Experimental Physics.

Course Learning Outcomes

After the successful completion of the course, the students shall be able to

- Understand variational principle and its applications: Geodesics in two and three dimensions, Euler Lagrange Equation and simple problems in one and two dimensions.
- Acquire basic concept of Hamiltonian, Hamilton's principle and Hamiltonian equation of motion, Poisson and Lagrange brackets.
- Learn elementary group theory: definition and properties of groups, subgroups, Homomorphism, isomorphism, normal and conjugate groups, representation of groups, Reducible and Irreducible groups.
- Learn the theory of probability: Random variables and probability distributions, Expectation values and variance.

Unit 1

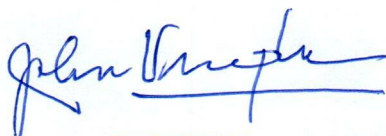
Variable Calculus: Variational Principle, Euler's Equation and its Application to Simple Problems. Geodesics. Calculus of Variations. Concept of Lagrangian: Generalized coordinates. Definition of canonical moment, Euler-Lagrange's Equations of Motion and its Applications to Simple Problems (e.g., Simple Pendulum and One dimensional harmonic oscillator). Definition of Canonical Momenta. Canonical Pair of Variables. Definition of Generalized Force: Definition of Hamiltonian (Legendre Transformation). Hamilton's Principle. Poisson Brackets and their properties. Lagrange Brackets and their properties.

(25 Lectures)

Unit 2

Group Theory: Review of sets, Mapping and Binary Operations, Relation, Types of Relations. Groups: Elementary properties of groups, uniqueness of solution, Subgroup, Centre of a group, Co-sets of a subgroup, cyclic group, Permutation/Transformation. Homomorphism and Isomorphism of group. Normal and conjugate subgroups, Completeness and Kernel. Some special groups : $SO(2)$, $SO(3)$, $SU(2)$, $SU(3)$.

(25 Lectures)



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Unit 3

Advanced Probability Theory: Fundamental Probability Theorems. Conditional Probability, Bayes' Theorem, Repeated Trials, Binomial and Multinomial expansions. Random Variables and probability distributions, Expectation and Variance, Special Probability distributions: The binomial distribution, The poisson distribution, Continuous distribution: The Gaussian (or normal) distribution, The principle of least squares.

(25 Lectures)

References for Theory :

Essential Readings :

1. Mathematical Methods for Physicists: Weber and Arfken, 2005, Academic Press.
2. Mathematical Methods for Physicists: A Concise Introduction: Tai L. Chow, 2000, Cambridge Univ. Press.
3. Elements of Group Theory for Physicists by A. W. Joshi, 1997, John Wiley.
4. Group Theory and its Applications to Physical Problems by Morton Hamermesh, 1989, Dover
5. Introduction to Mathematical Probability, J. V. Uspensky, 1937, Mc Graw-Hill.

Additional Readings :

1. Introduction to Mathematical Physics: Methods & Concepts: Chun Wa Wong, 2012, Oxford University Press

DSE: Classical Dynamics (32227626)
Credit : 06 (Theory-05, Tutorial-01)
Theory : 75 Hours
Tutorial : 15 Hours

Course Objective

This course on classical dynamics trains the student in problem solving ability and develops understanding of physical problems. The emphasis of this course is to enhance the understanding of Classical Mechanics (Lagrangian and Hamiltonian Approach).

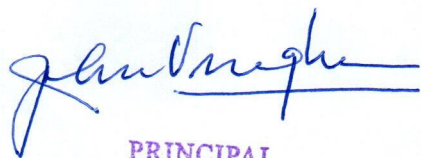

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B.Sc.(P) Chemistry

CC Paper-4 : Chemistry of s- and p- Block Elements, States of Matter & Chemical Kinetics

This paper involve study of three major states of matter i.e. solid, liquid and gas. Practical component of this paper involves surface tension measurements using Stalagmometer, viscosity measurement using Ostwald's viscometer and pHmetric titration. Students did projects in group of 3-4 students where they performed some activities using materials available at home and explain many concepts which we experience in daily life.


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SEMESTER-IV

Course Code: CHEMISTRY –Core Paper-4

Course Title: Chemistry of s- and p-Block Elements, States of Matter and Chemical Kinetics

Total Credits: 06

(Credits: Theory-04, Practical-02)

(Total Lectures: Theory- 60, Practical-60)

Objectives:

The objective of this paper is to provide basic understanding of the fundamental principles of metallurgy through study of the methods of extraction of metals, recovery of the by-products during extraction, applications of metals, alloy behaviour and their manufacturing processes. The course illustrates the diversity and fascination of inorganic chemistry through the study of properties and utilities of s- and p-block elements and their compounds. The students will learn about the properties of ideal and real gases and deviation from ideal behaviour, properties of liquid, types of solids with details about crystal structure. The student will also learn about the reaction rate, order, activation energy and theories of reaction rates.

Learning Outcomes:

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

- Understand the chemistry and applications of s- and p-block elements.
- Derive ideal gas law from kinetic theory of gases and explain why the real gases deviate from ideal behaviour.
- Explain Maxwell-Boltzmann distribution, critical constants and viscosity of gases.
- Explain the properties of liquids especially surface tension and viscosity.
- Explain symmetry elements, crystal structure specially NaCl, KCl and CsCl
- Define rate of reactions and the factors that affect the rates of reaction.
- Understand the concept of rate laws e.g., order, molecularity, half-life and their determination
- Learn about various theories of reaction rates and how these account for experimental observations.

Section A: Inorganic Chemistry (Lectures:30)

Unit 1:

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy with reference to cyanide process for silver and gold, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, van Arkel-De Boer process, Mond's process and Zone Refining.

(Lectures: 4)

Unit 2:

s- and p- block elements

Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Allred-Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group. Compounds of s- and p-block elements, diborane and concept of multicentre bonding. Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial and environmental chemistry. Hydrides of nitrogen (NH_3 , N_2H_4 , N_3H , NH_2OH) Oxoacids of P, S and Cl, Halides and oxohalides: PCl_3 , PCl_5 , SOCl_2 and SO_2Cl_2 .

(Lectures: 26)

Section B: Physical Chemistry (Lectures:30)

Unit 3:

Kinetic Theory of Gases

Postulates of kinetic theory of gases and derivation of the kinetic gas equation, deviation of real gases from ideal behaviour, compressibility factor, causes of deviation, van der Waals equation of state for real gases. Boyle temperature (derivation not required), critical phenomena, critical constants and their calculation from van der Waals equation, Andrews isotherms of CO_2 , Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions, most probable, average and root mean square velocities (no derivation), collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules, viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

(Lectures: 10)

Unit 4:

Liquids

Surface tension and its determination using stalagmometer, Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer, effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

(Lectures: 3)

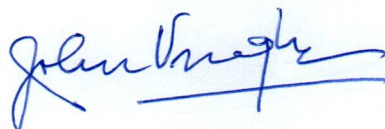
Unit 5:

Solids

Forms of solids, symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of crystallography - law of constancy of interfacial angles.

Law of rational indices, Miller indices. X-ray diffraction by crystals, Bragg's law, structures of NaCl, KCl and CsCl (qualitative treatment only), defects in crystals. Glasses and liquid crystals.

(Lectures: 6)



Unit 6:

Chemical Kinetics

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)

(Lectures: 11)

Practical:

(Credits: 2, Laboratory periods: 60)

Section A: Inorganic Chemistry

Semi-micro qualitative analysis of mixtures using H_2S or any other scheme- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations: NH_4^+ , Pb^{2+} , Bi^{3+} , Cu^{2+} , Cd^{2+} , Fe^{3+} , Al^{3+} , Co^{2+} , Ni^{2+} , Mn^{2+} , Zn^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , K^+

Anions: CO_3^{2-} , S^{2-} , SO_3^{2-} , NO_2^- , CH_3COO^- , Cl^- , Br^- , I^- , NO_3^- , SO_4^{2-} , PO_4^{3-} , BO_3^{3-} , $\text{C}_2\text{O}_4^{2-}$, F^- .

(Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry

1. Surface tension measurement (use of organic solvents excluded):

Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

2. Viscosity measurement (use of organic solvents excluded):

- a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald viscometer.
- b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

3. Chemical Kinetics

Study the kinetics of the following reactions by integrated rate method:

- a) Acid hydrolysis of methyl acetate with hydrochloric acid.
- b) Compare the strength of HCl and H_2SO_4 by studying the kinetics of hydrolysis methyl acetate.

References:

Theory:

1. Lee., J. D. **A new Concise Inorganic Chemistry**, Pearson Education.

- Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkin's Inorganic Chemistry**, Oxford.
- Miessler, G. L.; Tarr, D.A.(2014), **Inorganic Chemistry**, Pearson.
- Castellan, G. W.(2004), **Physical 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.
- B.R.Puri, L.R.Sharma, M.S.Pathania, (2017), **Principles of Physical Chemistry**, Vishal Publishing Co.

Practical:

- Svehla, G. (1996), **Vogel's Qualitative Inorganic Analysis**, Prentice Hall.
- Khosla, B.D.; Garg, V.C.; Gulati, A.(2015), **Senior Practical Physical Chemistry**, R. Chand & Co.

Teaching Learning Process:

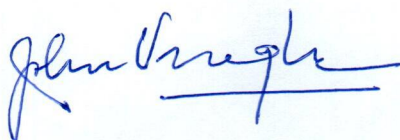
- Through chalk and board method.
- Revising and asking questions from students at the end of class
- Motivating students to do some activity related to the topic
- Power point presentation
- Correlating the topic with real life cases.
- Quiz contest among students on important topic.

Assessment Methods:

- Graded assignments
- Conventional class tests
- Class seminars by students on course topics with a view to strengthening the content through width and depth
- Quizzes
- End semester university examination.

Keywords:

Metallurgy, Periodicity, Anomalous behaviour, Ellingham diagrams, Hydrometallurgy, Allotropy, Diagonal relationship, Multicentre bonding, Ideal/real gases, Surface tension, Viscosity, Crystal systems, Rate Law, Rate constant



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Assessment Methods:

- Graded assignments
- Conventional class tests
- Class seminars by students on course topics with a view to strengthening the content through width and depth
- Quizzes
- End semester university examination.

Keywords:

Green Chemistry, Twelve principles, Sustainable chemistry, Green energy, Marine antifoulant, Non toxic pigments.

Course Code: CHEMISTRY –SEC-9

Course Title: Pharmaceutical Chemistry

Total Credits: 04

(Credits: Theory-02, Practical-02)

(Total Lectures: Theory- 30, Practical-60)

Objectives:

The objective of this paper is to develop basic understanding of drugs discovery, design, development and their side effects. The course will cover synthesis of major drug classes including-analgesics, antipyretics, anti- inflammatory agents, antibacterial and antifungal agents, antiviral agents, central nervous system agents and drugs for HIV--AIDS. An overview of fermentation process and production of certain dietary supplements and certain common antibiotics will be discussed.

Learning Outcomes:

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

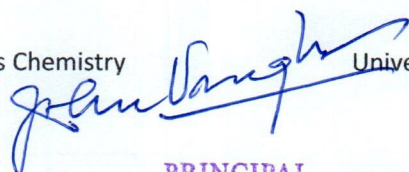
- Gain insight into retro-synthesis approach in relation to drug design and drug discovery.
- Learn synthetic pathways of major drug classes.
- Understand the fermentation process and production of ethanol, citric acids, antibiotics and some classes of vitamins.

Unit 1:

Introduction

Drug discovery, design and development: Sources of drugs: biological, marine, minerals and plant tissue culture, physio-chemical aspects (optical, geometric and bioisosterism) of drug molecules and biological action, drug receptor interaction, basic retro-synthetic approach for development of drug. Cause of side effect of drugs like ibuprofen, cetirizine, thalidomide. Difference between drug and poison.

(Lectures: 7)



Unit 2:

Drugs and Pharmaceuticals

Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin and natural colours

Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazole, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), central nervous system agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antileprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

(Lectures:15)

Unit 3:

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

(Lectures: 8)

Practical:

(Credits: 2, Laboratory periods: 60)

Chemistry Lab: Pharmaceutical chemistry

1. Preparation of aspirin and its analysis.
2. Preparation of paracetamol and its analysis.
3. Preparation of sulphacetamide of sulphonamide and its analysis.
4. Determination of alcohol contents in liquid drugs/galenical.
5. Determination of ascorbic acid in vitamin C tablets by iodometric or coulometric titrations.
6. Synthesis of ibuprofen.
7. Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry.

References:

Theory:

1. Patrick, G. (2017), **Introduction to Medicinal Chemistry**, Oxford University Press.
2. Singh H.; Kapoor V.K. (1996), **Medicinal and Pharmaceutical Chemistry**, Vallabh Prakashan.
3. Foye, W.O.; Lemke, T. L.; William, D.A. (1995), **Principles of Medicinal Chemistry**, B.I. Waverly Pvt. Ltd.



Practical:

1. Kjonaas, R.A.; Williams, P.E.; Counce, D.A.; Crawley, L.R. **Synthesis of Ibuprofen**. J. Chem. Educ., 2011, 88 (6), pp 825–828 DOI: 10.1021/ed100892p.
2. Marsh, D.G.; Jacobs, D.L.; Veening, H. **Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry**. J. Chem. Educ., 1973, 50 (9), p 626. DOI: 10.1021/ed050p626

Teaching Learning Process:

The teaching learning process will involve the traditional chalk and black board method. Certain topics like retro-synthetic approach and fermentation processes are taught through audio-visual aids. Students are encouraged to participate actively in the classroom through regular presentations on curriculum based topics.

Assessment Methods:

Assessment will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Retro-synthesis, Drug discovery, Design and synthesis, Side effects, Fermentation.

Course Code: CHEMISTRY –SEC-10

Course Title: Chemistry of Cosmetics and Perfumes

Total Credits: 04

(Credits: Theory-02, Practical-02)

(Total Lectures: Theory- 30, Practical-60)

Objectives:

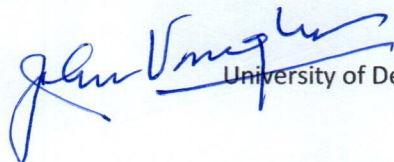
Cosmetic plays an important role in our everyday lives as they make an individual's appearance more attractive and boost one's self-esteem and confidence. Keeping in view the tremendous potential which the cosmetic industry has today around the globe, this course will be useful for introducing students of Chemistry honours to the world of cosmetic chemistry. This has been designed to impart the theoretical and practical knowledge on basic principles of cosmetic chemistry, manufacture, formulation of various cosmetic products.

Learning outcomes:

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

- Learn basic of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products.
- Learn the use of safe, economic and body-friendly cosmetics
- Prepare new innovative formulations.

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Practical:

1. Kjonaas, R.A.; Williams, P.E.; Counce, D.A.; Crawley, L.R. **Synthesis of Ibuprofen**. J. Chem. Educ., 2011, 88 (6), pp 825–828 DOI: 10.1021/ed100892p.
2. Marsh, D.G.; Jacobs, D.L.; Veening, H. **Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry**. J. Chem. Educ., 1973, 50 (9), p 626. DOI: 10.1021/ed050p626

Teaching Learning Process:

The teaching learning process will involve the traditional chalk and black board method. Certain topics like retro-synthetic approach and fermentation processes are taught through audio-visual aids. Students are encouraged to participate actively in the classroom through regular presentations on curriculum based topics.

Assessment Methods:

Assessment will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Retro-synthesis, Drug discovery, Design and synthesis, Side effects, Fermentation.

Course Code: CHEMISTRY –SEC-10

Course Title: Chemistry of Cosmetics and Perfumes

Total Credits: 04

(Credits: Theory-02, Practical-02)

(Total Lectures: Theory- 30, Practical-60)

Objectives:

Cosmetic plays an important role in our everyday lives as they make an individual's appearance more attractive and boost one's self-esteem and confidence. Keeping in view the tremendous potential which the cosmetic industry has today around the globe, this course will be useful for introducing students of Chemistry honours to the world of cosmetic chemistry. This has been designed to impart the theoretical and practical knowledge on basic principles of cosmetic chemistry, manufacture, formulation of various cosmetic products.

Learning outcomes:

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

- Learn basic of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products.
- Learn the use of safe, economic and body-friendly cosmetics
- Prepare new innovative formulations.

Unit 1:

Cosmetics- Definition, History, Classification, Ingredients, Nomenclature, Regulations.

(Lectures: 4)

Unit 2:

Face Preparation: Structure of skin, Face powder, Compact powder, Talcum powder.

(Lectures: 6)

Unit 3:

Skin Preparation: Face cream, vanishing cream, cold cream, suntan cream, lather shaving cream

(Lectures: 5)

Unit 4:

Hair preparation: Structure of hair, classification of hair, Hair dye- classification – temporary, semi-permanent, demi permanent, permanent, formulation, hair sprays, shampoo- types of shampoo, conditioners

(Lectures: 6)

Unit 5:

Colored preparation: Nail preparation Structure of nail, Nail lacquers, Nail polish remover Lipsticks

(Lectures: 4)

Unit 6:

Personal hygiene products: Antiperspirants and deodorants, oral hygiene products, flavours and essential oils

(Lectures: 5)

Practical:

(Credits: 02, Laboratory periods: 60)

Preparation of:

1. Talcum powder.
2. Shampoo.

3. Enamels.
4. Face cream.
5. Nail polish and nail polish remover.
6. Hand wash
7. Hand sanitizer
8. Body lotion
9. Soap
10. Tooth powder
11. Tooth paste

References:

1. Barel, A.O.; Paye, M.; Maibach, H.I.(2014),**Handbook of Cosmetic Science and Technology**, CRC Press.
2. Garud, A.; Sharma, P.K.; Garud, N. (2012),**Text Book of Cosmetics**, Pragati Prakashan.
3. Gupta, P.K.; Gupta, S.K.(2011),**Pharmaceutics and Cosmetics**, Pragati Prakashan
4. Butler, H. (2000),**Poucher's Perfumes, Cosmetic and Soap**, Springer
5. Kumari, R.(2018),**Chemistry of Cosmetics**, Prestige Publisher.

Additional Resources:

1. Flick, E.W.(1990),**Cosmetic and toiletry formulations**, Noyes Publications / William Andrew Publishing.
2. Natural Ingredients for Cosmetics; EU Survey 2005
3. Formulation Guide for cosmetics; The Nisshin OilliO Group, Ltd.
4. Functional Ingredients & Formulated Products for Cosmetics & Pharmaceuticals; NOF Corporation

Teaching Learning Process:

- Conventional chalk and board teaching with power point presentation, you tube videos. and presentations from students on relevant topics.
- Theory coupled with preparation of cosmetic products in lab.

Assessment Methods:

Internal assessment through assignments and class test. End semester written and practical examination.

Keywords:

Cosmetic Products, Ingredients, Formulations, Raw materials, Lab. preparation, Ideal characteristics

- Quizzes
- End semester university examination.

Keywords:

Chemical Technology; Society; Energy; Polymer; Pollutants.

Course Code: CHEMISTRY –SEC-4

Course Title: Chemoinformatics

Total Credits: 04

(Credits: Theory-02, Practicals-02)

(Total Lectures: Theory- 30, Practicals-60)

Objectives:

The aim of the course is to introduce the students to computational drug design through structure-activity relationship, QSAR and combinatorial chemistry. The students will learn about the target analysis, virtual screening for lead discovery, structure based and ligand based design method and the use of computational techniques, library preparation and data handling.

Learning Outcomes:

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

- Have a comprehensive understanding of drug discovery process and techniques including structure-activity relationship, quantitative structure activity relationship and the use of chemoinformatics in this, including molecular modelling and docking studies.
- Appreciate role of modern computation techniques in the drug discovery process and perform their own modelling studies.

Unit 1:

Introduction to Chemoinformatics: History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular modelling and structure elucidation.

(Lectures: 2)

Unit 2:

Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification.

(Lectures: 2)

Unit 3:

Searching chemical structures: Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.

(Lectures: 6)

Unit 4:

Applications: Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity.

(Lectures: 6)

Unit 5:

Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra; Computer Assisted Structure elucidations; Computer Assisted Synthesis Design

(Lectures: 6)

Unit 6:

Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Chemoinformatics in Drug Design.

(Lectures: 8)

Practical:

(Credits: 2, Laboratory periods: 60)

1. Overview of Rational Drug Design, Ligands and Targets
2. In silico representation of chemical information
 - i. CIF IUCr Crystallographic Information Framework
 - ii. CML Chemical Markup Language
 - iii. SMILES -- Simplified Molecular Input Line Entry Specification
 - iv. InChi -- IUPAC International Chemical Identifier
 - v. Other representations
3. Chemical Databases and Data Mining
 - i. Cambridge Structural Database CCDC CSD
 - ii. Crystallographic Open Database COD
 - iii. Protein Data Bank PDB Ligand Explorer
 - iv. Chempidder
 - v. Other Data Bases

4. Molecular Drawing and Interactive Visualization

- i. ChemDraw
- ii. MarvinSketch
- iii. ORTEP
- iv. Chimera, RasMol, PyMol

5. Computer-Aided Drug Design Tools

- i. Molecular Modeling Tools
- ii. Structural Homology Modeling Tools
- iii. Docking Tools and Screening Tools
- iv. Other tools

6. Building a Ligand

- i. Building ab initio
- ii. Building from similar ligands
- iii. Building with a known macromolecular target
- iv. Building without a known macromolecular target
- v. Computational assessment of activity and toxicity and drugability.

References:

1. Leach, A. R.; Gillet, V. J. (2007), **An introduction to Chemoinformatics**, Springer.
2. Gasteiger, J.; Engel, T. (2003), **Chemoinformatics: A text-book**. Wiley-VCH.
3. Gupta, S. P. (2011), **QSAR & Molecular Modeling**. Anamaya Pub.
4. Gasteiger, J. **Handbook of cheminformatics: from data to knowledge in 4 volumes**, Wiley.

Additional Resources:

1. Jürgen, B. (2004), **Chemoinformatics Concepts, Methods, and Tools for Drug Discovery**, Springer

Teaching Learning Process:

The course aims to introduce students to different cheminformatics methods and its use in drug research through practicals. It is a rather new discipline of science. It concerns with the applications of computer to solving the chemistry problems related to drug designing and drug discovery.

The course will give emphasis on active learning in students through a combination of lectures, tutorials and practical sessions. The underlying principles will be explained in lectures and the practicals will establish the understanding of these principles through applications to drug research.

Assessment Methods:

- Formative assessment supporting student learning in Cheminformatics practicals
- Summative assessment
- Review of a case study
- Exercise based on SAR and QSAR-Report
- Practical exam of five hours

Programming in Java (BSCS08B)

Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective

This course introduces fundamental concepts of Object Oriented Programming using Java. Basic concepts such as data types, expressions, control structures, functions and arrays are covered. Students are exposed to extensive Java programming to solve practical programming problems.

Course Learning Outcomes

On successful completion of the course, students will be able to:

1. develop and execute Java programs using iteration and selection.
2. create classes and their objects.
3. implement OOPS concepts to solve problems using JAVA

Unit 1

Introduction to Java: Features of Java, JDK environment, structure of Java programs

Unit 2

Programming Fundamentals: Data types, variables, operators, expressions, arrays, keywords, naming convention, decision making constructs , iteration, type casting, methods.

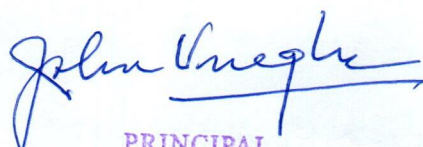
Unit 3

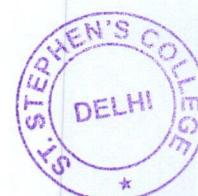
Object Oriented Programming Overview: Abstraction, encapsulation, inheritance, polymorphism.

Unit 4

Classes and Objects: Creating classes and objects, modifiers and access control, constructors, implementation of single and multilevel inheritance, implementation of polymorphism using overloading, overriding and dynamic method dispatch.

Unit 5


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Strings: String class methods, string buffer methods.

Practical

9. Write a program to find the largest of n natural numbers.
10. Write a program to find whether a given number is prime or not.
11. Write a menu driven program for following:
 - a) display a Fibonacci series
 - b) compute Factorial of a number
 - c) to check whether a given number is odd or even.
 - d) to check whether a given string is palindrome or not.
12. Write a program to print the sum and product of digits of an Integer and reverse the Integer.
13. Write a program to create an array of 10 integers. Accept values from the user in that array. Input another number from the user and find out how many numbers are equal to the number passed, how many are greater and how many are less than the number passed.
14. Write a program that will prompt the user for a list of 5 prices. Compute the average of the prices and find out all the prices that are higher than the calculated average.
15. Design a class named Car, having registration number, model and engine as its private members. Here engine is an object of a class called Engine with the private members: Chassis number and make. Define a suitable constructor of Car and override toString() Method to print the details of a car. Assume appropriate data types for the instance Members of the classes. Write a Java program to test the above class.
16. Write a program that computes the area of a circle, rectangle and a Cylinder using function overloading.

References

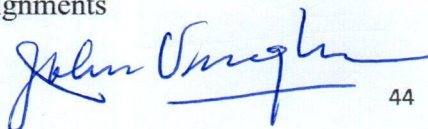
1. Horstmann, C. S. (2017). *Core Java - Vol. I – Fundamentals (10th Edition)*. Pearson.

Additional Resources

1. Balagurusamy, E. (2014). *Programming with JAVA: A Primer (5th Edition)*. McGraw Hill Education (India) Private Limited.
2. Schildt, H. (2018). *Java: The Complete Reference (10th Edition)*. McGraw-Hill Education.
3. Schildt, H. & Skrien, D. (2013). *Java Fundamentals - A comprehensive Introduction*. TMH.

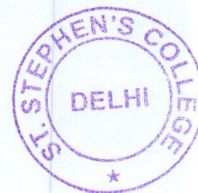
Teaching Learning Process

- Talk and chalk method
- Computer based presentations by teachers.
- Group Discussions
- Assignments



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- Offline and online Quiz
- Presentations by group of students for enhanced learning.

Tentative weekly teaching plan is as follows:

Week 1 - 2	Unit 1 - Introduction to Java Features of Java, JDK environment, structure of Java programs
Week 3 - 5	Unit 2 - Programming Fundamentals Data types, variables, operators, expressions, arrays, keywords, naming convention, decision making constructs , iteration, type casting, methods.
Week 6 - 7	Unit 3 - Object Oriented Programming Overview Abstraction, encapsulation, inheritance, polymorphism
Week 8 - 12	Unit 4 - Classes and Objects Creating classes and objects, modifiers and access control, constructors, implementation of single and multilevel inheritance, implementation of polymorphism using overloading, overriding and dynamic method dispatch
Week 13 - 15	Unit 5 - Strings String class methods, string buffer methods

Assessment Methods

- Unit-wise assignments, presentations, viva, quiz, as announced by the instructor in the class
- End semester exam
- Internal assessment

Keywords

Abstraction, encapsulation, inheritance, polymorphism.

Advanced Programming in Java (BSCS09A)

Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective

This course builds over basic Java language skills acquired by the student in earlier semester. The students are exposed to the advanced features available in Java such as exception handling, file handling, interfaces, packages and GUI programming.

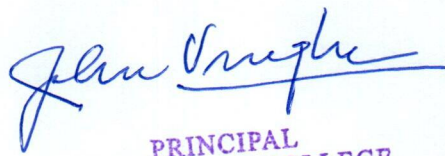


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SEC – System Administration and Maintenance

The course focuses on administration of operating systems (Windows and Linux/UNIX), installation and maintenance. Students will be able to: Distinguish between features of Linux and Windows operating system; Learn install and uninstall hardware and software; Configure operating system environment; Troubleshoot network connectivity issues; Examine operatingsystem performance issues as well as file structure and properties.



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11-12	Cover Design: Design layout, decompose into geometric primitives.
13	Cover Design (contd.): Layers, levels, multilingual layout.
14	Publish: Export, store.
15	Publish (contd.): Print.

Assessment Methods

- Unit-wise assignments, presentations, viva, quiz as announced by the instructor in the class.
- Internal assessment
- End semester exam

Keywords

Skeleton, layout, transform

System Administration and Maintenance (BACS10A) Skill-Enhancement Elective Course - (SEC-4A) Credit:4

Course Objective

The course focuses on administration of operating systems(windows, linux/unix), installation and maintenance. The students will also learn the difference between desktop based and server based operating system.

Course Learning Outcomes

On successful completion of the course, a student will be able to:

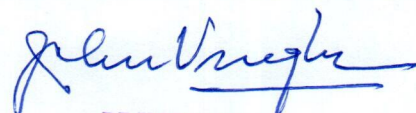
1. distinguish between features of Linux/Unix and windows operating system.
2. install/uninstall hardware and software.
3. configure system environment.
4. troubleshoot network connectivity issues.
5. examine system performance issues.
6. examine file structure and properties.

Unit 1

Introduction to Operating system: Basics of operating system, services, features and functions of different operating systems, Kernel, API, CLI, GUI, devices and device drivers, IPv4, IPv6.

Unit 2

Exploring different Operating Systems: Introduction to Linux/Unix based operating systems, introduction to Windows based operating systems, difference between Linux/Unix and other


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operating systems, introduction to server based operating systems, difference between desktop based (Windows 10) and server based operating systems like Windows server 2003/2008.

Unit 3

Linux/Ubuntu System Environment: Configuring desktop environment and desktop settings, installing and configuring software and hardware, exploring file structure, terminal, shell, basic Unix Commands like cat, ls, cd, date, cal, man, echo, pwd, mkdir, rm, rmdir, kill etc.

Unit 4

Windows System Environment: Configuring desktop environment and desktop settings, installing and configuring software and hardware, explore system configuration using control panel, creating users, add/ delete users, difference between workgroup and domain, concept of user profiles – creating and roaming, concept of Active Directory, process and disk management, Windows task manager, exploring file structure and file properties, backup and recovery.

Unit 5

Network Administration :Examine network settings using commands like ipconfig/ifconfig, hostname, net, netstat, whoami etc., troubleshoot network connectivity issues using commands like: ipconfig, ping, tracert, route etc., sharing resources (files, printers etc.) on the network, accessing a system remotely using remote desktop.

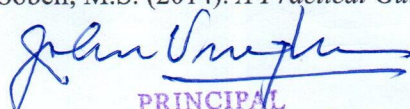
Practical

Practicals based on System Administration and Maintenance

1. Installation of LINUX operating system.
2. Installation of WINDOWS operating system
3. Installation of office productivity software (MS Office/ Open Office) .
4. User Management
 - a. Graphical tools
 - b. Command line tools include commands like useradd, userdel, passwd, etc.
 - c. Edit the local configuration files directly using vi editor.
5. Directory management commands
 - a. Write a syntax and usage the directory management commands with all options.
 - i. Ls command
 - ii. cd command
 - iii. pwd command
 - iv. mkdir command
 - v. rmdir command
6. Process management commands and their execution.
 - a. Ps
 - b. Kill
 - c. nice
7. Study the Firewall Configuration in Windows in detail.
8. Study the Firewall Configuration in Linux.
9. Study the Networks tools like ipconfig/ifconfig, netstat, whoami , trace route , Ping etc.
10. Start-up and shutdown scripts on Linux

References

1. Panek, W., & Wentworth, T. (2010). *Mastering Windows 7 administration*. Wiley Publishing Inc.
2. Snyder, G., Hein, T. R., & EviNemeth, B. W. (2018). *UNIX and Linux System Administration Handbook* (Fifth edition). Pearson.
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Additional Resources

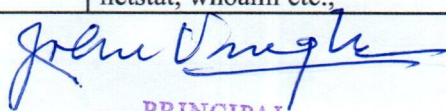
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2. Limoncelli, T.A., Hogan, C., & Chalup, S. R. (2007). *The Practice of System and Network Administration*. Addison-Wesley.

Teaching Learning Process

- Talk and chalk method
- Computer based presentations by teachers to explain certain topics.
- Group Discussions
- Assignments
- Offline and online Quiz
- Presentations by group of students for enhanced learning.

Tentative weekly teaching plan is as follows:

Week	Topics
1	Introduction to Operating system: Basics of operating system, services, features and functions of different operating system.
2	Introduction to Operating system (contd.): Kernel, API, CLI, GUI, devices and device drivers, IPv4, IPv6.
3	Exploring different Operating systems: Introduction to Linux/Unix based operating systems, introduction to Windows based operating systems, difference between Linux/Unix and other operating systems.
4	Exploring different Operating systems (contd.): Introduction to desktop based and server based operating systems.
5	Linux/Ubuntu system environment: Linux desktop tour, configuring desktop environment and desktop settings.
6	Linux/Ubuntu system environment (contd.): Installing and configuring software and hardware, exploring file structure.
7	Linux/Ubuntu system environment (contd.): Terminal, shell, basic Unix commands like cat, ls, cd, date, cal, man, echo, pwd, mkdir, rm, rmdir ps, kill etc.
8	Windows system environment: Windows desktop tour, configuring desktop environment and desktop settings, installing and configuring software and hardware.
9	Windows system environment (contd.): Explore system configuration using control panel, creating users, add/ delete users, difference between workgroup and domain.
10	Windows system environment (contd.): Concept of user profiles – creating and roaming, concept of active directory, process and disk management.
11	Windows system environment (contd.): Windows task manager, exploring file structure and file properties, backup and recovery.
12	Network Administration: Examine network settings using commands like ipconfig/ifconfig, hostname, net, netstat, whoami etc.,



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13	Network Administration (contd.): Troubleshoot network connectivity issues using commands like: ipconfig, ping, tracert, route etc.
14-15	Network Administration (contd.): Sharing resources (files, printers etc.) on the network, Accessing a system remotely using remote desktop.

Assessment Methods

- Unit-wise assignments, presentations, viva, quiz as announced by the instructor in the class.
- Internal assessment
- End semester exam

Keywords

Desktop Operating system, Server Operating system, Shell, Network Administration.

Android Programming (BACS10B)

Skill-Enhancement Elective Course - (SEC-4B) Credit:4

Course Objective

The course is designed for students to help them learn how to develop android apps. They will also learn android architecture and key principles underlying the design.

Course Learning Outcomes

On successful completion of this course, a student will be able to:

1. describe various components of an Android application.
2. design user interfaces using various widgets, dialog boxes, menus.
3. design and implement interaction among various activities/applications using intents.
4. develop application(s) that require database handling.

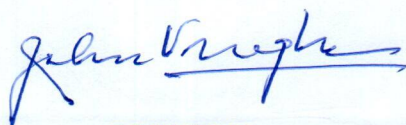
Unit 1

Introduction: Overview of Java programming, Android architecture, Android components including activities, view and view group, services, content providers, broadcast receivers, intents, parcels, instance state. Android development tools like Android virtual device manager, Android SDK manager, Android emulator, Android profiler, Android debug bridge.

Unit 2

User Interface Architecture: application context, intents: explicit intents, returning results from activities, implicit intents, intent filter, intent resolution, and applications of implicit intents, activity life cycle, activity stack, application's priority and the process' states.

Unit 3

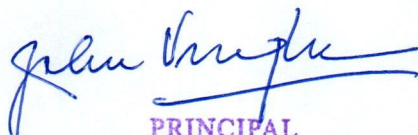


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SEC – Android Programming

This course is designed for students to help them learn how to develop android apps. They will also learn android architecture and key principles underlying the design. Students will be able to: describe various components of an Android application; Design user interfaces using various widgets, dialog boxes and menus; Design and implement interactions among various applications using intents; Develop application(s) that require database handling.


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13	Network Administration (contd.): Troubleshoot network connectivity issues using commands like: ipconfig, ping, tracert, route etc.
14-15	Network Administration (contd.): Sharing resources (files, printers etc.) on the network, Accessing a system remotely using remote desktop.

Assessment Methods

- Unit-wise assignments, presentations, viva, quiz as announced by the instructor in the class.
- Internal assessment
- End semester exam

Keywords

Desktop Operating system, Server Operating system, Shell, Network Administration.

Android Programming (BACS10B)

Skill-Enhancement Elective Course - (SEC-4B) Credit:4

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3. design and implement interaction among various activities/applications using intents.
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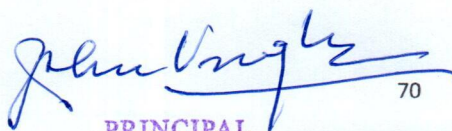
Unit 1

Introduction: Overview of Java programming, Android architecture, Android components including activities, view and view group, services, content providers, broadcast receivers, intents, parcels, instance state. Android development tools like Android virtual device manager, Android SDK manager, Android emulator, Android profiler, Android debug bridge.

Unit 2

User Interface Architecture: application context, intents: explicit intents, returning results from activities, implicit intents, intent filter, intent resolution, and applications of implicit intents, activity life cycle, activity stack, application's priority and the process' states.

Unit 3


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User Interface Design: Layouts, optimizing layout hierarchies, form widgets, text fields, button control, toggle buttons, spinners, auto-complete textview, edittext, images, image buttons, menu, dialog.

Unit 4

Database using SQLite: SQLite, Content Values and Cursors, creating SQLite databases, querying a database, adding, updating, and removing rows.

Practical

Practicals Based on Android Programming:

1. Create "Hello World" application. That will display "Hello World" in the middle of the screen in the emulator. Also display "Hello World" in the middle of the screen in the Android Phone.
2. Create an application with login module. (Check username and password).
3. Create spinner with strings taken from resource folder (res >> value folder) and on changing the spinner value, Image will change.
4. Create a menu with 5 options and selected option should appear in text box.
5. Create a list of all courses in your college and on selecting a particular course teacher-incharge of that course should appear at the bottom of the screen.
6. Create an application with three option buttons, on selecting a button colour of the screen will change.
7. Create and Login application as above. On successful login, pop up the message.
8. Create an application to Create, Insert, update, Delete and retrieve operation on the database.

References

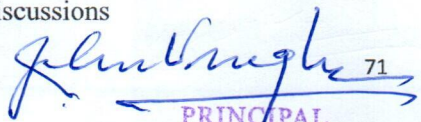
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2. Phillips, B., Stewart, C., Hardy, B., & Marsicano, K. (2015). *Android Programming: The Big Nerd Ranch Guide*. Big Nerd Ranch, LLC.
3. Sheusi, J. C. (2013). *Android Application Development for Java Programmers*. Cengage Learning.

Teaching Learning Process

- Talk and chalk method
- Computer based presentations by teachers to explain certain topics.
- Group Discussions


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- Assignments
- Offline and online Quiz
- Presentations by group of students for enhanced learning.

Tentative weekly teaching plan is as follows:

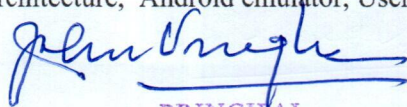
Week	Topics
1	Introduction: Overview of Java programming, Android architecture.
2	Introduction (contd.): Android components including activities, view and view group, services, content providers.
3	Introduction (contd.): Broadcast receivers, intents, parcels, instance state. Android development tools like Android virtual device manager,
4	Introduction (contd.): Android development tools like Android SDK manager, Android emulator, Android profiler, Android debug bridge.
5	User Interface Architecture: Application context, intents: explicit intents, returning results from activities, returning results from activities.
6	User Interface Architecture (contd.): Intents: implicit intents, intent filter, intent resolution, and applications of implicit intents.
7	User Interface Architecture (contd.): Activity lifecycle, activity stack, application's priority and the process' states.
8	Database using SQLite: SQLite, content values and cursors.
9	Database using SQLite (contd.): Creating SQLite databases, introduction to querying a database.
10	Database using SQLite (contd.): Querying a database: adding, updating, and removing rows.
11	User Interface Design: Layouts, optimizing layout hierarchies.
12	User Interface Design (contd.): form widgets, text fields, button control.
13-14	User Interface Design (contd.): Toggle buttons, spinners, auto-complete textview, edittext.
15	User Interface Design (contd.): Images, image buttons, menu, dialog.

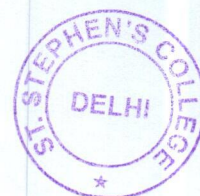
Assessment Methods

- Unit-wise assignments, presentations, viva, quiz as announced by the instructor in the class.
- Internal assessment
- End semester exam

Keywords

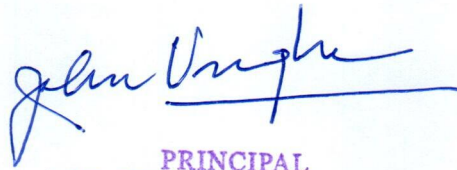
Android architecture, Android emulator, User interface design, Database.


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DSE – Programming in JAVA

This course will introduce students to the fundamentals of computer programming in an object-oriented framework using Java as programming language. Students will be able to: understand the concepts of object-oriented software design; Develop, compile and run Java programs; Use object-oriented software design principles such as inheritance and polymorphism.



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1	Multimedia: Introduction to multimedia, components, uses of multimedia, multimedia applications, virtual reality
2	Text: Fonts and faces, using text in multimedia, font editing and design tools, hypermedia and hypertext.
3	Images: Still images – bitmaps, vector drawing, 3D drawing and rendering.
4	Images (contd.): Natural light and colors, computerized colors, color palettes, image file formats.
5	Sound, Video and Animation: Digital Audio, MIDI audio, MIDI vs digital audio.
6	Sound, Video and Animation (contd.): Audio file formats, how video works, analog video, digital video.
7	Sound, Video and Animation (contd.): Video file formats, video shooting and editing.
8	Sound, Video and Animation (contd.): Principles of animation, animation file formats.
9	Sound, Video and Animation (contd.): Animation techniques.
10	Internet and Multimedia: WWW and HTML, Multimedia on the web.
11	Internet and Multimedia (contd.): Web servers, web browsers, web page makers and site builders.
12	Making Multimedia: Stages of a multimedia project, requirements to make good multimedia.
13	Making Multimedia (contd.): Hardware peripherals - connections, memory and storage devices.
14-15	Making Multimedia (contd.): Multimedia software and authoring tools.

Assessment Methods

- Unit-wise assignments, presentations, viva, quiz as announced by the instructor in the class.
- Internal assessment
- End semester exam

Keywords

Hypermedia, Hypertext, Bitmap, Video, Animation, HTML

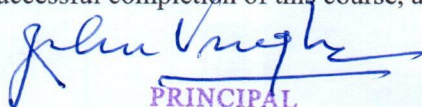
Programming in Java (BACS05A) Discipline Specific Elective - (DSE-I) Credit:6

Course Objective

This course will introduce students to the fundamentals of computer programming in an object oriented framework using Java as programming language.

Course Learning Outcomes

On successful completion of this course, a student will be able to:


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1. understand the concepts of object-oriented software design.
2. develop, compile and run Java programs using basic programming constructs.
3. use object-oriented software design principles like inheritance and polymorphism .
4. use visibility modifiers (public, private, protected) to implement appropriate abstraction and encapsulation.

Unit 1

Introduction to Java programming: Java development environment, Java program structure.

Unit 2

Java Programming Constructs: Data types, variables, constants, scope and life time of variables, operators, expressions, type conversion and casting, control flow, conditional statements, loops, break and continue statements, arrays, command line arguments, methods.

Unit 3

Classes and Objects: Class, object, constructor, destructor, parameter passing, static fields and methods, access control, this reference, overloading of methods and constructors, garbage collection, accessibility modifiers.

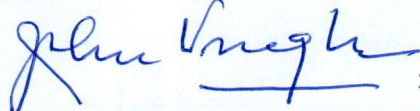
Unit 4

OOPS concepts: Encapsulation, inheritance, polymorphism, dynamic binding, dynamic method dispatch, method overriding, final classes and methods, abstract classes and methods.

Practical

Practicals based on Java:

1. Write a java program to add, subtract, multiply and divide any two numbers entered by the user.
2. Write a java program to compute the square, cube of a number entered by a user using methods.
3. Write a java program to demonstrate the use of :
 - a. Bitwise operators.
 - b. Shift operators.
4. Write a java program to compute maximum of three numbers:
 - a. Using ternary operator.
 - b. Using if-else statement.
5. Write a menu driven program(using switch-case) which accepts a number as user input :
 - a. Checks whether the number is even or odd
 - b. Checks whether the number is prime
6. Write a menu driven program(using switch-case) which accepts a number as user input:
 - a. Prints sum of digits of the given number
 - b. Prints reverse of the given number
7. Write a program to display the first n terms of a Fibonacci series.
8. Write a method to compute the factorial of a number. Use this method to compute the sum of the series: $1 + x/1! + x^2/2! + x^3/3! + \dots x^n/n!$



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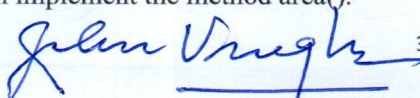
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9. Write a java program that accepts a list of elements from the user in an array. Calculate the sum and average of the numbers entered. Accept the size of the array as command line argument.
10. Write a java program that accepts a list of elements from the user in an array and displays the elements in the ascending order.
11. Write a java program to create a class "Student" having:
 - a. Data members: RollNo, Name, Course
 - b. Methods: getData()-To retrieve values of data members
displayData()-To display values of data members
12. Write a java program to create a class "Room" having:
 - a. Data members: Length, Breadth, Height as dimensions of the room
 - b. Three constructors:
 - i. Having no parameter -that accepts values of data members from the user.
 - ii. Having one parameter -which specifies the same value of all dimensions.
 - iii. Having three parameters-which passes different values of all dimensions.
13. Write a java program to create a class "Student" having:
 - a. Private Data members: RollNo, Name, Marks1, Marks2, Marks3
 - b. Constructor: -To assign values to data members
 - c. Methods: -
 - i. CalculatePercentage()-To calculate percentage of marks
 - ii. CalculateDivision()- calculates division based on formula:
 - a) Ist Div if percentage is >60
 - b) IInd Div if percentage is between 50 and 60
 - c) IIIrd Div if percentage is <50
 - iii. displayMarksheet()-To display values of data members as well as percentage and division of student
14. Write a java program that calculates the area of circle, rectangle and triangle using method overloading
15. Create a class Employee containing information about employees of same organization. It should have following data members:
 - a. EmpId (Private),
 - b. CompanyName(static and final)
 - c. No-of-employees (static)

It should have a static method to calculate no. of employees in the organisation based on the number of objects of employees created and a display() method to display Number of employees in that organization.

16. Create a Person class. Create some objects of this class (by taking information from the user). Inherit the class Person to create two classes Teacher and Student class. Maintain the respective information in the classes and create and display objects of these two classes using Runtime Polymorphism.
17. Create a Circle class having data member radius. Create a subclass of circle called Cylinder having data members: radius and height. Both classes should have a method called area() that calculates their area.
18. Create an abstract class called shape having abstract method area() and two variables dimension1 and dimension2. Create two subclasses of shape, rectangle and triangle class which implement the method area().

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2. Schildt, H. (2014). *Java The Complete reference* (9th Edition). Tata Mc Graw Hill.

Additional Resources

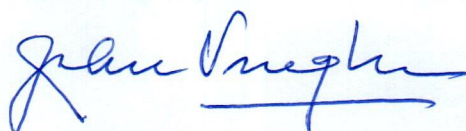
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2. Horstmann, C. S. (2016). *Core Java Volume 1-Fundamentals* (10th Edition). Pearson Education.

Teaching Learning Process

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- Group Discussions
- Assignments
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- Presentations by group of students for enhanced learning.

Tentative weekly teaching plan is as follows:

Week	Topics
1	Introduction to Java programming: Java development environment, Java program structure.
2	Java Programming Constructs: Data types, variables, constants, scope and life time of variables.
3	Java Programming Constructs (contd.): Operators, expressions.
4	Java Programming Constructs (contd.): Type conversion and casting, control flow, conditional statements.
5	Java Programming Constructs (contd.): Looping constructs, break and continue statements.
6	Java Programming Constructs (contd.): Arrays, command line arguments, methods.
7	Classes and Objects: Classes and Objects.
8	Classes and Objects (contd.): Constructors and constructor, overloading.
9	Classes and Objects (contd.): Methods, parameter passing, static fields and methods, this reference.
10	Classes and Objects (contd.): Overloading methods, garbage collection.
11	Classes and Objects (contd.): Access control and accessibility modifiers.
12	OOP concepts: Inheritance, encapsulation, polymorphism.
13	OOP concepts (contd.): Dynamic binding, dynamic method Dispatch, method overriding.
14-15	OOP concepts (contd.): Final classes and methods, abstract classes and methods.



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Assessment Methods

- Unit-wise assignments, presentations, viva, quiz as announced by the instructor in the class.
- Internal assessment
- End semester exam

Keywords

Object Oriented Programming, Overloading, Inheritance, Data abstraction, Encapsulation

Programming in Python (BACS05B)

Discipline Specific Elective - (DSE-I) Credit:6

Course Objective

The course introduces programming in Python and develop Python based solutions for simple problems.

Course Learning Outcomes

On successful completion of this course, a student will be able to:

1. select a suitable programming construct and inbuilt data structure for a situation.
2. develop and document modular python programs.
3. use classes and objects in application programs.

Unit 1

Introduction to Python: Structure of a Python program, Python interpreter/Python shell, identifiers and keywords, literals, strings, basic operators, input, output statements, Python standard libraries, notion of class, object.

Unit 2

Functions: Built in functions, function definition and calls, default parameter values.

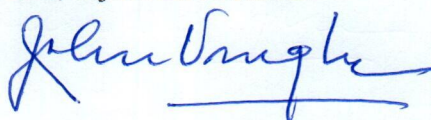
Creating Python Programs: Input and output statements, control statements - branching, looping, exit function, break, continue, and pass, mutable and immutable structures, strings, lists, tuples and associated operations.

Unit 3

Control Structures: conditional statements, loops, exit, break and continue statements.

Unit 4

Classes: classes, objects and methods.



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Skill Enhancement Paper

SEC-2: Mathematical Typesetting System: LaTeX

Total Marks: 100 (Theory: 38, Internal Assessment: 12, and Practical: 50)

Workload: 2 Lectures, 4 Practicals (per week) **Credits:** 4 (2+2)

Duration: 14 Weeks (28 Hrs. Theory + 56 Hrs. Practical) **Examination:** 2 Hrs.

Course Objectives: The purpose of this course is to help you begin using LaTeX, a mathematical typesetting system designed for the creation of beautiful books – and especially for books that contain a lot of mathematics, complicated symbols and formatting.

Course Learning Outcomes: This course will enable the students to:

- i) Learn to create and typeset a LaTeX document.
- ii) Typeset a mathematical document using LaTeX.
- iii) Learn about pictures and graphics in LaTeX.
- iv) Create beamer presentations.

Unit 1: Getting Started with LaTeX

Introduction to TeX and LaTeX, Creating and typesetting a simple LaTeX document, Adding basic information to documents, Environments, Footnotes, Sectioning, Displayed material.

Unit 2: Mathematical Typesetting

Accents and symbols; Mathematical typesetting (elementary and advanced): Subscript/Superscript, Fractions, Roots, Ellipsis, Mathematical symbols, Arrays, Delimiters, Multiline formulas, Putting one thing above another, Spacing and changing style in math mode.

Unit 3: Graphics and PSTricks

Pictures and graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions.

Unit 4: Getting Started with Beamer

Beamer, Frames, Setting up beamer document, Enhancing beamer presentation.

References:

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Lamport, Leslie (1994). *LaTeX: A Document Preparation System*, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint.

Additional Reading:

- i. Dongen, M. R. C. van (2012). *LaTeX and Friends*. Springer-Verlag.

Practicals to be done in the Computer Lab using a suitable LaTeX Editor:

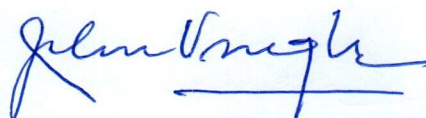
[1] Chapter 9 (Exercises 4 to 10), Chapter 10 (Exercises 1, 3, 4, and 6 to 9), and Chapter 11 (Exercises 1, 3, 4, 5).

Teaching Plan (Theory of SEC-2: Mathematical Typesetting System: LaTeX):

Weeks 1 to 3: Introduction to TeX and LaTeX, Creating and typesetting a simple LaTeX document, adding basic information to documents, Environments, Footnotes, Sectioning, Displayed material.

[1] Chapter 9 (Sections 9.1 to 9.5).

[2] Chapter 2 (Sections 2.1 to 2.5).

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Weeks 4 to 7: Accents and symbols; Mathematical typesetting (elementary and advanced): Subscript/Superscript, Fractions, Roots, Ellipsis, Mathematical symbols, Arrays, Delimiters, Multiline formulas, Putting one thing above another, Spacing and changing style in math mode.

[1] Chapter 9 (Sections 9.6, and 9.7).

[2] Chapter 3 (Sections 3.1 to 3.3).

Weeks 8 to 11: Pictures and Graphics in LaTeX, Simple pictures using PS Tricks, Plotting of functions.

[1] Chapter 9 (Section 9.8), and Chapter 10 (Sections 10.1 to 10.3).

[2] Chapter 7 (Sections 7.1, and 7.2).

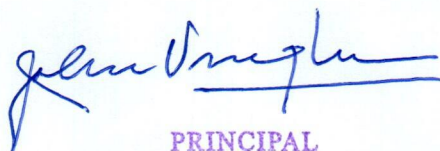
Weeks 12 to 14: Beamer, Frames, Setting up beamer document, Enhancing beamer presentation.

[1] Chapter 11 (Sections 11.1 to 11.4).

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Learn to create and typeset a LaTeX document.	(i) Topics to be explained using LaTeX editor.	• Presentations and class discussions.
2.	Typeset a mathematical document using LaTeX.	(ii) Students to be given homework/assignments.	• Assignments and class tests.
3.	Learn about pictures and graphics in LaTeX.	(iii) Students to be encouraged to look for new applications.	• Mid-term examinations.
4.	Create beamer presentations.		• Practical examinations. • End-term examinations.

Keywords: LaTeX, Mathematical typesetting, PSTricks, Beamer.



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Semester-VI

Skill Enhancement Paper

SEC-4: Statistical Software: R

Total Marks: 100 (Theory: 38, Internal Assessment: 12, and Practical: 50)

Workload: 2 Lectures, 4 Practicals (per week) **Credits:** 4 (2+2)

Duration: 14 Weeks (28 Hrs. Theory + 56 Hrs. Practical) **Examination:** 2 Hrs.

Course Objectives: The purpose of this course is to help you begin using **R**, a powerful free software program for doing statistical computing and graphics. It can be used for exploring and plotting data, as well as performing statistical tests.

Course Learning Outcomes: This course will enable the students to:

- Be familiar with **R** syntax and use **R** as a calculator.
- Understand the concepts of objects, vectors and data types.
- Know about summary commands and summary table in **R**.
- Visualize distribution of data in **R** and learn about normality test.
- Plot various graphs and charts using **R**.

Unit 1: Getting Started with R - The Statistical Programming Language

Introducing **R**, using **R** as a calculator; Explore data and relationships in **R**; Reading and getting data into **R**: combine and scan commands, viewing named objects and removing objects from **R**, Types and structures of data items with their properties, Working with history commands, Saving work in **R**; Manipulating vectors, Data frames, Matrices and lists; Viewing objects within objects, Constructing data objects and their conversions.

Unit 2: Descriptive Statistics and Tabulation

Summary commands; Summary statistics for vectors, Data frames, Matrices and lists; Summary tables.

Unit 3: Distribution of Data

Stem and leaf plot, Histograms, Density function and its plotting, The Shapiro–Wilk test for normality, The Kolmogorov–Smirnov test.

Unit 4: Graphical Analysis with R

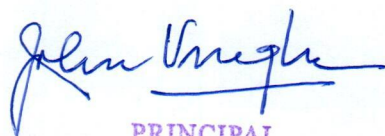
Plotting in **R**: Box-whisker plots, Scatter plots, Pairs plots, Line charts, Pie charts, Cleveland dot charts, Bar charts; Copy and save graphics to other applications.

References:

- Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
- Gardener, M. (2012). *Beginning R: The Statistical Programming Language*, Wiley Publications.

Additional Reading:

- Verzani, John (2014). *Using R for Introductory Statistics* (2nd ed.). CRC Press, Taylor & Francis Group.


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Practicals to be done in the Computer Lab using Statistical Software R:

[1] Chapter 14 (Exercises 1 to 3)

[2] Relevant exercises of Chapters 2 to 5, and 7

Note: The practical may be done on the database to be downloaded from <https://data.gov.in/>

Teaching Plan (Theory of SEC-4: Statistical Software: R):

Weeks 1 to 3: Introducing R, using R as a calculator; Explore data and relationships in R, Reading and getting data into R: Combine and scan commands, viewing named objects and removing objects from R, Types and structures of data items with their properties, Working with history commands, Saving work in R.

[1] Chapter 14 (Sections 14.1 to 14.4).

[2] Chapter 2.

Weeks 4 and 5: Manipulating vectors, Data frames, Matrices and lists; Viewing objects within objects, Constructing data objects and their conversions.

[2] Chapter 3.

Weeks 6 to 8: Summary commands: Summary statistics for vectors, Data frames, Matrices and lists; Summary tables.

[2] Chapter 4.

Weeks 9 to 11: Stem and leaf plot, Histograms, Density function and its plotting, The Shapiro–Wilk test for normality, The Kolmogorov–Smirnov test.

[2] Chapter 5.

Weeks 12 to 14: Plotting in R: Box-whisker plots, Scatter plots, Pairs plots, Line charts, Pie charts, Cleveland dot charts, Bar charts; Copy and save graphics to other applications.

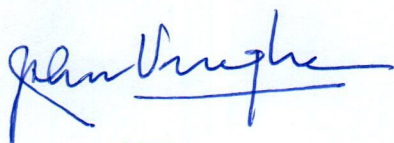
[1] Chapter 14 (Section 14.7).

[2] Chapter 7.

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Be familiar with R syntax and use R as a calculator. Understand the concepts of objects, vectors and data types.	(i) Each topic to be explained with illustrations using R software.	• Presentations and class discussions. • Assignments and class tests.
2.	Know about summary commands and summary table in R.	(ii) Students be given homework/ assignments.	• Mid-term examinations.
3.	Visualize distribution of data in R and learn about normality test.	(iii) Students be encouraged to look for new applications.	• Practical examinations.
4.	Be familiar with R syntax and use R as a calculator. Understand the concepts of objects, vectors and data types.		• End-term examinations.

Keywords: Objects, Vectors, Data types, Summary commands, Shapiro–Wilk test, Bar charts.



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Semester-V

Skill Enhancement Paper

SEC-3: Transportation and Network Flow Problems

Total Marks: 100 (Theory: 55, Internal Assessment: 20 and Practical: 25)

Workload: 3 Lectures, 2 Practicals (per week) **Credits:** 4 (3+1)

Duration: 14 Weeks (42 Hrs. Theory + 28 Hrs. Practical) **Examination:** 3 Hrs.

Course Objectives: This course aims at providing applications of linear programming to solve real-life problems such as transportation problem, assignment problem, shortest-path problem, minimum spanning tree problem, maximum flow problem and minimum cost flow problem.

Course Learning Outcomes: This course will enable the students to:

- i) Formulate and solve transportation problems.
- ii) Learn to solve assignment problems using Hungarian method.
- iii) Solve travelling salesman problem.
- iv) Learn about network models and various network flow problems.
- v) Learn about project planning techniques namely, CPM and PERT.

Unit 1: Transportation Problems

Transportation problem and its mathematical formulation, North West corner method, Least cost method and Vogel's approximation method for determination of starting basic feasible solution, Algorithm for solving transportation problem.

Unit 2: Assignment and Traveling Salesperson Problems

Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem, Traveling salesperson problem.

Unit 3: Network Models

Network models, Minimum spanning tree algorithm, Shortest-route problem, Maximum flow model.

Unit 4: Project Management with CPM/PERT

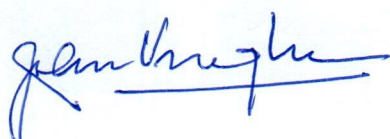
Project network representation, CPM and PERT.

References:

1. Hillier, Frederick S., & Lieberman, Gerald J. (2017). *Introduction to Operations Research*, (10th ed.). McGraw Hill Education (India) Pvt. Ltd. New Delhi.
2. Taha, Hamdy A. (2007). *Operations Research: An Introduction* (8th ed.). Pearson Education India. New Delhi.

Additional Reading:

- i. Bazaraa, Mokhtar S., Jarvis, John J., & Sherali, Hanif D. (2010). *Linear Programming and Network Flows* (4th ed.). John Wiley & Sons.



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Practicals to be done in the Computer Lab using a suitable Software:

Use TORA/Excel spreadsheet to solve transportation problem, Assignment problem, Traveling salesperson problem, Shortest-route problem, Minimum spanning tree algorithm, Maximum flow model, CPM and PERT calculations of exercises from the chapters 5 and 6 of [2].

[1] Case 9.1: Shipping Wood to Market, and Case 9.3: Project Pickings.

Teaching Plan (Theory of SEC-3: Transportation and Network Flow Problems):

Weeks 1 to 4: Transportation problem and its mathematical formulation, North West corner method, least cost method and Vogel's approximation method for determination of starting basic feasible solution. Algorithm for solving transportation problem.

[2] Chapter 5 (Sections 5.1, and 5.3).

Weeks 5 to 7: Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem, traveling salesperson problem.

[2] Chapter 5 (Section 5.4), and Chapter 9 (Section 9.3)

Weeks 8 to 11: Network models, minimum spanning tree algorithm, shortest-route problem, maximum flow model.

[2] Chapter 6 (Sections 6.1 to 6.4).

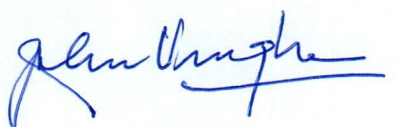
Weeks 12 to 14: Project network, CPM and PERT.

[2] Chapter 6 (Section 6.5).

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Formulate and solve transportation problems.	(i) Topics to be explained using TORA/Excel. (ii) Students to be given homework/assignments. (iii) Students to be encouraged to look for new applications.	• Presentations and class discussions. • Assignments and class tests. • Mid-term examinations. • Practical examinations. • End-term examinations.
2.	Learn to solve assignment problems using Hungarian method. Solve travelling salesman problem.		
3.	Learn about network models and various network flow problems.		
4.	Learn about project planning techniques namely, CPM and PERT.		

Keywords: Transportation problem, Assignment problem, Traveling salesperson problem, Network flows, CPM, PERT.


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1. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
2. Electricity, Magnetism & Electromagnetic Theory, S.Mahajanand Choudhury, 2012, Tata McGraw
3. Electricity and Magnetism, J.H.Fewkes& J.Yarwood. Vol.I, 1991, Oxford Univ. Press.
4. Problems and Solutions in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan & Ravi Varshney.
5. Schaum's Outline of Electric Circuits, J. Edminister & M. Nahvi, 3rd Edn., 1995, McGraw Hill.

References for Laboratory Work:

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

CC-IV: Waves and Optics (32221202)

Credit : 06 (Theory-04, Practical-02)

Theory : 60 Hours

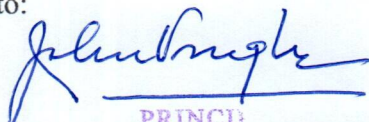
Practical : 60 Hours

Course Objective

This course reviews the concepts of waves and optics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with explaining ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. The course also provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.

Course Learning Outcomes

On successfully completing the requirements of this course, the students will have the skill and knowledge to:


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- Understand Simple harmonic oscillation and superposition principle.
- Understand different types of waves and their velocities: Plane, Spherical, Transverse, Longitudinal.
- Understand Concept of normal modes in transverse and longitudinal waves: their frequencies and configurations.
- Understand Interference as superposition of waves from coherent sources derived from same parent source.
- Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture, understand Fraunhofer and Fresnel Diffraction.
- In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt first hand. The motion of coupled oscillators, study of Lissajous figures and behaviour of transverse, longitudinal waves can be learnt in this laboratory course.

Unit 1

Superposition of Collinear Harmonic oscillations: Simple harmonic motion (SHM). Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

(6 Lectures)

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies and their uses.

(2 Lectures)

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

(4 Lectures)

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

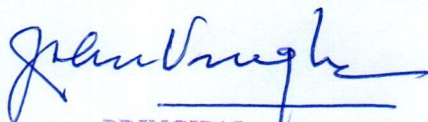
(8 Lectures)

Unit 2

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

(4 Lectures)

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination


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(Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

(10 Lectures)

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

(6 Lectures)

Unit 3

Diffraction:

Fraunhofer diffraction: Single slit. Rectangular and Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

(10 Lectures)

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Cornu's spiral and its applications. Straight edge, a slit and a wire.

(10 Lectures)

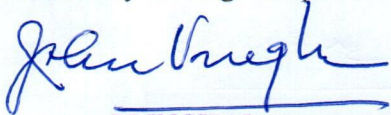
Practical: 60 Hours

Dedicated demonstration cum laboratory session on the construction, and use of spectrometer and lasers, and necessary precautions during their use.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab.

At least 06 experiments from the following:

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 -T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster's focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.


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11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

References for Theory:

Essential Readings:

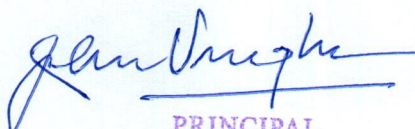
1. Vibrations and Waves, A.P. French, 1stEdn., 2003, CRC press.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
4. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
5. Optics, Eugene Hecht, 4thEdn., 2014, Pearson Education.

Additional Readings:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. Optics, (2017), 6th Edition, Ajoy Ghatak, McGraw-Hill Education, New Delhi
4. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications

References for Laboratory Work:

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press


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SEC: Computational Physics Skills (32223902)

Credit:04 (Theory-02, Practical-02)

Theory: 30 Hours

Practical : 60 Hours

Course Objectives

This course is intended to give an insight to computer hardware and computer applications. Students will familiarize with use of computer to solve physics problems. They will learn a programming language namely fortran and data visualization using GNU plot. Further they will also learn to prepare long formatted document using latex.

Course Learning Outcomes

Students will be able to

- Use computers for solving problems in Physics.
- Prepare algorithms and flowcharts for solving a problem.
- Use Linux commands on terminal
- Use an unformatted editor to write sources codes.
- Learn “Scientific Word Processing”, in particular, using LaTeX for preparing articles, papers etc. which include mathematical equations, picture and tables.
- Learn the basic commands of Gnuplot.

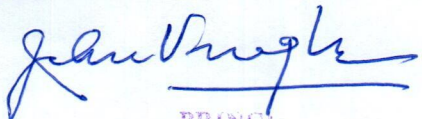
Unit 1

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor.

Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of $\sin(x)$ as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

(4 Lectures)

Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.


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(5 Lectures)

Unit 2

Control Statements: Types of Logic(Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO- CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems Programming:

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using $\exp(x)$ series evaluated at $x=1$

(6 Lectures)

Unit 3

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

(6 Lectures)

Unit 4

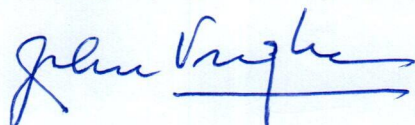
Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

(9 Lectures)

Practicals/Hands on exercises:

PRACTICALS-SEC LAB: Computational Physics Skills Lab

Teacher may give long duration project based on this paper.


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1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

References

1. Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
2. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
3. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010).
4. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
5. Elementary Numerical Analysis, K.E.Atkinson, 3rd Edn., 2007, Wiley India Edition.

SEC: Electrical circuits and Network Skills (32223903)

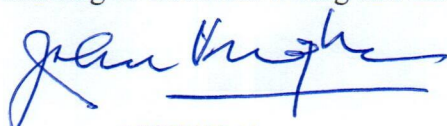
Credit:04 (Theory-02, Practical-02)

Theory: 30 Hours

Practical : 60 Hours

Course Objectives

To develop an understanding of basic principles of electricity and its household applications. To impart basic knowledge of solid state devices and their applications, understanding of electrical wiring and installation.


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References for Laboratory Work:

1. Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444
2. Learning Scientific Programming with Python, Christian Hill, Cambridge University Press (2016)
3. Computational Problems for Physics: With Guided Solutions Using Python, Rubin H. Landau, Manuel José Páez, CRC Press (2018).
4. Numerical Recipes in C⁺⁺: The Art of Scientific Computing, W.H. Press et.al., 2nd Edn., Cambridge University Press (2013).
5. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.

DSE: Nuclear and Particle Physics (32227504)

Credit : 06 (Theory-05, Tutorial-01)

Theory : 75 Hours

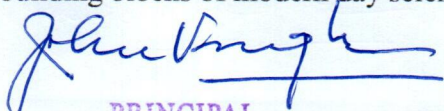
Tutorial : 15 Hours

Course Objective

The objective of the course is to impart the understanding of the sub atomic particles and their properties. It will emphasize to gain knowledge about the different nuclear techniques and their applications in different branches Physics and societal application. The course will focus on the developments of problem based skills.

Course Learning Outcomes

- To be able to understand the basic properties of nuclei as well as knowledge of experimental determination of the same, the concept of binding energy, its various dependent parameters, N-Z curves and their significance
- To appreciate the formulations and contrasts between different nuclear models such as Liquid drop model, Fermi gas model and Shell Model and evidences in support.
- Knowledge of radioactivity and decay laws. A detailed analysis, comparison and energy kinematics of alpha, beta and gamma decays.
- Familiarization with different types of nuclear reactions, Q- values, compound and direct reactions.
- To know about energy losses due to ionizing radiations, energy losses of electrons, gamma ray interactions through matter and neutron interaction with matter. Through the section on accelerators students will acquire knowledge about Accelerator facilities in India along with a comparative study of a range of detectors and accelerators which are building blocks of modern day science.


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- It will acquaint students with the nature and magnitude of different forces, particle interactions, families of sub-atomic particles with the different conservation laws, concept of quark model.
- The acquired knowledge can be applied in the areas of nuclear medicine, medical physics, archaeology, geology and other interdisciplinary fields of Physics and Chemistry. It will enhance the special skills required for these fields.

Unit 1

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density, matter density (experimental determination of each), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/Z plot, angular momentum, parity, magnetic moment, electric moments.

(10 Lectures)

Unit 2

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, nucleon separation energies (up to two nucleons), Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure and the basic assumptions of shell model.

(11 Lectures)

Unit 3

Radioactivity decay: Decay rate and equilibrium (Secular and Transient) (a) Alpha decay: basics of α -decay processes, theory of α -emission, Gamow factor, Geiger Nuttall law, α -decay spectroscopy, decay Chains. (b) β -decay: energy kinematics for β -decay, β -spectrum, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission from the excited state of the nucleus & kinematics, internal conversion.

(10 Lectures)

Unit 4

Nuclear Reactions: Types of Reactions, units of related physical quantities, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

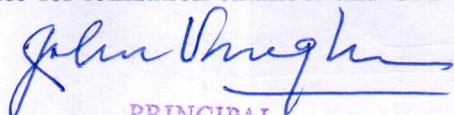
(8 Lectures)

Unit 5

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter (photoelectric effect, Compton scattering, pair production), neutron interaction with matter.

(9 Lectures)

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle for ionization chamber and GM Counter. Basic principle of Scintillation Detectors


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and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

(9 Lectures)

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons (Principal, construction, working, advantages and disadvantages).

(7 Lectures)

Unit 6

Particle physics: Particle interactions (concept of different types of forces), basic features, Cosmic Rays, types of particles and its families, Conservation Laws (energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness) concept of quark model, color quantum number and gluons.

(11 Lectures)

References for Theory :

Essential Readings:

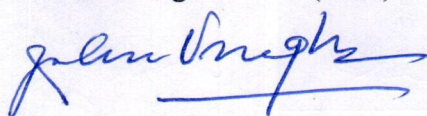
1. Basic ideas and concepts in Nuclear Physics: An introductory approach by K Heyde, third edition, IOP Publication, 1999.
2. Nuclear Physics by S N Ghoshal, First edition, S. Chand Publication, 2010.
3. Introductory Nuclear Physics by K S Krane, Wiley-India Publication, 2008.
4. Nuclear Physics: principles and applications by J Lilley, Wiley Publication, 2006.
5. Radiation detection and measurement, G F Knoll, John Wiley & Sons, 2010.
6. Introduction to elementary particles by D J Griffiths, Wiley, 2008.

Additional Readings:

1. Concepts of Nuclear Physics by B L Cohen, Tata McGraw Hill Publication, 1974.
2. Physics and Engineering of Radiation Detection by S N Ahmed, Academic Press Elsevier, 2007.
3. Techniques for Nuclear and Particle Physics experiments by WR Leo, Springer, 1994.
4. Modern Physics by R A Serway, C J Moses and C A Moyer, 3rd edition, Thomson Brooks Cole, 2012.
5. Modern Physics for Scientists and Engineers by S T Thornton and A Rex, 4th edition, Cengage Learning, 2013.
6. Modern Physics by R A Serway, C J Moses and C A Moyer, 3rd edition, Thomson Brooks Cole, 2012.
7. Concepts of Modern Physics by Arthur Beiser, McGraw Hill Education, 2009.

References for Tutorial:

1. Schaum's Outline of Modern Physics, McGraw-Hill, 1999.
2. Schaum's Outline of College Physics, by E. Hecht, 11th edition, McGraw Hill, 2009.
3. Modern Physics by K Sivaprasath and R Murugesan, S Chand Publication, 2010.
4. Nuclear Physics "Problem-based Approach" Including MATLAB by Hari M. Aggarwal, PHI Learning Pvt. Ltd. (2016).



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दिल्लीविश्वविद्यालय
UNIVERSITY OF DELHI

Six-Month **Ability Enhancement Compulsory Course (AECC-I)**
Environmental Studies
at Undergraduate Level

Learning Outcome-based Curriculum Framework
(Effective from Academic Year 2019–20)



Revised Syllabus as approved by

Academic Council

Date: 15 July

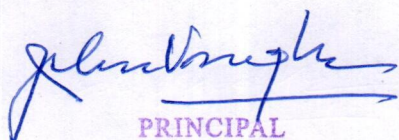
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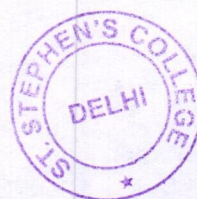
Executive Council

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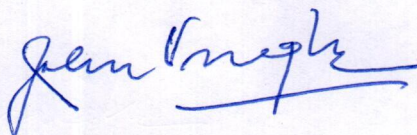
Applicable for students registered with Regular Colleges,
Non Collegiate Women's Education Board and School of Open Learning


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Introduction

Content: The Compulsory course on Environmental Studies at Undergraduate level (AECC-I) aims to train students to cater to the need for ecological citizenship through development of a strong foundation on the critical linkages between ecology-society-economy.

Learning Outcome based approach to Curriculum Planning

1. Graduate Attributes in Subject

- a. **Disciplinary knowledge**
Enable students to develop a comprehensive understanding of various facets of life forms, ecological processes, and the impacts on them by humans during the Anthropocene era.
- b. **Critical thinking**
Build capabilities to identify relevant environmental issues, analyse the various underlying causes, evaluate the practices and policies, and develop framework to make informed decisions.
- c. **Moral and ethical awareness/reasoning**
Develop empathy for all life forms, appreciation for the various ecological linkages within the web of life, awareness and responsibility towards environmental protection and nature preservation.

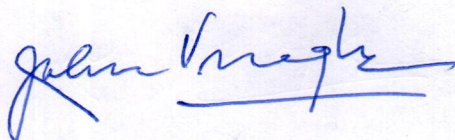
2. Programme Learning Outcome in course

The course will empower the undergraduate students through:

- i. Gaining of in-depth knowledge on natural processes and resources that sustain life and govern economy.
- ii. Understanding and predicting the consequences of human actions on the web of life, global economy, and quality of human life.
- iii. Development of critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- iv. Acquisition of values and attitudes towards understanding complex environmental-economic-social challenges, and active participation in solving current environmental problems and preventing the future ones.
- v. Encouraging adoption of sustainability as a practice in life, society, and industry.

3. Qualification Description

Graduates will evolve into ecologically, environmentally, and socially informed and responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.



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Environmental Studies

Compulsory course on Environmental Studies at UG level (AECC I)

Course Learning Outcomes

The course will empower the undergraduate students by helping them to:

- i. Gain in-depth knowledge on natural processes and resources that sustain life and govern economy.
- ii. Understand the consequences of human actions on the web of life, global economy, and quality of human life.
- iii. Develop critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- iv. Acquire values and attitudes towards understanding complex environmental-economic-social challenges, and active participation in solving current environmental problems and preventing the future ones.
- v. Adopt sustainability as a practice in life, society, and industry.

Unit 1

Introduction to Environmental Studies (2 lectures)

- Multidisciplinary nature of environmental studies; components of environment: atmosphere, hydrosphere, lithosphere, and biosphere
- Scope and importance; Concept of sustainability and sustainable development; Brief history of environmentalism

Suggested Readings

1. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 8th Edition. Wiley Publishing, USA. **Chapter 1** (Pages: 1-17); **Chapter 2** (Pages: 22-23); **Chapter 3** (Pages: 40, 41); **Chapter 4** (Pages: 64, 66).
2. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 1** (Page: 3-28).

Unit 2

Ecosystems (6 lectures)

- Definition and concept of Ecosystem
- Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem: Physical (energy flow), Biological (food chains, food web, ecological succession), and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis
- Types of Ecosystems: Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries); importance and threats with relevant examples from India
- Ecosystem services (Provisioning, Regulating, Cultural, and Supporting); Ecosystem preservation and conservation strategies; Basics of Ecosystem restoration

Suggested Readings

1. Odum, E.P., Odum, H.T., and Andrews, J. (1971). *Fundamentals of Ecology*. Saunders, Philadelphia, USA. **Chapter 1** (Pages: 1-16); **Chapter 2** (Pages: 18-76); **Chapter 10** (Pages: 414-458).
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 3** (Pages: 38-52); **Chapter 4** (Pages: 53-62); **Chapter 5** (Pages: 100-103); **Chapter 6** (Pages: 106-128).
3. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 13** (Pages: 307-323); **Chapter 18** (Pages: 420-442); **Chapter 28** (Pages: 747-769).

Unit 3**Natural Resources (8 lectures)**

- Land resources: Minerals, soil, agricultural crops, natural forest products, medicinal plants, and forest-based industries and livelihoods; Land cover, land use change, land degradation, soil erosion, and desertification; Causes of deforestation; Impacts of mining and dam building on environment, forests, biodiversity, and tribal communities
- Water resources: Natural and man-made sources; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts, and international & inter-state conflicts over water
- Energy resources: Renewable and non-renewable energy sources; Use of alternate energy sources; Growing energy needs; Energy contents of coal, petroleum, natural gas and bio gas; Agro-residues as a biomass energy source
- Case studies: Contemporary Indian issues related to mining, dams, forests, energy, etc (e.g., National Solar Mission, Cauvery river water conflict, Sardar Sarovar dam, Chipko movement, Appiko movement, Tarun Bharat Sangh, etc)

Suggested Readings

1. Gadgil, M. and Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press, Berkeley, USA. (pp. 1-245).
2. McCully, P. (1996). *Rivers no more: the environmental effects of dams*, In: *Silenced Rivers: The Ecology and Politics of Large Dams*, Zed Books, New York, USA. **Page. 29-64**.
3. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapters 10, 11, 12, 13** (Pages: 180-263); **Chapter 14** (Pages: 272-275); **Chapter 15** (Pages: 286-289).
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 25** (Pages: 623-663).

Unit 4**Biodiversity and Conservation (8 lectures)**

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity
- India as a mega-biodiversity nation; Biogeographic zones of India; Biodiversity hotspots; Endemic and endangered species of India; IUCN Red list criteria and categories
- Value of biodiversity: Ecological, economic, social, ethical, aesthetic, and informational values of biodiversity with examples; sacred groves and their importance with examples

- Threats to biodiversity: Habitat loss, degradation, and fragmentation; Poaching of wildlife; Man-wildlife conflicts; Biological invasion with emphasis on Indian biodiversity; Current mass extinction crisis
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; National Parks, Wildlife Sanctuaries, and Biosphere reserves; Keystone, Flagship, Umbrella, and Indicator species; Species reintroduction and translocation
- Case studies: Contemporary Indian wildlife and biodiversity issues, movements, and projects (e.g., Project Tiger, Project Elephant, Vulture breeding program, Project Great Indian Bustard, Crocodile conservation project, Silent Valley movement, Save Western Ghats movement, etc)

Suggested Readings

1. Primack, R.B. (2014). *Essentials of Conservation Biology*, Oxford University Press, USA. Page. 1-536.
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 5** (Pages: 97-99); **Chapter 16** (Pages: 299-318).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapters 24** (Pages: 599-690); **Chapter 26** (Pages: 664-714).

Unit 5

Environmental Pollution (8 lectures)

- Environmental pollution (Air, water, soil, thermal, and noise): causes, effects, and controls; Primary and secondary air pollutants; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures for various types of urban, industrial waste, Hazardous waste, E-waste, etc; Waste segregation and disposal
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues, Plastic waste management rules, Bhopal gas tragedy, etc

Suggested Readings

1. Brusseau, M.L., Pepper, I.L. and Gerba, C.P. (2019). *Environmental and Pollution Science*, 3rd Edition. Academic Press, USA. **Chapter 16** (Pages: 243-255); **Chapter 18** (Pages: 280-305); **Chapter 21** (Pages: 352-358); **Chapter 22** (Pages: 365-374); **Chapter 23** (Pages: 378-388); **Chapter 25** (Pages: 416-426).
2. Carson, R. (2002). *Silent Spring*. Houghton Mifflin Harcourt, USA. Pp. 1-264.
3. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 19** (Pages: 359-381); **Chapter 21** (Pages: 401-421); **Chapter 23** (Pages: 440-453).
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapters 19, 20, 12** (Pages: 445-535).

Unit 6

Global Environmental Issues and Policies (7 lectures)

- Causes of Climate change, Global warming, Ozone layer depletion, and Acid rain; Impacts on human communities, biodiversity, global economy, and agriculture

- International agreements and programmes: Earth Summit, UNFCCC, Montreal and Kyoto protocols, Convention on Biological Diversity(CBD), Ramsar convention, The Chemical Weapons Convention (CWC), UNEP, CITES, etc
- Sustainable Development Goals: India's National Action Plan on Climate Change and its major missions
- Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980; Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Suggested Readings

1. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. **Chapter 2** (Pages: 23-39); **Chapter 3** (Pages: 41-86).
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 19** (Pages: 370-376); **Chapter 20** (Pages: 385-399).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 23** (Pages: 555-598); **Chapter 30** (Pages: 801-807).

Unit 7

Human Communities and the Environment (6 lectures)

- Human population growth: Impacts on environment, human health, and welfare; Carbon foot-print
- Resettlement and rehabilitation of developmental project affected persons and communities; relevant case studies
- Environmental movements: Chipko movement, Appiko movement, Silent valley movement, Bishnois of Rajasthan, Narmada Bachao Andolan, etc
- Environmental justice: National Green Tribunal and its importance
- Environmental philosophy: Environmental ethics; Role of various religions and cultural practices in environmental conservation
- Environmental communication and public awareness: case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan, National Environment Awareness Campaign (NEAC), National Green Corps (NGC) "Eco-club" programme, etc)

Suggested Readings

1. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. **Chapter 10** (Pages: 416-473).
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 2** (Pages: 33-36); **Chapter 8** (Pages: 148-162).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 1** (Pages: 23-26); **Chapter 31** (Pages: 826-842).

Field work/ Practicals

(Equal to 5 lectures, including two mandatory field visits)

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc., or any nearby lake or pond, explaining the theoretical aspects taught in the class room
- Visit to any biodiversity park/ reserve forest/ protected area/ zoo/ nursery/ natural

history museum in and around Delhi, such as Okhla bird sanctuary/ Asola Bhatti Wildlife Sanctuary/ Yamuna Biodiversity Park/ Sultanpur National Park, explaining the theoretical aspects taught in the classroom

- Visit to a local polluted site (urban/rural/industrial/agricultural), wastewater treatment plants, or landfill sites, etc
- Study of common plants and animals; basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building, and critical reasoning among students

Essential Readings

1. Brusseau, M.L., Pepper, I.L., and Gerba, C.P. (2019). *Environmental and Pollution Science*, 3rd Edition. Academic Press, USA. (pp. 1-520).
2. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. (pp. 1-837).
3. Gadgil, M., and Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press, Berkeley, USA. (pp. 1-245).
4. Raven, P.H., Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 8th Edition. Wiley Publishing, USA. (pp. 1-472).
5. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. (pp.1-842).

Weekly Lesson Plan

Week 1

Multidisciplinary nature of environmental studies; components of environment: atmosphere, hydrosphere, lithosphere, and biosphere
Scope and importance; Concept of sustainability and sustainable development; Brief history of environmentalism

Week 2

Definition and concept of Ecosystem: Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem: Physical (energy flow), Biological (food chains, food web, ecological succession), and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis

Week 3

Types of Ecosystems: Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries); importance and threats with relevant examples from India
Ecosystem services (Provisioning, Regulating, Cultural, and Supporting); Ecosystem preservation and conservation strategies; Basics of Ecosystem restoration

Week 4

Land cover, land use change, land degradation, soil erosion, and desertification; Causes of deforestation; Impacts of mining and dam building on environment, forests, biodiversity, and tribal communities

Natural and man-made sources of water; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts, and international & inter-state conflicts over water

Week 5

Renewable and non-renewable energy sources; Use of alternate energy sources; Growing energy needs; Energy contents of coal, petroleum, natural gas and bio gas; Agro-residues as a biomass energy source

Case studies: Contemporary Indian issues related to mining, dams, forests, energy, etc (e.g., National Solar Mission, Cauvery river water conflict, Sardar Sarovar dam, Chipko movement, Appiko movement, Tarun Bharat Sangh, etc).

Week 6

Definition of Biodiversity; Levels of biological diversity; India as a mega-biodiversity nation; Biogeographic zones of India; Biodiversity hotspots; Endemic and endangered species of India; IUCN Red list criteria and categories

Value of biodiversity: Ecological, economic, social, ethical, aesthetic, and informational values of biodiversity with examples; sacred groves and their importance with examples

Week 7-8

Threats to biodiversity: Habitat loss, degradation, and fragmentation; Poaching of wildlife; Man-wildlife conflicts; Biological invasion with emphasis on Indian biodiversity; Current mass extinction crisis; Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; National Parks, Wildlife Sanctuaries, and Biosphere reserves; Keystone, Flagship, Umbrella, and Indicator species; Species reintroduction and translocation

Case studies: Contemporary Indian wildlife and biodiversity issues, movements, and projects (e.g., Project Tiger, Project Elephant, Vulture breeding program, Project Great Indian Bustard, Crocodile conservation project, Silent Valley movement, Save Western Ghats movement, etc)

Week 9

Environmental pollution (Air, water, soil, thermal, and noise): causes, effects, and controls; Primary and secondary air pollutants; Air and water quality standards

Related case studies

Week 10

Nuclear hazards and human health risks; Control measures for various types of urban, industrial waste, Hazardous waste, E-waste, etc; Waste segregation and disposal

Related case studies

Week 11

Causes of Climate change, Global warming, Ozone layer depletion, and Acid rain; Impacts on human communities, biodiversity, global economy, and agriculture

International agreements and programmes: Earth Summit, UNFCCC, Montreal and Kyoto protocols, Convention on Biological Diversity(CBD), Ramsar convention, The Chemical Weapons Convention (CWC), UNEP, CITES, etc

Week 12

Sustainable Development Goals: India's National Action Plan on Climate Change and its major missions

Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980; Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Week 13

Human population growth: Impacts on environment, human health, and welfare; Carbon foot-print; Resettlement and rehabilitation of developmental project affected persons and communities; relevant case studies; Environmental movements: Chipko movement, Appiko movement, Silent valley movement, Bishnois of Rajasthan, Narmada Bachao Andolan, etc; Environmental justice: National Green Tribunal and its importance

Week 14

Environmental philosophy: Environmental ethics; Role of various religions and cultural practices in environmental conservation

Environmental communication and public awareness: case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan, National Environment Awareness Campaign (NEAC), National Green Corps (NGC) "Eco-club" programme, etc)

Week 15-16

Practical/project

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc., or any nearby lake or pond, explaining the theoretical aspects taught in the class room
- Visit to any biodiversity park/ reserve forest/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, such as Okhla bird sanctuary/ Asola Bhatti Wildlife Sanctuary/ Yamuna Biodiversity Park/ Sultanpur National Park, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (urban/rural/industrial/agricultural), wastewater treatment plants, or landfill sites, etc
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building, and critical reasoning among students
- Basic exercise to Calculate and Assess carbon footprint/ Solid waste generation/ water consumption for a specific duration at individual/ family/ college/ locality level.

Teaching Learning process

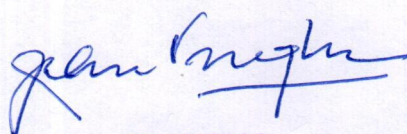
The teaching-learning methodologies are designed to provide the undergraduate students a comprehensive understanding of the subject in a simplistic manner as well as evoke critical reasoning and analytical thinking among them. The various approaches to teaching-learning process include classroom lectures, video presentations, and ICT enabled teaching tools. For enhancing practical understanding, field visits are encouraged to relevant places in Delhi like Biodiversity parks, Protected areas, Wetlands, Sewage treatment plants, etc.

Assessment methods

1. Written examinations (Semester exams, Internal assessment)
2. Project work and reports related to field visits and practical learning
3. Assignment/presentations on any contemporary environmental issue

Keywords

Environment, Ecosystem, Biodiversity, Conservation, Pollution, Natural Resources, Environmental Degradation, Protection, Sustainable Development, Climate Change, Environmental Justice, Environmental Ethics, Environmental Communication


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Standing Committee on Academic Matters dated 17.08.2018
Annexure No.-33

32

B.A./ B.Com./ B.Sc. (Hons.)
General Elective (GE) in Physical Education (Semester-2)

GE (II) : OBESITY MANAGEMENT

PART A: THEORY

Duration: 2 Hrs

Maximum Marks : 50

Unit-I: Obesity & its Assessment

- 1.1 Concept and Causes of Obesity
- 1.2 Health Risks Associated with Obesity
- 1.3 Assessment of Obesity - Body Mass Index (BMI), Waist-Hip Ratio, Skinfold Thickness (Abdomen, triceps, thigh, Supra-iliac)

Unit-II: Management of Obesity through Diet

- 2.1 Nutrition and Balanced Diet
- 2.2 Dietary Aids and Gimmicks
- 2.3 Obesity and weight management through diet

Unit-III : Weight Management through physical activities and Behaviour modification

- 3.1 Importance of maintaining Healthy Weight, Weight Management and Energy Balance
- 3.2 Principles of weight management; Aerobic & anaerobic activities
- 3.3 Behaviour Modification techniques for weight management

PART B : PRACTICAL

Maximum Marks : 25

1. Use BMI to identify the actual body weight status and desirable body weight status of at least ten students.
2. Calculate BMR and Waist-Hip ratio of at least ten students.
3. Measurement of Body Composition for calculating body fat and lean body mass

Assessment of Practical

Practical (Demonstration/ Performance)	: 10 Marks
Viva	: 10 Marks
Record Book on all topics of Practical	: 05 Marks

PART C : INTERNAL ASSESSMENT

Maximum Marks : 25

1. Presentation/ Written Test : 10 Marks
2. Project / Assignment : 10 Marks
3. Attendance : 05 Marks

MARKING SCHEME : Theory = 50 Marks, Practical = 25 Marks, Internal Assessment = 25 Marks

SEMESTER CREDITS FOR THE PAPER = 6 CREDITS

- Each period will be of one hour.
- 4 theory periods per week per semester = 4 credits
- 4 Practical periods per week per semester = 2 credits

INSTRUCTIONS TO THE EXAMINERS

- The examiners will set nine questions (eight descriptive and one question on short notes containing three options whereby, a student has to attempt any two) equally distributed throughout the entire syllabus.
- The students will be required to attempt any five questions.
- Each question will carry ten marks.

SUGGESTED READINGS

1. Anspaugh, D. J., Hamrick, M. H., & Rosato, P. D. (2006). *Wellness: Concepts and applications*. McGraw-Hill Companies.
2. Callender, M. A. (1981). *Nutrition and preventive health care*. Macmillan.
3. Hales, D. (2006). *An invitation to health*. Cengage Learning.
4. Hoeger, W. W. K., & Hoeger, S. A. (2007). *Fitness & Wellness*. Belmont, USA: Thomson Wadsworth
5. Howley, E. T., & Franks, H. D. (1986). *Health/Fitness Instructor's Handbook*. Human Kinetics Publishers, Inc., Marketing Director, Box 5076, Champaign, IL.
6. Kandel D.K. (2012). *Test Measurement and Evaluation*. Sports Spiritual Sciences Publications, New Delhi.
7. Kumar, S. S., Rana, A., & Kumbhik, S. (2008). *Fitness, Aerobics & Gym Operations*. New Delhi: Khel Sahitya Kendra
8. Sharma K. et al. (2014). *Fitness Aerobics & Gym Operations*, Iyoti Enterprises, Delhi.
9. Tiwari S. (1999). *Exercise Physiology*. Sports Publications, Delhi.

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Standing Committee on Academic Matters dated 17.08.2018
Annexure No.-33

354

B.A./ B.Com./ B.Sc. (Hons.)
General Elective (GE) in Physical Education (Semester-3)

GE (H) : AEROBICS TRAINING

PART A: THEORY

Duration: 2 Hrs

Maximum Marks : 50

Unit-I : Introduction

- 1.1. Introduction to Aerobics, Evolution of Aerobics
- 1.2. Benefits of participation in Aerobics
- 1.3. Individualized and Group Training in Aerobics

Unit-II : Aerobics

- 2.1. Forms of Aerobics (Floor, Step, Weight and Aqua Aerobics)
- 2.2. Appropriate Aerobic Gear, Flooring and Required Equipment
- 2.3. Need, Benefits and Selection of Music for Aerobics

Unit-III : Group Training

- 3.1. Development of Aerobic Fitness Programmes
- 3.2. Group Training Methods, Group Formation
- 3.3. Prevention and Care Specific to Aerobics - Foot Injuries, Shin Injuries, Knee Injuries, Multiple Site Injuries

PART B : PRACTICAL

Maximum Marks : 25

1. Develop a 5-10 minute routine of aerobics.
2. Compilation of music on a pen drive for low-impact, medium-impact and high-impact floor aerobics.
3. Demonstrate various group formations in an aerobics routine.

Assessment of Practical

Practical (Demonstration/ Performance)	10 Marks
Viva	10 Marks
Record Book on all topics of Practical	05 Marks

PART C : INTERNAL ASSESSMENT

Maximum Marks : 25

1. Presentation/ Written Test : 10 Marks
2. Project / Assignment : 10 Marks
3. Attendance : 05 Marks

MARKING SCHEME : Theory = 50 Marks, Practical = 25 Marks, Internal Assessment = 25 Marks

SEMESTER CREDITS FOR THE PAPER - 6 CREDITS

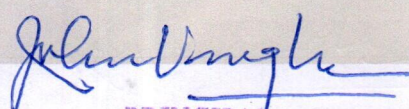
- Each period will be of one hour.
- 4 theory periods per week per semester = 4 credits
- 4 Practical periods per week per semester = 2 credits

INSTRUCTIONS TO THE EXAMINERS

- The examiners will set nine questions (eight descriptive and one question on short notes containing three options whereby, a student has to attempt any two) equally distributed throughout the entire syllabus.
- The students will be required to attempt any five questions.
- Each question will carry ten marks.

SUGGESTED READINGS

1. James, L. (2011). The first book of life skill. Embassy Book Distributors.
2. Kumar, M. (2000). Developing communication skills. Delhi: Macmillan.
3. Kumar, S., & Pushpata. (2011). Communication skills. Oxford.
4. Peel, M. (1995). Improving your communication skills. Kogan Page.
5. Ratnan, M., & Sharma, S. (2011). Communication skills. Oxford.
6. Sharma, P.C. (2008). Communication skills & personality development, NiraliPrakashan, Pune.


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36

B.A./ B.Com./ B.Sc. (Hons.)
General Elective (GE) in Physical Education (Semester-4)

GE (H) : FITNESS & EXERCISE MANAGEMENT

PART A: THEORY

Duration: 2 Hrs

Maximum Marks : 50

Unit-I : Physical Fitness

- 1.1. Concept and Significance of Physical Fitness
- 1.2. Components of Physical Fitness, Assessment of Health Related Physical Fitness Components - Cardio-respiratory Endurance, Body Composition, Muscular Strength, Muscular Endurance, Flexibility
- 1.3. Principles of Training, Development of Fitness

Unit-II : Suggested Exercises for Fitness

- 2.1. Exercises for developing Cardio-respiratory Endurance, Weight Management, Resistance Training, Flexibility
- 2.2. Exercises for Children, Youth, Adults, Women, Senior citizens
- 2.3. Exercises for Coronary Heart Disease, Obesity, Diabetes, Asthma and Pulmonary Disease

Unit-III : Exercise Programming and Management

- 3.1. Health Appraisal, Setting Fitness Goals, Measuring Energy Expenditure
- 3.2. Behaviour Modification, Fitness Module, Prevention of Injuries and First-Aid
- 3.3. Evaluation of the implemented programmes of fitness and Report generating

PART B : PRACTICAL

Maximum Marks : 25

1. Assessment of Wellness and Fitness for Life : Lifestyle Assessment Inventory (Assessment Activity -1), Physical Activity Readiness Questionnaire (PAR-Q), Functional Fitness Test for Senior Citizens
2. Evaluation of Fitness : Cooper's 9/12 min. (Girls/Boys) Run/ Walk Test, Sit and Reach Test/Modified Sit & Reach Test, Modified Sit-ups (one minute), Pull-ups/ Flexed Arm Hang (one minute), Body Mass Index (BMI), Basal Metabolic Rate (BMR), Waist-Hip Ratio (WHR)

Assessment of Practical

Practical (Demonstration/ Performance) :	10 Marks
Viva :	10 Marks
Record Book on all topics of Practical :	05 Marks

Maximum Marks : 25

PART C : INTERNAL ASSESSMENT

1. Presentation/ Written Test : 10 Marks
2. Project / Assignment : 10 Marks
3. Attendance : 05 Marks

MARKING SCHEME : Theory = 50 Marks, Practical = 25 Marks, Internal Assessment = 25 Marks

SEMESTER CREDITS FOR THE PAPER = 6 CREDITS

- Each period will be of one hour.
- 4 theory periods per week per semester = 4 credits
- 4 Practical periods per week per semester = 2 credits

INSTRUCTIONS TO THE EXAMINERS

- The examiners will set nine questions (eight descriptive and one question on short notes containing three options whereby, a student has to attempt any two) equally distributed throughout the entire syllabus.
- The students will be required to attempt any five questions.
- Each question will carry ten marks.

SUGGESTED READINGS

1. Anspaugh, D.J., Hamrick, M. J., & Rosato, F. D. (2013). Wellness - Concept and Applications. USA: McGraw Hill Higher Education.
2. Carnalose, D. N. (1993). Fitness management. WCB Brown & Benchmark.
3. Fahey, T. D., Insel, P. M., & Roth, W. T. (2009). Fit & well. USA: McGraw Hill.
4. Howley, E. T., & Franks, B. D. (2007). Health/Fitness Instructor's Handbook. Human Kinetics Publishers, Inc., Marketing Director, Box 5076, Champaign, IL.
5. Kansal D.K. (2012). Test Measurement and Evaluation, Sports Spiritual Sciences Publications, Delhi.
6. Kumari, S. S., Rana, A., & Kaushik, S. (2008). Fitness, Aerobics & Gym Operations, KhelSahitya Kendra, Delhi.
7. Powers, S. K., Dodd, S. L., & Noland, V. J. (2006). Total Fitness and Wellness, Daryl Fox, USA.
8. Tiwari S. (1999). Exercise Physiology Sports Publications, Delhi.

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GE I

Delhi through the Ages: The Making of its Early Modern History

Course Objective:

The objective of the paper is to teach students about the changes in the city of Delhi from its early inception to the eighteenth century. The course teaches how the city grew into one of the largest cities in the world and was the capital of some of the great empires of its time. As the capital of these empires, Delhi profited from continuous immigration, state patronage and a vibrant cultural life. But the course also wants students to learn that the city was not merely dependent upon its rulers for cultural and political sustenance. It focuses on Sufis, litterateurs and merchants who also gave the city its unique character and resilience in the face of political turbulence. Other than recourse to readings the course tries to acquaint students with Delhi through project work and introspection of Delhi's presence and its uneasy relationship with its past.

Learning Outcomes:

Upon completion of this course the student shall be able to:

- Analyse different kinds of sources -- archaeological, architectural and a variety of textual materials.
- Use these materials and correlate their sometimes discordant information.
- Analyse processes of urbanization and state formation.
- Describe the difficulties in appropriating narratives of the state with the history of particular localities.

Course Content:

Unit I: Between Myth and History -- Delhi's Early Past: Indraprastha, Lalkot

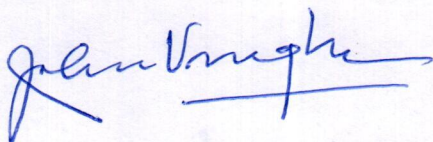
Unit II: From settlements to cityscape — Understanding the Many cities of Delhi

Unit III: Delhi's 13th and 14th Century settlements

Case study of any two: 1) Dehli-ikuhna'smnsJid-J'ami '(old Delhi/Mehrauli), 2) Siri, 3) Ghiyaspur-Kilukhri, 4) Tughluqabad, 5) Jahanpanah, and 6) Firuzabad

Unit IV: Shajahanabad: Qila Mubarak (Red Fort) as a site of power and the morphology of the city.

Unit V: 18th century Delhi: political upheaval and social empowerment — complicated understandings of 'decline'.



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ESSENTIAL READINGS AND UNIT WISE TEACHING OUTCOMES:

Unit 1: This unit will introduce students to the early history of Delhi, focusing on Indraprastha and the Tomara and Chauhan constructions. (Teaching Time: 2 weeks Approx.)

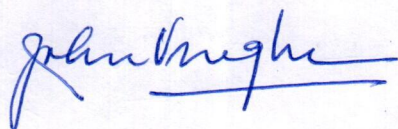
- Richard J. Cohen, "An Early Attestation of the Toponym Dhilli", *Journal of the American Oriental Society*, Vol. 109 (1989), pp. 513-519.
- Singh, Upinder. (2006). *Ancient Delhi*, Delhi: Oxford University Press

Unit 2: This unit will study the proverbial 'seven cities of Delhi', focusing primarily on Sultanate settlements. It will discuss the possible reasons for the shift of capitals, how settlements of the 13 century gradually appeared as conjoined cities under the Tughluqs, and the differences between these urban spaces. (Teaching Time: 3 weeks Approx.)

- Ali, Athar. (1985). "Capital of the Sultans: Delhi through the 13th and 14th Centuries", in R.E. Frykenberg, ed., *Delhi Through the Age: Essays in Urban History, Culture and Society*, Delhi: Oxford University Press, pp. 34-44
- Habib, Irfan. (1978). 'Economic History of the Delhi Sultanate -- an Essay in Interpretation' *Indian Historical Review* vol. 4, pp. 287-303.
- Kumar, Sunil. (2011). "Courts, Capitals and Kingship: Delhi and its Sultans in the Thirteenth and Fourteenth Centuries CE" in Albrecht Fuess and Jan Peter Hartung.(eds.).*Court Cultures in the Muslim World: Seventh to Nineteenth Centuries*, London: Routledge, pp. 123-148
- Kumar, Sunil. (2019) "The Tyranny of Meta-Narratives; Re-reading a History of Sultanate Delhi", in Kumkum Roy and Naina Dayal.(Ed.).*Questioning Paradigms, Constructing Histories. A Festschrift for Romila Thapar*, Aleph Book Company, pp 222-235.

Unit 3: This unit will study any two of the six sites in Delhi in detail. Students will be encouraged to use the readings mentioned below and correlated to the teaching units in the course content to plan field trips (Teaching Time: 3 weeks Approx.)

- Flood, Finbarr B. (2008). "Introduction" in Finbarr B. Flood, *Piety and Politics in the Early Indian Mosque*, Delhi: Oxford University Press, pp. xi-lxxviii



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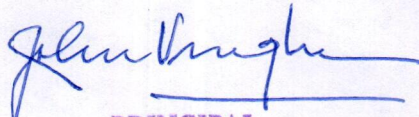


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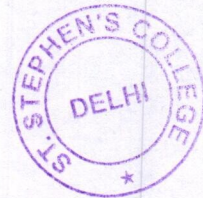
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Semester-I

GE-1: Calculus OR GE-1: Analytic Geometry and Theory of Equations

GE-1: Calculus

Total Marks: 100 (Theory: 75, Internal Assessment: 25)

Workload: 5 Lectures, 1 Tutorial (per week) **Credits:** 6 (5+1)

Duration: 14 Weeks (70 Hrs.) **Examination:** 3 Hrs.

Course Objectives: The main aim of this course is to learn about applications of derivatives for sketching of curves and conics and application of definite integrals for calculating volumes of solids of revolution, length of plane curves and surface areas of revolution. Various notions related to vector-valued functions and functions of several variables are also discussed in this course.

Course Learning Outcomes: This course will enable the students to:

- Sketch the curves in Cartesian and polar coordinates as well as learn techniques of sketching the conics.
- Visualize three dimensional figures and calculate their volumes and surface areas.
- Understand limits, continuity and derivatives of functions of several variable and vector-valued functions.

Unit 1: Applications of Derivatives and Limits

(Lectures: 20)

The first derivative test, Concavity and inflection points, Second derivative test, Curve sketching using first and second derivative test; Limits at infinity, Horizontal asymptotes, Vertical asymptotes, Graphs with asymptotes; L'Hôpital's rule.

Unit 2: Applications of Definite Integrals

(Lectures: 15)

Volumes by slicing, Volumes of solids of revolution by the disk method, Volumes of solids of revolution by the washer method, Volume by cylindrical shells, Length of plane curves, Arc length of parametric curve, Area of surface of revolution.

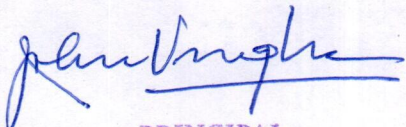
Unit 3: Conics, Vector-Valued Functions and Partial Derivatives

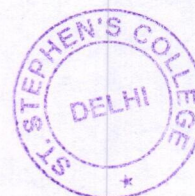
(Lectures: 35)

Techniques of sketching conics, Reflection properties of conics; Polar coordinates, graphing in polar coordinates; Vector-valued functions: Limits, Continuity, Derivatives, Integrals, Arc length, Unit tangent vector, Curvature, Unit normal vector; Functions of several variables: Graphs and level curves, Limits and continuity, Partial derivatives and differentiability, The chain rule, Directional derivatives and gradient vectors, Tangent plane and normal line, Extreme values and saddle points.

References:

- Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). *Calculus* (10th ed.). John Wiley & Sons Singapore Pvt. Ltd. Reprint (2016) by Wiley India Pvt. Ltd. Delhi.
- Strauss, M. J., Bradley, G. L., & Smith, K. J. (2007). *Calculus* (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Sixth impression 2011.


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Additional Reading:

- i. Thomas, Jr. George B., Weir, Maurice D., & Hass, Joel (2014). *Thomas' Calculus* (13th ed.). Pearson Education, Delhi. Indian Reprint 2017.

Teaching Plan (GE-1: Calculus):

Weeks 1 and 2: The first derivative test, Concavity and inflection points, Second derivative test, Curve sketching using first and second derivative test. [2] Chapter 4 (Section 4.3).

Weeks 3 and 4: Limits at infinity, Horizontal asymptotes, Vertical asymptotes, Graphs with asymptotes; L'Hôpital's rule. [2] Chapter 4 (Sections 4.4, and 4.5). [1] Chapter 3 (Section 3.3), and Chapter 6 (Section 6.5).

Weeks 5 and 6: Volumes by slicing, Volumes of solids of revolution by the disk method, Volumes of solids of revolution by the washer method, Volume by cylindrical shells. [1] Chapter 5 (Sections 5.2, and 5.3).

Week 7: Length of plane curves, Arc length of parametric curves, Area of surface of revolution. [1] Chapter 5 (Sections 5.4, and 5.5).

Week 8: Techniques of sketching conics, Reflection properties of conics. [1] Chapter 10 (Section 10.4).

Week 9: Polar coordinates, Graphing in polar coordinates. [1] Chapter 10 (Section 10.2).

Week 10: Vector-valued functions: Limit, continuity, Derivatives, Integrals, Arc length, Unit tangent vector, Curvature, Unit normal vector. [1] Chapter 12 (Sections 12.1 to 12.5).

Weeks 11 and 12: Functions of several variables: Graphs, Level curves, Limits and continuity, Partial derivatives and differentiability. [1] Chapter 13 (Section 13.1 to 13.4).

Week 13: Functions of several variables: The chain rule, Directional derivatives and gradient vectors. [1] Chapter 13 (Sections 13.5, and 13.6).

Week 14: Functions of several variables: Tangent plane and normal line, Extreme values and saddle points. [1] Chapter 13 (Sections 13.7, and 13.8).

GE-1: Analytic Geometry and Theory of Equations

Total Marks: 100 (Theory: 75, Internal Assessment: 25)

Workload: 5 Lectures, 1 Tutorial (per week) **Credits:** 6 (5+1)

Duration: 14 Weeks (70 Hrs.) **Examination:** 3 Hrs.

Course Objectives: The goal of this paper is to acquaint students with certain ideas about conic sections, vectors in coordinate system and general properties of roots of polynomial equations with some applications.

Course Learning Outcomes: After completion of this paper, the students will be able to:

- i) Classify and sketch conics four different types of conic sections—the circle, the ellipse, the hyperbola and the parabola—in Cartesian and polar coordinates.
- ii) Visualize and understand the properties of three dimensional objects— spheres and cylinders— using vectors.
- iii) Understand the properties of roots of polynomial equations.

Unit 1: Conic Sections, Parametrized Curves, and Polar Coordinates

(Lectures: 25)

Conic sections and quadratic equations: Circle, Parabola, Ellipse, and Hyperbola; Techniques for sketching: Parabola, Ellipse, and Hyperbola; Reflection properties of Parabola, Ellipse, and Hyperbola, Classifying conic sections by eccentricity, Classification of quadratic equations representing Lines, Parabola, Ellipse, and Hyperbola; Parameterization of plane curves, Conic sections in polar coordinates and their sketching.

1-2	Computer Fundamentals and Problem Solving: Basic Computer Organization: CPU, memory, I/O Units, Problem solving using computer, notion of an algorithm
3	Python interpreter/shell, indentation; identifiers and keywords; Creating Python Programs: Input and output statements, defining functions, literals, numbers, and strings;
4	Operators: arithmetic operators, relational operators, boolean operators, assignment operators, ternary operator and bitwise operator and expressions
5	Control statements (conditional statements, loop control statements,
6	Break, continue and pass, exit function, default arguments
7	Errors and exceptions
8	Strings and Lists: String class, built-in functions for string, string traversal, string operators and operations;
9	Lists creation, traversal, slicing and splitting operations, passing list to a function
10	Object Oriented Programming: Introduction to Classes, Objects and Methods,
11	Standard Libraries, File handling through libraries
12-13	Built-in data structures: Tuples, sets, dictionary, stacks, and queues
14-15	searching and sorting

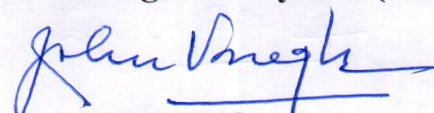
Assessment Methods

Written tests, assignments, quizzes, presentations as announced by the instructor in the class.

Keywords

Computer Hardware Organization, Problem solving for computer programming, Object oriented programming, Python

Database Management System (CSGE201) Generic Elective - (GE)


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Credit: 06

Course Objectives

The course introduces the concepts of database management systems to students, focusing on basics such as the importance and significance of a database, data model, schema creation and normalization.

Course Learning Outcomes

On successful completion of the course, students will be able to:

1. Describe the features of database management systems.
2. Differentiate between database systems and file systems.
3. Model an application's data requirements using conceptual modelling tools like ER diagrams and design database schemas based on the conceptual model.
4. Write queries in relational algebra / SQL.
5. Normalize a given database schema.

Detailed Syllabus

Unit 1

Introduction: Introduction to database, relational data model, DBMS architecture, data independence and data abstraction, DBA, database users, end users, front end tools

Unit 2

Data Modelling: Entity types, entity set, attribute and key, relationships, relation types, ER diagrams, database design using ER diagrams

Unit 3

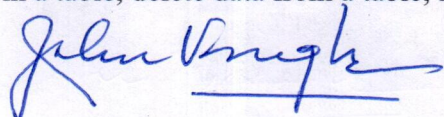
Relational Data Model: Relational model concepts, relational constraints, primary and foreign key, candidate key, alternate, composite, super-key.

Unit 4

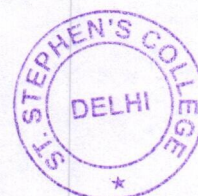
Data redundancy, Normalization: 1NF, 2NF, 3NF.

Unit 5

Structured Query Language: Introduction to SQL, concepts of Data Definition Language (DDL) and Data Manipulation Language (DML), DDL queries like create a data base, drop a database, create table, drop table, alter table, DML queries like inserting data in a table, update in a table, delete data from a table, filter data.



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Unit 6

Structured Query Language (continued..): Create relationships between database tables, auto increment, check, Null values, aggregate functions - min, max, count, average, sum, nested sub-queries, group by, having, exists, case, order by. Join operations - inner, left join, right join, natural join and Cartesian product. Overview of forms and reports.

Practicals:

1. Create a database having two tables with the specified fields, to computerize a library system of a Delhi University College.

LibraryBooks (Accession number, Title, Author, Department, PurchaseDate, Price)
IssuedBooks (Accession number, Borrower)

- Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
- Delete the record of book titled "Database System Concepts".
- Change the Department of the book titled "Discrete Maths" to "CS".
- List all books that belong to "CS" department.
- List all books that belong to "CS" department and are written by author "Navathe".
- List all computer (Department = "CS") that have been issued.
- List all books which have a price less than 500 or purchased between "01/01/1999" and "01/01/2004".

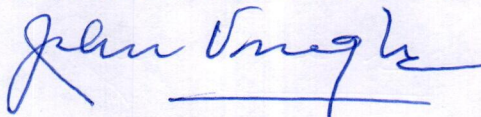
2. Create a database having three tables to store the details of students of Computer Department in your college, as per the given schema.

Personal information about Student (College roll number, Name of student, Date of birth, Address, Marks(rounded off to whole number) in percentage at 10 + 2, Phone number)
Paper Details (Paper code, Name of the Paper)
Student's Academic and Attendance details (College roll number, Paper code, Attendance, Marks in home examination).

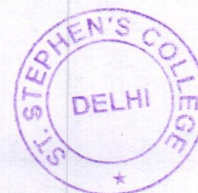
- Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
- Design a query that will return the records (from the second table) along with the name of student from the first table, related to students who have more than 75% attendance and more than 60% marks in paper 2.
- List all students who live in "Delhi" and have marks greater than 60 in paper 1.
- Find the total attendance and total marks obtained by each student.
- List the name of student who has got the highest marks in paper 2.

3. Create the following tables and answer the queries given below:

Customer (CustID, email, Name, Phone, ReferrerID)
Bicycle (BicycleID, DatePurchased, Color, CustID, ModelNo)
BicycleModel (ModelNo, Manufacturer, Style)
Service (StartDate, BicycleID, EndDate)



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- a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
- b) List all the customers who have the bicycles manufactured by manufacturer "Honda".
- c) List the bicycles purchased by the customers who have been referred by customer "C1".
- d) List the manufacturer of red colored bicycles.
- e) List the models of the bicycles given for service.

4. Create the following tables, enter at least 5 records in each table and answer the queries given below.

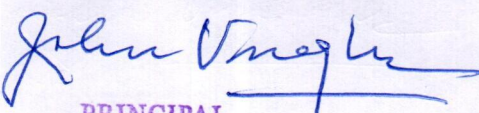
EMPLOYEE (Person_Name, Street, City)
 WORKS (Person_Name, Company_Name, Salary)
 COMPANY (Company_Name, City)
 MANAGES (Person_Name, Manager_Name)

- a) Identify primary and foreign keys.
- b) Alter table employee, add a column "email" of type varchar(20).
- c) Find the name of all managers who work for both Samba Bank and NCB Bank.
- d) Find the names, street address and cities of residence and salary of all employees who work for "Samba Bank" and earn more than \$10,000.
- e) Find the names of all employees who live in the same city as the company for which they work.
- f) Find the highest salary, lowest salary and average salary paid by each company.
- g) Find the sum of salary and number of employees in each company.
- h) Find the name of the company that pays highest salary.

5. Create the following tables, enter at least 5 records in each table and answer the queries given below.

Suppliers (SNo, Sname, Status, SCity)
 Parts (PNo, Pname, Colour, Weight, City)
 Project (JNo, Jname, Jcity)
 Shipment (Sno, Pno, Jno, Qunatity)

- a) Identify primary and foreign keys.
- b) Get supplier numbers for suppliers in Paris with status>20.
- c) Get suppliers details for suppliers who supply part P2. Display the supplier list in increasing order of supplier numbers.
- d) Get suppliers names for suppliers who do not supply part P2.
- e) For each shipment get full shipment details, including total shipment weights.
- f) Get all the shipments where the quantity is in the range 300 to 750 inclusive.
- g) Get part nos. for parts that either weigh more than 16 pounds or are supplied by suppliers S2, or both.
- h) Get the names of cities that store more than five red parts.
- i) Get full details of parts supplied by a supplier in London.
- j) Get part numbers for part supplied by a supplier in London to a project in London.
- k) Get the total number of project supplied by a supplier (say, S1).
- l) Get the total quantity of a part (say, P1) supplied by a supplier (say, S1).


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References

1. Bayross, I. (2010) *SQL, PL/SQL the Programming Language of Oracle*. 4th edition. BPB Publications.
2. Elmasri, R., & Navathe, S. (2017). *Fundamentals of Database Systems*. 7th edition. Pearson Education.
3. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2011), *Database System Concepts*. 6th edition. Tata McGraw-Hill Education.

Additional Resources

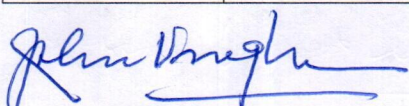
1. Date, C.J., Kanman, A. & Swamynathan, S. (2006). *An Introduction to Database Systems*. 8th edition. Pearson Education.
2. Ramakrishnan, R. Gehrke, J. (2014), *Database Management Systems*. 3rd edition. Tata McGraw Hill Education.
3. MWidenius, M., Axmark, D., Cole, J., Lentz, A., & Dubois, P. (2002). *MySQL Reference Manual*. O'Reilly Community Press.

Course Teaching Learning Process

- Use of ICT tools in conjunction with traditional class- room teaching methods
- Interactive sessions
- Class discussions

Tentative weekly teaching plan is as follows:

Week	Topics
1	Introduction: Introduction to database, relational data model,
2-3	DBMS architecture, data independence and data abstraction, DBA, database users, end users, front end tools
4-5	Data Modeling: Entity types, entity set, attribute and key, relationships, relation types, E-R diagrams, database design using ER diagrams
6-7	Relational Data Model: Relational model concepts, relational constraints, Primary and foreign key, candidate key, alternate, composite, superkey
8	Data redundancy, Normalization: 1NF, 2NF, 3NF.


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9	Introduction to SQL, concepts of Data Definition Language (DDL) and Data Manipulation Language (DML),
10	DDL commands to create a data base, drop a database, create table, drop table, alter table
11	DML commands to inserting data in a table, update in a table, delete data from a table,
12	Create relationships between database tables, auto increment, check, Null values,
13	SQL queries to filter data, Group by, having, exists, case, order by
14	SQL queries for aggregate functions - min, max, count, average, sum, nested sub-queries, Join operations - inner, left join, right join, natural join, Cartesian product.
15	Overview of Forms and Reports.

Assessment Methods

Written tests, assignments, quizzes, presentations as announced by the instructor in the class.

Keywords

Databases, E-R diagrams, normalization, structured query language

Computer Networks (CSGE301) Generic Elective - (GE)

Credit: 06

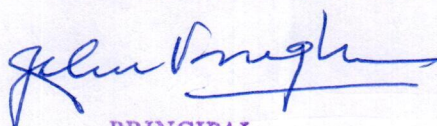
Course Objective

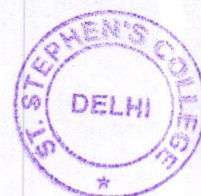
This course covers the fundamental concepts of computer networks, standard models of computer networks having layered architecture, data communication, network topologies, web technologies and internet applications.

Course Learning Outcomes

On successful completion of this course, a student will be able to:

1. State the use of computer networks and different network topologies.


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12	Hyperlinks, tables, web forms
13	Inserting images, Frames, hosting options and domain name registration
14	Customized Features: Cascading style sheet (css) for text formatting and other manipulations.
15	Cascading style sheet (css) and other manipulations

Assessment Methods

Written tests, assignments, quizzes, presentations as announced by the instructor in the class.

Keywords

network topologies, data communication, OSI model, TCP/IP model, HTML, web design.

Information Security and Cyber Laws (CSGE401) Generic Elective - (GE)

Credit: 06

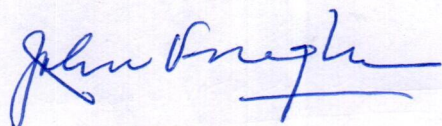
Course Objectives

This course introduces the students to the concepts of information security and different type of attacks in the cyber space. The course also introduces countermeasures to mitigate attacks and different existing cyber laws.

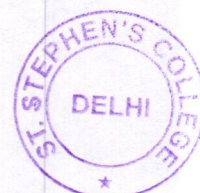
Course Learning Outcomes

On successful completion of the course, students will be able to:

1. Learn, structure, mechanics and evolution of various crime threats
2. Learn to protect information systems from external attacks by developing skills in enterprise security, wireless security and computer forensics.
3. Analyse the risks involved while sharing their information in cyber space and numerous related solutions like sending protected and digitally signed documents
4. Insights of ethical hacking and usage of password cracking tools
5. Get an overview of different ciphers used for encryption and decryption.



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Detailed Syllabus

Unit 1

Definitions :Protection, Security, risk, threat, vulnerability, exploit, attack, confidentiality, integrity, availability, non-repudiation, authentication , authorization, codes, plain text, encryption, decryption, cipher text, key, ciphers, Symmetric and asymmetric cryptography, Public key , private key ,Crypt analysis,, Cyber forensics. Substitution cipher (Caesar), Transposition cipher (Rail-Fence),

Unit 2

Risk analysis, process, key principles of conventional computer security, security policies, data protection, access control, internal vs external threat, security assurance, passwords, access control, computer forensics and incident response.

Unit 3

CYBER ATTACKS (definitions and examples): Denial-of-service attacks, Man-in-the-middle attack, Phishing, spoofing and spam attacks, Drive-by attack, Password attack, SQL injection attack, Cross-site scripting attack, Eavesdropping attack, Birthday attack, Malware attacks, Social Engineering attacks

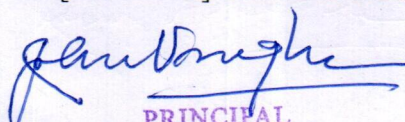
Unit 4

Brief Introduction of handling the attacks described in UNIT 3. Firewalls, logging and intrusion detection systems, e-mail security, security issues in operating systems, ethics of hacking and cracking.

Unit 5

Definitions: Digital Signature and Electronic Signature, Digital Certificate

- i.[Section 43] Penalty and compensation for damage to computer etc.
- ii.[Section 65] Tampering with computer source documents
- iii.[Section 66A] Punishment for sending offensive messages through communication service etc.
- iv.[Section 66B] Punishment for dishonestly receiving stolen computer resource or communication device
- v.[Section 66C] Punishment for identity theft
- vi.[Section 66D] Punishment for cheating by impersonation by using computer resource
- vii.[Section 66E] Punishment for violation of privacy
- viii.[Section 66F] Punishment for cyber terrorism
- ix.[Section 67] Punishment for publishing or transmitting obscene material in electronic form
- x.[Section 67A] Punishment for publishing or transmitting of material containing sexually explicit act, etc. in electronic form
- xi.[Section 67B] Punishment for publishing or transmitting of material depicting children in sexually explicit act, etc. in electronic form
- xii.[Section 72] Breach of confidentiality and privacy


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Unit 6

Brief introduction of IT infrastructure in India, National agencies handling IT.

Practical

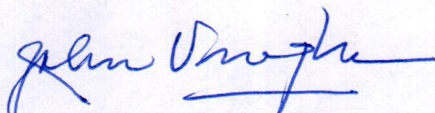
1. Demonstrate the use of Network tools: ping, ipconfig, ifconfig, tracert, arp, netstat, whois
2. Use of Password cracking tools : John the Ripper, Ophcrack. Verify the strength of passwords using these tools.
3. Perform encryption and decryption of Caesar cipher. Write a script for performing these operations.
4. Perform encryption and decryption of a Rail fence cipher. Write a script for performing these operations.
5. Use nmap/zenmap to analyse a remote machine.
6. Use Burp proxy to capture and modify the message.
7. Demonstrate sending of a protected word document.
8. Demonstrate sending of a digitally signed document.
9. Demonstrate sending of a protected worksheet.
10. Demonstrate use of steganography tools.
11. Demonstrate use of gpg utility for signing and encrypting purposes.

References

1. Merkow, M., & Breithaupt, J.(2005) *Information Security Principles and Practices*. 5th edition. Prentice Hall.
2. Snyder, G.F. (2010). *Network Security*, Cengage Learning.
3. Whitman, M. E. & Mattord, H. J. (2017) *Principles of Information Security*. 6th edition. Cengage Learning.

Additional Resources:

1. Basta, A., & Halton, W., (2010) *Computer Security: Concepts, Issues and Implementation*, Cengage Learning India.


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2. Anderson, R. (2008) *Security engineering: A guide to building dependable Distributed Systems*. 2nd edition. John Wiley & Sons.

Web Resources:

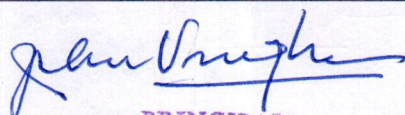
1. <https://blog.netwrix.com/2018/05/15/top-10-most-common-types-of-cyber-attacks/>
2. <https://www.ibef.org/industry/infrastructure-sector-india.aspx>

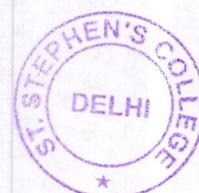
Course Teaching Learning Process

- Use of ICT tools in conjunction with traditional class room teaching methods
- Interactive sessions
- Class discussions

Tentative weekly teaching plan is as follows:

Week	Topics
1-2	Definitions : Protection , Security, risk, threat, vulnerability, exploit, attack, confidentiality, integrity, availability, non-repudiation, authentication, authorization, codes, plain text, encryption, decryption, cipher text, key, ciphers, Symmetric and asymmetric cryptography
3	Public key, private key, Crypt analysis, Cyber forensics. Substitution cipher (Caesar), Transposition cipher (Rail-Fence)
4	Risk analysis, process, key principles of conventional computer security, security policies
5-6	Data protection, access control, internal vs external threat, security assurance, Passwords, access control, computer forensics and incident response
7-8	Cyber attacks, types and examples)
9	Brief Introduction of handling the attacks described in UNIT 3.
10	Firewalls, logging and intrusion detection systems, e-mail security
11	Security issues in operating systems, ethics of hacking and cracking.
12-14	Digital Signature and Electronic Signature, Digital Certificate, Penalty and compensation, Punishment for various attacks
15	Brief introduction of IT security infrastructure in India. National


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	agencies handling IT security.
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Assessment Methods

Written tests, assignments, quizzes, presentations as announced by the instructor in the class.

Keywords

Information security, cyber laws, risk analysis, attacks.

5. Generic Elective Courses: Computer Applications for Non Hons Courses

IT Fundamentals (CSGE501) Generic Elective - (GE)

Credit: 06

Course Objectives

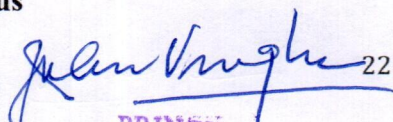
This course introduces the students to the basic concepts of computers. The aim is to bridge the fundamental concepts of computers with the present level of knowledge of the students. The course also aims to skill the students so that they can make use of information technology effectively in all walks of life.

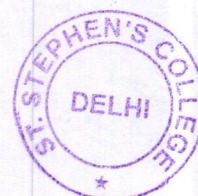
Course Learning Outcomes

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

1. develop a vocabulary of key terms related to the computer and to software program menus, identify the components of a personal computer system and use the interface deftly.
2. organize files and documents on storage devices.
3. compose, format and edit a word document.
4. use spreadsheet for storing data and performing preliminary analysis.
5. acquire fundamental knowledge of networking and distinguish between different types of networks.
6. acquire knowledge of internet applications and use them.

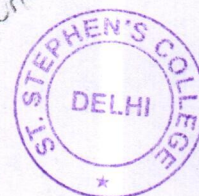
Detailed Syllabus


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Standing Committee on Academic Matters dated 17.08.2018
Annexure No.-33

DESCRIPTION	EXISTING COURSE CONTENTS	PROPOSED COURSE CONTENTS	CHANGE/ RATIONAL
		Physiology	
PART-A THEORY	Unit-I: Health Education 1.1 <i>Health Education: Meaning, Concept and Principles</i> 1.2 <i>Health – Importance, Components, Health Promoting Behaviours</i> 1.3 Role of Personal Hygiene, Mental Hygiene, Sleep Hygiene, Occupational Hygiene in <i>physical education and sports</i> 1.4 Role of Different Agencies in Promoting Health (WHO, UNICEF, Local Bodies) Unit II: Anatomy and Physiology 2.1 <i>Basic Concept, Need and Importance of Anatomy and Physiology in Physical Education</i> 2.2 Definition and Description of Cell, Tissue, Organ and System 2.3 <i>Brief</i> introduction to Skeletal System, Muscular System, Circulatory System, Respiratory System, Digestive System, Excretory System, Nervous System and Endocrine System 2.4 Physiological Factors Affecting Development of Physical Fitness Components Unit-III: Training Effects on Anatomical and Physiological Systems 3.1 Effects of Exercise on Skeletal System, Muscular System, Circulatory System, Respiratory System, Digestive System, Excretory System, Nervous System and Endocrine System 3.2 Concepts of Warming-up, Conditioning, Cooling-down 3.3 Concepts of Fatigue, Stitch, Cramp, Oxygen Debt, Second Wind 3.4 Markers for Training Effects - Maximum Heart Rate, Vital Capacity, Stroke Volume, Temperature Regulation, Lactate Threshold and VO ₂ max.	Unit-I: Health Education 1.1. Concept and Dimensions of Health 1.2. Meaning and Importance of Health Education and Healthful Living 1.3. Role of Personal Hygiene, Mental Hygiene, Sleep Hygiene, Occupational Hygiene in life 1.4. Role of Different Agencies in Promoting Health (WHO, UNICEF, Local Bodies) Unit II: Anatomy and Physiology 2.1. Definition of Anatomy and Physiology, Importance of Anatomy and Physiology in Physical Education 2.2. Definition and Description of Cell, Tissue, Organ and System 2.3. Introduction to Skeletal System, Muscular System, Circulatory System, Respiratory System, Digestive System, Excretory System, Nervous System and Endocrine System Unit-III: Training Effects on Anatomical and Physiological Systems 3.1. Effects of Exercise on Skeletal System, Muscular System, Circulatory System, Respiratory System, Digestive System, Excretory System, Nervous System and Endocrine System 3.2. Concept of Warming-up, Conditioning, Cooling-down, Fatigue, Stitch, Cramp, Oxygen Debt, Second Wind 3.3. Markers for Training Effects - Maximum Heart Rate, Vital Capacity, Stroke Volume, Temperature Regulation, Lactate Threshold and VO ₂ max.	Unit-I 1.1 & 1.2 Logical rearrangement of contents Unit-II 2.1 Redefined 2.3 Brief deleted 2.4 Deleted Unit-III 3.2 and 3.3 merged
PART-B PRACTICAL	1. <i>Asanas with Therapeutic Value (Any five asanas): Karnapeedasana, Padmasana, Dhanurasana, Sarvangasana, Paschimottanasana, Chakrasana, Halasana, Matsyasana, Ardhamatsyendrasana, Usthrasana, Mayurasana, Shirshasana, Vajrasana</i> 2. Draw and label any five anatomical and physiological systems. 3. Demonstrate Warming-up/ Conditioning/ Cooling-down exercises.	1. Draw and label any five anatomical and physiological systems. 2. Demonstrate Warming-up / Conditioning / Cooling-down exercises. 3. Measurement of Heart Rate, Vital Capacity and Oxygen Debt	1. Deleted, not relevant to theory (Replaced with Measurement of Heart Rate, Vital Capacity and Oxygen Debt)
	SEMESTER-4 : DSC-IV Posture, Athletic Care and First Aid	SEMESTER-4 : DSC-I (D) Posture and Athletic Care	
PART-A	Unit-I: Posture	Unit-I: Posture	Unit-I



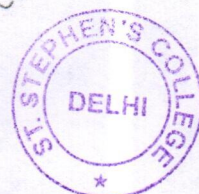
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DESCRIPTION	EXISTING COURSE CONTENTS	PROPOSED COURSE CONTENTS	CHANGE/ RATIONAL
THEORY	1.1 Posture – Concept, Significance, Benefits 1.2 Bad Posture (Sitting, Standing, Walking, Lying down); Effects of Bad Posture on Our Body 1.3 Postural Deformities – Types and Causes (Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot), Corrective Exercises 1.4 Illnesses due to Improper Posture (Back Pain, Neck Pain), Corrective Exercises Unit-II: Athletic Care 2.1 Sports Medicine and Athletic Care - Concept and Significance, Factors causing Injuries 2.2 General Principles of Prevention of Injuries 2.3 Common Sports Injuries (Strain and Muscle and Ligament Sprain, Frozen Shoulder, Lower Back Strain, Tennis and Golfer's Elbow, Runner's Knee, Shin Pain, Blister, Concussion, Abrasion, Laceration, Haematoma, Fracture, Dislocation) 2.4 Management of Injuries (Strain and Muscle and Ligament Sprain, Frozen Shoulder, Lower Back Strain, Tennis and Golfer's Elbow, Runner's Knee, Shin Pain, Blister, Concussion, Abrasion, Laceration, Haematoma, Fracture, Dislocation) Unit-III: First Aid, Ergogenic Aids and Rehabilitation 3.1 Sports Injuries and First Aid (P.R.I.C.E.) 3.2 Rehabilitation - Aim and Objective, Recovery (Ice bath, Contrast Bath, Hot Fomentation) 3.3 Therapeutic Modalities (Therapeutic Ultrasound, Interferential Therapy Unit, T.E.N.S., Infrared Lamp, Wax Bath, Short Wave Diathermy) 3.4 Muscle Strengthening through Active and Passive Exercise	1.1. Meaning of Posture, Significance of Good Posture 1.2. Correct Posture of Sitting, Standing, Walking and Lying down 1.3. Causes and Types of Postural Deformities (Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot) 1.4. Corrective Exercises for Postural Deformities, Back Pain and Neck Pain Unit-II: Athletic Care 2.1. Concept and Significance of Athletic Care and Sports Medicine 2.2. Safety Measures and Prevention of Injuries 2.3. Common Sports Injuries (Strain, Sprain, Frozen Shoulder, Tennis Elbow, Golfer's Elbow, Shin Pain, Blister, Concussion, Abrasion, Laceration, Haematoma, Fracture, Dislocation) 2.4. First Aid and Management of Injuries (Strain, Sprain, Frozen Shoulder, Tennis Elbow, Golfer's Elbow, Shin Pain, Blister, Concussion, Abrasion, Laceration, Haematoma, Fracture, Dislocation) Unit-III: Ergogenic Aids and Rehabilitation 3.1. Concept and Types of Ergogenic Aids 3.2. Role of Ergogenic Aids in different Sports 3.3. Concept and Significance of Rehabilitation 3.4. Therapeutic Modalities (Ice bath, Contrast Bath, Hot Fomentation, Therapeutic Ultrasound, Interferential Therapy Unit, T.E.N.S., Infrared Lamp, Wax Bath, Short Wave Diathermy), and Muscle Strengthening through Active and Passive Exercises	Contents not changed but reframed Topic 1.4 deleted Unit-II 2.1 Reframed 2.2 Replaced 2.3 Muscle and Ligament & Lower back strain deleted 2.4 First-Aid added Unit-III First-Aid deleted from the unit title since it is a part of management of injury Ergogenic Aids : Contents Added since only title existed earlier 3.1 Shifted to practical 3.3 Covered under 3.4
PART-B PRACTICAL	1. Demonstrate Stretching and Strengthening Exercises for Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot, Back Pain and Neck Pain 2. Illustration and Demonstration of Active and Passive Exercises 3. Asanas with Therapeutic Value (Any five asanas): Karnapeedasana, Padmasana, Dhanurasana, Sarvangasana, Paschimottanasana, Chakrasana, Halasana, Matsyasana, Ardhamatsyendrasana, Ushtrasana, Mayurasana, Shirshasana, Vajrasana 4. Practice P.R.I.C.E. in First Aid.	1. Demonstrate Corrective Exercises for Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot, Back Pain, Neck Pain 2. Practice P.R.I.C.E. and First Aid 3. Demonstrate any two Physiotherapy modalities/ Muscle Strengthening Exercises	- Point no. 1 & 2 merged - Point no. 3 deleted (Not relevant to theory) - Added physiotherapy modalities

UGC enlists 4 SEC papers (Semesters-3, 4, 5, 6); however, in the current syllabus, SEC is offered only in Semester 5 & 6. No papers are available to teach in 3rd and 4th semester; while there are 3 options to choose one each in 5th & 6th semester. Course Contents are required to be revised to make them more

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13

B.A. PROGRAMME WITH PHYSICAL EDUCATION
Discipline Specific Core Courses (Semester-4)

DSC-I(D) : POSTURE AND ATHLETIC CARE

PART A: THEORY

Duration: 3Hrs

Maximum Marks : 50

Unit-I: Posture

- 1.1. Meaning of Posture, Significance of Good Posture
- 1.2. Correct Posture of Sitting, Standing, Walking and Lying down
- 1.3. Causes and Types of Postural Deformities (Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot)
- 1.4. Corrective Exercises for Postural Deformities, Back Pain and Neck Pain

Unit-II: Athletic Care

- 2.1. Concept and Significance of Athletic Care and Sports Medicine
- 2.2. Safety Measures and Prevention of Injuries
- 2.3. Common Sports Injuries (Strain, Sprain, Frozen Shoulder, Tennis Elbow, Golfer's Elbow, Shin Pain, Blister, Concussion, Abrasion, Laceration, Haematoma, Fracture, Dislocation)
- 2.4. First Aid and Management of Injuries (Strain, Sprain, Frozen Shoulder, Tennis Elbow, Golfer's Elbow, Shin Pain, Blister, Concussion, Abrasion, Laceration, Haematoma, Fracture, Dislocation)

Unit-III: Ergogenic Aids and Rehabilitation

- 3.1. Concept and Types of Ergogenic Aids
- 3.2. Role of Ergogenic Aids in different Sports
- 3.3. Concept and Significance of Rehabilitation
- 3.4. Therapeutic Modalities (Ice bath, Contrast Bath, Hot Fomentation, Therapeutic Ultrasound, Interferential Therapy Unit, T.E.N.S., Infrared Lamp, Wax Bath, Short Wave Diathermy), and Muscle Strengthening through Active and Passive Exercises

PART B : PRACTICAL

Maximum Marks : 25

1. Demonstrate Corrective Exercises for Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot, Back Pain, Neck Pain
2. Practice P.R.I.C.E. and First Aid
3. Demonstrate any two Physiotherapy modalities/ Muscle Strengthening Exercises

Assessment of Practical

Practical (Demonstration/ Performance) :	10 Marks
Viva :	10 Marks
Record Book on all topics of Practical :	05 Marks

PART C : INTERNAL ASSESSMENT

Maximum Marks : 25

1. Presentation/ Written Test : 10 Marks
2. Project / Assignment : 10 Marks
3. Attendance : 05 Marks

MARKING SCHEME : Theory = 50 Marks, Practical = 25 Marks, Internal Assessment = 25 Marks

SEMESTER CREDITS FOR THE PAPER = 6 CREDITS

- Each period will be of one hour.
- 4 theory periods per week per semester = 4 credits
- 4 Practical periods per week per semester = 2 credits

INSTRUCTIONS TO THE EXAMINERS

- The examiners will set nine questions (eight descriptive and one question on short notes containing three options, whereby, a student has to attempt any two) equally distributed throughout the entire syllabus.
- The students will be required to attempt any five questions.
- Each question will carry ten marks.

SUGGESTED READINGS

1. Beotra, Alka (2001-02) Drug Education Handbook on Drug Abuse in Sports, Applied Nutrition Sciences, Mumbai.
2. Jain, J. (2004) KhelDawaonKa (New Delhi : Delhi University Press).
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4. Pande, P. K. (1987) Outline of Sports Medicine (New Delhi :Jaypee Brothers).
5. Roy, Steven and Richard, Irvin (1983) Sports Medicine, Benjamin Cummings, Boston, USA.
6. Sharma K. et.al. (2014), Fitness Aerobics & Gym Operations, Jyoti Enterprises, Delhi.
7. Singh, Ajmer et. al. (2000), Modern Text Book of Physical Education, Health & Sports, Kalyani Publishers.
8. Singh, Ajmer et.al. (2006), Essentials of Physical Education, Kalyani Publishers.

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