## XXVII. SYLLABUS FOR JNU ENTRANCE EXAMINATION 2020-21

### 1. SCHOOL OF INTERNATIONAL STUDIES

The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

#### Master of Arts

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<tbody>
<tr>
<td>1</td>
<td>School of International Studies</td>
<td>Politics (with specialization in International Studies) – PISM (201)</td>
<td>Five disciplines are covered in the test – Sociology, Political Science, International Relations, History and Economics. There is sufficient choice in questions for applicants from each discipline to be able to attempt the required number of questions. The BA syllabi of these disciplines generally found in most Indian universities are kept in mind while setting questions.</td>
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<tr>
<td>2</td>
<td>International Relations and Area Studies – IRAM (234)</td>
<td></td>
<td>Five disciplines are covered in the test – Sociology, Political Science, International Relations, History and Economics. There is sufficient choice in questions for applicants from each discipline to be able to attempt the required number of questions. The BA syllabi of these disciplines generally found in most Indian universities are kept in mind while setting questions. The emphasis will be on Area Studies in International Relations,</td>
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<td>3</td>
<td>Economics (with specialization in World Economy) – EILM (202)</td>
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<td>The entrance examination will contain multiple choice questions and the syllabus will include Microeconomics, Macroeconomics, Mathematics, Statistics, International Trade and Development Economics taught at the Bachelor’s level.</td>
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#### Ph.D.

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<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
</tr>
</thead>
</table>
| 1      | Centre for Canadian, US and Latin American Studies (CCUS&LAS) | Canadian Studies – CANH (826) | **Canadian Studies**  
  1. Multiculturalism and Ethnicity in Canada  
  2. Immigration policies and Integration  
  3. Environmental issues  
  4. Contemporary political, social and economic issues in Canada  
  5. Party System and Electoral Politics  
  6. Political Culture  
  7. Federalism and Provincial Government  
  8. Quebec and issues of Regionalism  
  9. Foreign Policy approaches and trends  
  10. Canada and India relations  
  11. Regional Economic Integration  
  12. Inter-American relations  
  13. Canada and United Nations; Peace-keeping, peace-building and peace-enforcement  
  14. Canada and the Global Security: Arms Control and Disarmament  
  15. Nuclear Non-proliferation, Missile Control Regime |
| 2      | Latin American Studies – LAMH (828) | **Latin American Studies**  
  1. Government and politics in Latin America: executive, legislature, judiciary  
  2. Political Culture, Parties and movements  
  3. Role of Labour, peasantry and middle class |
<table>
<thead>
<tr>
<th>United States Studies – USSSH (827)</th>
<th>US Studies</th>
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</thead>
<tbody>
<tr>
<td>4. Theories of development</td>
<td>1. Bill of Rights – American Constitution</td>
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<tr>
<td>5. Church</td>
<td>2. Federalism</td>
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<tr>
<td>6. Military</td>
<td>3. Media, political parties and elections</td>
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<tr>
<td>7. Environmental issues</td>
<td>4. Congress, judiciary and judicial review</td>
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<tr>
<td>8. Indigenous communities</td>
<td>5. Power and role of the US President and domestic factors in Foreign Policy.</td>
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<tr>
<td>9. Independence movements and ideas</td>
<td>6. US Policy towards South Asian Countries</td>
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<tr>
<td>10. Social movements</td>
<td>7. US Foreign policy during Cold War (Containment Policy, Marshall Plan, Alliance Building, Truman Doctrine)</td>
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<tr>
<td>11. Latin America in world affairs</td>
<td>8. Foreign Policy trends and patterns in Post-Cold War America (UN, West Asia, Europe, Asia, international institutions).</td>
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<tr>
<td>13. India and Latin America</td>
<td>10. Waves of immigration to America: old, new and newest</td>
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<tr>
<td>15. Contemporary political, social and economic issues in major Latin American and Caribbean countries</td>
<td>12. Social problems: Gun violence, racism, abortion, teenage pregnancy, homelessness, drugs and alcoholism</td>
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<td>13. Terrorism and counter terrorism strategy</td>
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<td>14. US in the Post Pandemic Era</td>
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<tr>
<th>Centre for European Studies (CES)</th>
<th>European Studies – EUPH (829)</th>
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<tr>
<td>4. The test is divided into two sections, research methodology and area studies.</td>
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<tr>
<td>Section I - Meaning and importance of Research – Types of Research Concepts in Social Research: Data, Research Methods, Techniques, Concepts and Indicators, Variables, Sample, Research Designs, Selection and formulation of Research Problem, Hypothesis, Research Questions, Issues in social research: Subjectivity and Objectivity, Reliability and Validity,</td>
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<tr>
<td>Section II - The syllabus will be on contemporary issues, discourses, debates and developments in politics, society, foreign policy, security and economy of European states/ European Union.</td>
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<tr>
<th>Centre for International Legal Studies (CILS)</th>
<th>Int. Legal Studies – ILGH (830)</th>
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<tr>
<td>5. The syllabus for the entrance examination will contain multiple choice questions covering two sections (50% each).</td>
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<tr>
<td>Section A (Subject-specific knowledge):</td>
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<tr>
<td>1) General Principles relating to International Law; history nature and subjects of international law; statehood and international legal personality; sources of international law; relationship between international law and municipal law; jurisdiction and state immunity; recognition of states; Diplomatic and Consular Immunities;</td>
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<tr>
<td>2) Functions and processes of International Law; public order, global justice; human rights; trade and sustainable development; global public goods and common heritage of mankind; Antarctica, Outer Space; Atmosphere and areas beyond national jurisdiction;</td>
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<tr>
<td>3) Law of International Organisations; United Nations, World Trade Organisation, UN Specialized Agencies;</td>
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<td>4) Responsibility and Enforcement in International Law; peaceful settlement of disputes; world court and other international tribunals;</td>
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<td>5) Law of the Sea; International Environmental Law; International Humanitarian</td>
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<td>6</td>
<td>Centre for International Trade &amp; Development (CITD)</td>
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<td>Centre for East Asian Studies (CEAS)</td>
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</table>
10. Contemporary issues and concerns in Political Geography and Geopolitics
11. Research Methodology: GIS and its Applications
12. Qualitative and Quantitative Methods in International Relations
13. Research Design

(C) International Organization (ORG)

1. Concept, definition and classification of international organization(s)
2. Roles, functions and powers of international organizations
3. Theoretical approaches to international organization
4. International organizations in world politics
5. Historical development of international organization during 19th and early 20th centuries
6. League of Nations
7. The second generation international organizations: The United Nations and its system - establishment, activities, problems
8. Global problems (like war and peace, development, human rights, environment) with reference to the role of the United Nations
9. Reform and restructuring of the United Nations including the Security Council
10. Economic and financial organizations - the IMF, the IBRD and the WTO
11. Regional organizations of Europe, Africa, Asia, Americas
12. India's role in various international organizations
13. Globalization, global governance and international organizations

(D) Diplomacy and Disarmament (DAD)

1. Diplomacy: history, theory and practice
2. Diplomacy: bilateral, multilateral, regional and global
3. Economic and trade diplomacy
4. Paradiplomacy or constituent diplomacy
5. Negotiations: theory and practice
6. Climate change and environmental negotiations
7. Nuclear politics including arms control, non-proliferation and disarmament
8. Theories of deterrence
9. Chemical and biological weapons
10. War: concept, theory and evolution
11. Peace: concept and theory in mainstream and critical-theoretical perspectives
12. Revolution in military affairs
13. Conflict management and resolution
15. National security
16. Terrorism including nuclear terrorism and counter-terrorism
17. Non-traditional security including human security
18. Environmental security
19. Technology and global politics
20. Critical theory and Critical Security Studies including the Copenhagen, Paris and Aberystwyth schools of thought
21. Critical Terrorism Studies
22. Critical Military Studies

(E) Research Methodology (Common)

1. Inductive and deductive reasoning
2. Ontology and epistemology
3. Philosophy of science especially the contribution of Bertrand Russell, Karl Popper, Thomas Kuhn, Imre Lakatos and Paul Feyerabend
| 4. | Positivism, Interpretivism and Critical Social Science |
| 5. | Qualitative method: rationale, characteristics and applications |
| 6. | Case study research: single case study and multiple case studies |
| 7. | Comparative study |
| 8. | Content analysis |
| 9. | Sources in research: primary and secondary |
| 10. | Archival research: major archives for international research in India |
| 11. | Quantitative method: rationale, characteristics and applications |
| 12. | Basic statistical techniques |
| 13. | Sampling: concept, logic and types |
| 14. | Correlation and causation |
| 15. | Observation including participant and non-participant observation |
| 16. | Ethnography |
| 17. | Interviews |
| 18. | Mixed methods |
| 19. | Research puzzle |
| 20. | Hypothesis: rationale and characteristics, and variables, *i.e.* independent, dependent and intervening |
| 21. | Research ethics including plagiarism |

**Centre for Russian and Central Asian Studies (CR&CAS)**

**Russian & Central Asian Studies – RCAH (839)**

The syllabus will cover an overview of the History, Politics, Foreign Policy, Economy and Sociology of the fifteen courtiers comprising the former Soviet Union, namely the Russian Federation, Belarus, Ukraine, Moldova, Georgia, Kazakhstan, Kyrgyzstan, Uzbekistan, Turkmenistan, Tajikistan, Azerbaijan, Armenia, Lithuania, Latvia and Estonia. The focus is on following thematic areas:

1. Comparative Politics and Theories of International Relations
2. Research Methods in Social Sciences
3. Bolshevik Revolution, Soviet Politics, industrialization debates, collectivization, Five-year plans, Soviet Economy, Social System and Foreign Policy
4. Glasnost, Perestroika, Nationalist Movements in the late 1980s’, disintegration of USSR, end of Cold War
6. Impact of Globalisation, liberalization on former Soviet States
7. India’s Relations with the post-Soviet States
8. Geopolitics, Energy Security, Foreign Policy, and Strategic Culture of the post-Soviet Space
9. Gender, Environment, Water, Migration, Human Security, Civil Society and Media in the post-Soviet Space/States

**Centre for South Asian Studies (CSAS)**

**South Asian Studies – SASH (840)**

Questions for the Entrance Examination will be drawn from the following areas:

1. Society and social issues in South Asia
2. Modern history of South Asia
3. Contemporary international politics
4. Politics and political system in South Asian countries.
5. Foreign, security and economic policies of the South Asian States.
6. Economic growth and development of South Asian countries.
7. Environmental issues in South Asia
8. Regional cooperation and economic integration issues in South Asia.

**Centre for Indo-Pacific Studies (CIPS)**

**Indo-Pacific Studies – IPSH (841)**

The Centre for Indo-Pacific Studies broadly covers the areas of Southeast Asia and Southwest Pacific.

The entrance will be based on a syllabus covering the following areas:

1) Regional History of Southeast Asia and Southwest Pacific.
2) Government and Politics in the region.
3) Economic issues in the region.
4) Security issues in the region.
5) India’s relations with the region of Southeast Asia and Southwest Pacific.
| Centre for Inner Asian Studies (CIAS) | Inner Asian Studies - IASH (842) | The test will comprise both research methodology and area studies. The following components include the syllabus: Research Methodology
1. Types of Research: descriptive, empirical, analytical, historical and doctrinal
2. Survey research
3. Case study research
4. Comparative study research
5. Review of literature for research
6. Primary and secondary sources; use of libraries and archives
7. Inductive and deductive methods of reasoning
8. Qualitative and Quantitative methods: characteristics and application
9. Sampling: concept, logic and types
10. Observation including participant and non-participant
11. Research proposal and designing, research questions and hypothesis formulation
12. Research ethics
Area Studies
1. Strategic Dimensions and Geopolitics of Central Asia, Mongolia and Afghanistan
2. International relations of Central Asia, Afghanistan and Mongolia,
3. Ethnicity and Religion in Central Asia, Afghanistan, Xinjiang, Inner Mongolia and Tibet.
4. Religious Extremism and Terrorism in Afghanistan, Central Asia and Xinjiang,
5. Society, Culture and Politics in Xinjiang, Inner Mongolia and Tibet.
7. China's Nationalities Policy in Xinjiang, Tibet and Inner Mongolia.
9. Social, Political and Economic Issues in Central Asia, Mongolia and Afghanistan
10. Energy Resources in Central Asia and Mongolia
11. Transportation Networks and trade linkages |
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| Centre for African Studies (CAFS) | African Studies - AFSH (843) | Geo-cultural Aspects: Land, People, Ecology, Environment, Languages and Culture
Historical Aspects:
   - Ancient African Empires
   - Indigenous political systems
   - Atlantic slave trade - its impact and implications
   - Industrial Revolution and the elimination of slave trade
Colonialism in Africa:
   - European partition of Africa
   - Asian (Indian) migration into Africa
   - Patterns of Colonial rule in Africa
   - Legacy of Colonialism
   - Growth of nationalism and Liberation Movements in Africa
Political Aspects:
   - Political independence and Constitutional changes in Africa
   - Growth of political parties and party-systems
   - The role of military
   - Democratization process in Africa
   - Rise and fall of Apartheid in South Africa
   - Concepts of Pan-Africanism and African socialism
Economic Aspects:
   - Nature of African Economy
   - Underdevelopment and Dependency patterns in Africa
   - Neo-colonial penetration and problems of economic independence
   - Development strategies in post-independence period |
|--------|---------------------------------------------------|------------------------------|--------------------------------------------------------------------------------------------------|
2) Energy Security and International Relations  
3) Political Economy of Energy Security  
4) Energy and Geopolitics  
5) India’s Energy Security: Policies and Politics  
6) Energy in Foreign policy  
7) Energy Security and Energy Governance  
8) Global energy trends and scenarios  
9) Debating Energy Security Transition: Role of Renewable Energy  
10) Energy Security and Global South  
11) Energy and Environment  
12) Energy Security and Cooperation: South Asia, Gulf, Central Asia and European Energy  
2. SCHOOL OF LANGUAGE, LITERATURE AND CULTURE STUDIES

The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through

Computer Based Test (CBT)

Part-time courses

CERTIFICATE OF PROFICIENCY

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<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Centre for Korean Studies (CKS)</td>
<td>COP-Mongolian – MONC (702)</td>
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<tr>
<td>2</td>
<td>Centre for Chinese, South East Asian Studies (CCSEAS)</td>
<td>COP-Bhasha Indonesia – BHAC (703)</td>
<td>Entrance exam of COP in Bahasa Indonesia is conducted as a joint test with other part time programme; Urdu, Pashto, Mongolian and Hebrew. The eligibility is 10+2 or equivalent exam pass. The examination is conducted in English. The syllabus covers: 1. General Knowledge; 2. GK of the country of the languages; 3. Aptitude test and General English.</td>
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<td>3</td>
<td>Centre for Indian Languages (CIL)</td>
<td>Urdu – URDC (704)</td>
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<td>4</td>
<td>Centre for Persian and Central Asian Studies (CPCAS)</td>
<td>COP in Pashto – PUSC (701)</td>
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<td>5</td>
<td>Centre for Arabic and African Studies (CAAS)</td>
<td>COP in Hebrew – HEBC (710)</td>
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ADVANCE DIPLOMA OF PROFICIENCY

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<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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<tbody>
<tr>
<td>1</td>
<td>Centre for Indian Languages (CIL)</td>
<td>ADOP-Mass Media in Urdu – URDA (502)</td>
<td>By and large the syllabus will cover the topics related to the general awareness and basic knowledge of Mass Media which will be based on the following topics:</td>
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<td>a. Types of Mass Media</td>
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<td>b. Language of Mass Media</td>
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<td>c. Social relevance of Mass Media</td>
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<td>d. Journalism</td>
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<td>e. Origin and development of Print Media</td>
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<td>f. Origin and development of Electronic Media/Social Media</td>
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<td>g. Major Mass Media Genres</td>
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### B.A. (Hons.) 1st year

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<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Centre for Persian and Central Asian Studies (CPCAS)</td>
<td>Persian – PERU (401)</td>
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<td>2</td>
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<td>Pushto – PUSU (410)</td>
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<td>3</td>
<td>Centre for Arabic and African Studies (CA&amp;AS)</td>
<td>Arabic – ARBU (402)</td>
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<td>4</td>
<td>Centre for Japanese Studies (CJS)</td>
<td>Japanese – JAPU (403)</td>
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<td>5</td>
<td>Centre for Korean Studies (CKS)</td>
<td>Korean – KORU (404)</td>
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<td>6</td>
<td>Centre for Chinese, South East Asian Studies (CCSEAS)</td>
<td>Chinese – CHNU (405)</td>
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<td>7</td>
<td>Centre for French and Francophone Studies (OFFS)</td>
<td>French – FRNU (406)</td>
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<td>8</td>
<td>Centre for German Studies (CGS)</td>
<td>German – GERU (407)</td>
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<td>9</td>
<td>Centre for Russian Studies (CRS)</td>
<td>Russian – RSNU (408)</td>
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<td>10</td>
<td>Centre for Spanish, Portuguese, Italian and Latin American Studies (CSPI&amp;LAS)</td>
<td>Spanish – SPNU (409)</td>
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The entrance test for this programme is a common test for all languages. Questions pertaining to general knowledge, artificial language, language aptitude and general English would be covered in the syllabus. The test will be conducted in the English language as a Computer Based Test (CBT).

### Master of Arts

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Centre for Persian and Central Asian Studies (CPCAS)</td>
<td>Persian – PERM (203)</td>
<td>1. Translation based on the vocabulary of newspapers, journals and magazines.</td>
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<td>2. Essays, short stories, novels from the different authors.</td>
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<td>3. (a) History of Persian Language with special reference to Avesta, Old</td>
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<td>Persian and Pahlavi scripts and Literature.</td>
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<td>(b) Literary History of Persian starting from Arab Invasions up to the end of</td>
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<td>Pahlavi period with special reference to Samanid, Ghaznavid, Seljuk, Mongol,</td>
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<td>Safavid, Qajar and Pahlavi periods.</td>
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<td>(c) A special study of Persian Literature produced in India.</td>
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<td>4. Geography and systems of Government in the Persian speaking world (i.e.</td>
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<td>Iran, Afghanistan, Tajikistan.)</td>
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<td>5. (a) A detailed account of new trends in Modern/Contemporary Persian Prose</td>
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and Poetry.
(b) Comparison between classical and Modern Persian Poetry.
(c) Selection of poems from Modern/Contemporary Persian Literature.
7. Indo-Persian Relations from the pre-historic days up to the Modern times with special reference to the following: (a) Historical, (b) Cultural, (c) Linguistics, (d) Literary, (e) Trade, scientific & technological relations with special reference to Modern times.

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<tr>
<th>2</th>
<th>Pashto - PUSM (236)</th>
<th>The test is conducted in Pashto and objective type questions pertaining to Afghanistan &amp; Pashto speaking countries, Pashto Language and literature, Pashto history, culture and tradition, Pashto grammar, Translation, Pashto terminologies and general awareness on Indo- Afghan relations.</th>
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<tbody>
<tr>
<td>3</td>
<td>Centre for Arabic and African Studies (CA&amp;AS)</td>
<td>Arabic – ARBM (204)</td>
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<tr>
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<td>1. History of Arabic literature—pres-Islamic, Islamic, Umayyid, Abbasid and modern periods</td>
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<td>2. Modern prose and poetry</td>
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<td>3. Arabic studies in India</td>
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<td>4. Criticism</td>
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<td>5. Major Arab and Indian writers</td>
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<td>6. Advanced Arabic grammar</td>
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<td>7. Translation (Arabic-English-Arabic)</td>
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<td>4</td>
<td>Centre for Japanese Studies (CJS)</td>
<td>Japanese – JAPM (205)</td>
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<td>1. General Awareness on topics such as Japan's</td>
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<td>• Geography</td>
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<td>• History</td>
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<td>• Society and Culture</td>
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<td>• Famous Works of Literature</td>
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<td>• Current affairs</td>
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<td>(Course list for B.A. programme given below for reference)</td>
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<td>2. Language ability in Japanese</td>
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<td>5</td>
<td>Centre for Korean Studies (CKS)</td>
<td>Korean – KORM (206)</td>
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<td>The test is conducted in Korean and objective type questions pertaining to Korea, Korean language, basic Korean literature, Korean culture (both traditional and modern) are covered. Questions may also test their knowledge of basic Hanja (Chinese characters). The test is Computer Based in Korean.</td>
</tr>
<tr>
<td>6</td>
<td>Centre for Chinese, South East Asian Studies (CCSEAS)</td>
<td>Chinese – CHNM (207)</td>
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<td>The test will be conducted in Chinese. Questions on Chinese and Chinese literature, history, civilization and culture of China and Sinophone countries, linguistics and language, translation and didactics of teaching a foreign language are some of the areas covered in the syllabus.</td>
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<tr>
<td>7</td>
<td>Centre for French and Francophone Studies (CFFS)</td>
<td>French and Francophone Studies – FRNM (208)</td>
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<td>The test will be conducted in French. Questions on French &amp; Francophone literature, history, civilization and culture of France and Francophone countries, linguistics and language, translation and didactics of teaching a foreign language are some of the areas covered in the syllabus.</td>
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<tr>
<td>8</td>
<td>Centre for German Studies (CGS)</td>
<td>German Literature – GRLM (209)</td>
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<td></td>
<td></td>
<td>1. Common for both:</td>
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<tr>
<td></td>
<td></td>
<td>• German history from 1750 till 1914</td>
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<tr>
<td></td>
<td></td>
<td>• German history after 1945. (Two German states; Reunification)</td>
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<td></td>
<td></td>
<td>• Basic Linguistics (Word Formation in German; Dependenzgrammatik; IC-analysis; speech act theory etc.)</td>
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<td>2. For candidates opting for German literature:</td>
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<tr>
<td></td>
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<td>• Trends in German Literature post 1945 till 2000</td>
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<td>• History of German Literature from 1750 till 1900. Representative authors and texts - an overview of the different periods from the Enlightenment to Realism</td>
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<td>• An overview of the main genres in German literature</td>
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<td>• The ability to interpret given texts from these periods.</td>
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<td>9</td>
<td></td>
<td>German Translation – GRTM (230)</td>
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</tbody>
</table>
| 10 | Centre for Indian Languages (CIL) | Hindi – HNDM (210) | Syllabus covers the courses prescribed in B.A./B.A.(Hons.) in various Colleges/Universities all over the Country, comprising the following topics:  
- History of Hindi Literature.  
- Major Literary Genres, Works, Movements and trends.  
- Major Writers and Critics of Hindi Literature. |
| 11 | Urdu – URDM (211) | By and large syllabus will cover the curriculums/ syllabuses of B.A./B.A. (Hons.) of Urdu as prescribed in various Universities/Colleges all over the Country. Which will commonly be based on the following topics:  
- History of Urdu Literature (From beginning till 20th century)  
- Classical Urdu Poetry: (Major classical Urdu poets and their selected works)  
- Classical Urdu Prose: (Major classical Urdu Prose writers and their selected works)  
- Modern Urdu Poetry: (Major Modern Urdu Poets and their selected works)  
- Modern Urdu Prose: (Major Modern Urdu Prose writers and their selected works)  
- Major Genres of Urdu Poetry Prose  
- Major literary movements and trends of Urdu Literature. |
| 12 | Centre for Russian Studies (CRS) | Russian – RSNM (212) | The Entrance Examination for this level is Computer Based Test (CBT) in Russian Language. The questions will be based on Advanced Russian Grammar, which may include cases, direct-indirect speech, aspects of verbs, use of verbs with and without prefixes, participles, gerund, active & passive voice etc. It also includes translation from Russian into English and English into Russian and works of prominent authors of 19th & 20th Century Russian Literature. |
| 13 | Centre for Spanish, Portuguese, Italian and Latin American Studies (CSP&LAS) | Spanish – SPNM (213) | The test will be conducted in Spanish. Questions on Spanish and Latin American literature, history, civilization, culture, linguistics and language, translation are some of the areas covered in the syllabus. |
| 14 | Centre for Linguistics (CL) | Linguistics – LiNM (214) | In order to get admitted into the Centre for Linguistics to do an M. A., the students are tested for their aptitude for language, general awareness about language and its function, holistic and scientific approach towards the knowledge of language, analytical abilities, grammatical judgment tasks, linguistics data analysis.  
The examination will be computer based test and will be conducted in English. |
<p>| 15 | Centre for English Studies (CES) | English – ENGM (215) | Candidates will be examined in Literature in English, Literature in India and Other Parts of the World, English in India, Literary and Cultural Theories, Non-Literary Artistic Forms, the Relationship between Literature, Culture and Society, and Practical Criticism of given literary pieces. The objective of the test is to select those who demonstrate not just in-depth knowledge of literature and culture, but literary sensibility and a capacity for original thinking. |</p>
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
</tr>
</thead>
</table>
| 1      | Centre for Persian and Central Asian Studies (CPCAS) | Persian –PERH (848) | 1. **Research Methodology**  
   i) References  
   ii) Applied Mechanisms of Research-  
   iii) Research Writings  
   iv) Use of Manuscripts, Archives and Texts in Research Works  
2. **Trends in Persian Literature: Prose and Poetry**  
   This will cover major works of the contemporary authors/poets, their age and society in which they lived. The texts of literary studies shall be studies from political, historical and sociological point of views to discern the currents and cross currents of society. The contributions of authors/poets to bring positive upheaval in society shall be the focal point of study.  
3. **History of Persian Literature**  
   This will cover the history of Persian Literature in which the major works, their influences and movements caused by them in the Persian speaking world will be taken into account. The entire study shall be undertaken within the framework of socio-political history and the major events of the country having literary relevance will be properly emphasized.  
4. **Indo-Persian Cultural Interactions**  
   This will briefly cover Indo-Persian Cultural interactions under the following broad topics:  
   i) Contacts between Indian & Persian Courts and their impact on life and letters of the countries.  
   ii) Translation of Indian texts and traditions in Persian and vice versa.  
   iii) Literary interactions between India and the Persian World  
   iv) Cultural events of literary significance, etc.  
   v) Cultural Exchange Programme after 1947 and diplomatic contacts between India and the Persian world.  
5. **Literary Interactions**  
   a) Persian literary translations in Indian languages and European language.  
   b) European works of universal significance in Persian Language.  
   c) Indian literature etc. in Persian language.  
   d) Contemporary themes and subjects in Persian literature vis a vis world literature.  
6. **Indo-Persian Literature:**  
   Historiography, Mysticism, Indian Style of writing (Prose & Poetry) etc. |
2. Criticism – schools and trends  
3. Major works of Indian writers in Arabic studies  
4. Major centre of Arabic and Islamic learning in India  
5. Classical and Modern Prose  
6. Classical and modern poetry  
7. Theory of translation |
| 3      | Centre for Japanese Studies (CJS) | Japanese –JAPH (850) | • Major literary works in Japanese literature  
• In depth Knowledge to discuss about some literary works and authors such as Kawabata Yasunari, Akutagawa Ryunosuke, etc in Japanese  
• Literary trends in Japan  
• Current affairs in Japan  
• Indo-Japanese relations in social, cultural, economic, political spheres  
• Cultural, and social history of Japan, contemporary society in Japan.  
• The research theme in which the candidate is interested. Details of the area in which the candidate would like to pursue research. |
| 4      | Centre for Korean Studies (CKS) | Korean –KORH (851) | The questions for the exam will cover research methodology, Korean language, linguistics, literature, culture, history, current affairs of Korea and translation studies. The examination will be in Korean language. The exam will be Computer Based Test (CBT) in Korean. |
| Centre for Chinese, South East Asian Studies (CCSEAS) | Chinese –CHNH (852) | The questions for the exam will cover research methodology, Chinese and Chinese literature, history, civilization and culture, linguistics & language, translation studies, didactics of teaching a foreign language, etc. The examination will be conducted in the Chinese language. |
| Centre for French and Francophone Studies (CFFS) | French –FRNH (853) | The questions for the exam will cover research methodology, French & Francophone literature, history, civilization and culture, linguistics & language, translation studies, didactics of teaching a foreign language. The examination will be conducted in the French language. |
| Center for German Studies (CGS) | German Literature – GERH (854) | 1. Common for all streams
- Research methodology
- Research Interest
- Research proposal
2. Particular streams
- German Literature
- German Linguistics
- Translation
- German History
- Didactics / German as Foreign Language |
| Centre for Indian Languages (CIL) | Hindi –HNDH (855) | Ph.D. programme syllabus of the entrance test shall consist of 50% of Research Methodology and 50% shall be Subject specific.
M.A. (Hindi) in various Colleges/Universities all over the country in general comprising the following topics:
- Origin and development of Hindi Language & Literature
- Major literary works and Authors, Genres, Movements, trends of Hindi Literature
- Research Methodology |
| Urdu –URDH (856) | Ph.D. programme syllabus of the entrance test shall consist of 50% of Research Methodology and 50% shall be Subject specific.
M.A. (Urdu) in various Colleges/Universities all over the country in general comprising the following topics:
- Research Methodology
- Textual Criticism
- Origin and development of Urdu Language
- History of Urdu Literature
- Dakkani Urdu Literature
- Classical Urdu Poetry and Prose
- Major genres of Urdu Poetry and Prose
- Major Literary movements and trends
- Major Critical Theories, Ideas and Critics
- Major works of research in Urdu and Researchers
- Major literary schools (dsabistan) of Urdu. |
| Tamil –TAMH (857) | Ph.D. programme syllabus of the entrance test shall consist of 50% of Research Methodology and 50% shall be Subject specific.
- Basic Research Methodology.
- History of Tamil Literature: Sangam period to Modern period.
- History of Tamil Language: Sangam Period to Modern period and Calduvel concept.
- History of Tamil Criticism: Commentators, Modern Criticism.
- History of Tamil Folklore: Tales, Ballads, Proverbs.
- History of Tamil Journals: Colonial Period, Post Colonial Period.
- History of Tamil Drama and Film: Puranic/ Dravidian Movement / Social Oriented.
- History of Comparative Literature: Reception and Influence Theory, Parallel Theory, Genres, Translations. |
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Details</th>
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</table>
| 11          | Hindi Translation --HTLH (858) Ph.D. programme syllabus of the entrance test shall consist of 50% of Research Methodology and 50% shall be Subject specific. Candidates seeking admission in Hindi Translation are expected to have detailed knowledge of the tradition of translation in India, specially the tradition of translation in Hindi—
  * Basic knowledge of Research Methodology
  * Basic knowledge of Hindi/Indian Literature
  * Knowledge of the different forms of translation,
  * Introduction and critical views on translation theories
  * Major translation thinkers and their contribution
  * Cultural aspects of translation
  * Methodology of translation
  * Translation and structure of language
  * Major works of translation
  * Indian Multilingualism and Translation
  * Role of Translation in Social Change
  * Technology and Translation
  * Emerging issues in Translation
  * Translation of Technical Terminology
  * Computer Assisted Translation Tools
  * Idea of Indian Literature/World Literature and Translation
  * Role of Translation in Comparative Literature |
| 12          | Centre for Russian Studies (CRS) Russian --RSNH (860) The Entrance Examination for this level is Computer Based Test (CBT) in Russian Language. The questions will be based on the Post graduate syllabi of the Centre of Russian Centre. The Test will consist of 50% questions on Research Methodology in the fields of Linguistics, Literature and Theory of Translation and 50% questions on Russian Grammar, 19th & 20th Century Soviet & Russian Literature, Translation of phrases & sentences and Culture. Candidates who qualify the CBT will be invited for a viva-voce which will be conducted in Russian. The candidate will be required to prepare a brief research proposal for the viva-voce based on his/her area of interest. |
| 13          | Centre for Spanish, Portuguese, Italian and Latin American Studies (CSPI&LAS) Spanish --SPNH (861) The questions for the exam will cover research methodology, Spanish & Latin American literature, history, civilization and culture, linguistics & language, translation studies, didactics of teaching a foreign language. The examination will be conducted in Spanish language. |
| 14          | Centre for Linguistics (CLIN) Linguistics --LINH (863) In order to get admitted into the Centre for Linguistics to do an M. Phil. & Ph.D., the students are tested for their knowledge that they acquire during their post-graduation in Linguistics from various Universities. The students are also tested for their very basic understanding of research aptitude which also involves critical thinking. The examination will be computer based test and will be conducted in English. |
| 15          | Centre for English Studies (CES) English --ENGH (864) Candidates will be examined in Literature in English, Literature in India and Other Parts of the World, English in India, Literary and Cultural Theories, Non-Literary Artistic Forms, and the Relationship between Literature, Culture and Society. The objective of the test would be to specifically assess the research aptitude of the candidates, and their suitability for a rigorous research programme. |
3. SCHOOL OF LIFE SCIENCES

The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.Sc.

|--------|---------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | School of Life Sciences (SLS)   | Life Sciences – SLSM (225)   | 1. Candidates will be tested in their basic knowledge in the core subjects of Life/Biological Sciences.  
2. The test would contain subject-specific questions encompassing different branches of Life/Biological Sciences taught at the undergraduate level in various UGC affiliated colleges/institutions in the country.  
3. There is no specific syllabus designed for the test, but the candidates are advised to follow the UGC approved syllabus in their respective subjects for guidance. |

Ph.D.

|--------|---------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | School of Life Sciences (SLS)   | Life Sciences – Group-I GONH (892) | 1. Candidates will be tested in their basic knowledge on research methodology and core subjects of Life/Biological Sciences,  
2. The test will contain questions based on research methodology/experimental techniques related to Life/Biological Sciences research. The test would also contain subject-specific questions encompassing different branches of Life/Biological Sciences taught at the postgraduate level in various UGC affiliated universities/institutions in the country.  
3. There is no specific syllabus designed for the test, but the candidates are advised to consult CSIR/UGC-NET JRF syllabus for guidance. |
|        |                                 | Life Sciences Group-II – GTWH (893) |                                                                                                                                                                                                                                     |
|        |                                 | Life Sciences Group-III – GTRH (894) |                                                                                                                                                                                                                                     |
|        |                                 | Life Sciences Group-IV – GFOH (895) |                                                                                                                                                                                                                                     |
|        |                                 | Life Sciences Group-V – GFIH (896) |                                                                                                                                                                                                                                     |
The pattern of JNU UG 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Master of Arts

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Centre for Economics studies and Planning (CESP)</td>
<td>Economics- ECOM (216)</td>
<td>Applicants will be tested for their analytical abilities and awareness of national and international economic issues of importance at present and in the recent past. Candidates are expected to be familiar with the content of a standard Economics course taught at the B.A. level. Especially for the benefit of applicants without an undergraduate degree in Economics, an enumeration of the areas to be covered is given below: (a) (i) Micro-economics (Demand Curves, Price and Income Elasticity of Demand, Cost Curves, Equilibrium of Firm under Perfect Competition and Monopoly) (ii) Macroeconomics (National Income, Theories of Income Determination, Monetary Policy, Trade and Balance of Payments) (b) Descriptive Statistics (Mean, Median and Mode, Standard Deviation, Correlation Coefficient), Elementary Probability Theory, Mathematics for Economists (Elementary Algebra, Coordinate Geometry and Elementary Calculus) (c) Problems of Economic History, Underdevelopment and Growth: (i) India's Economic Development prior to Independence: India's Planning and Development experience since Independence; Basic indicators of Development. (ii) International Economics Issues of Contemporary Relevance.</td>
</tr>
<tr>
<td>2</td>
<td>Centre for Historical Studies (CHS)</td>
<td>Modern History - MODM (217)</td>
<td>The MA exam is structured to test the students on: A. General comprehension</td>
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<td>3</td>
<td>Medieval History – MEDM (218)</td>
<td>B. A broad understanding of the social sciences and</td>
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<td>4</td>
<td>Ancient History – ANCM (219)</td>
<td>C. Themes related to political, economic and social history and on aspects of religion and culture pertaining to Indian and World history for the ancient, medieval, modern and contemporary periods.</td>
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</tbody>
</table>
| 5      | Centre for Political Studies (CPS) | Political Science – POLM (220) | The M.A. in Political Science continues to be distinctive in its commitment to teaching through lectures and tutorials in order to maintain high standards of excellence in the discipline. Candidates are expected to be familiar with the content of a standard B.A. course in Political Science. Applicants will be tested from areas given below:  
  
  **Unit I**  
  a) Social and Political Thought of Modern India  
  b) Western Political Thought  
  c) Concepts and Approaches in Political Theory  
  **Unit II**  
  d) Constitution and Political Institutions of India  
  e) State and Politics in India  
  f) Political Processes and Public Policies in India  
  **Unit III**  
  g) Comparative Government and Politics  
  h) International Relations  
  Applicants will be required to show familiarity with each Unit. |
| 6 | Centre for the Study of Regional Development (CSRD) | Geography-GEOM (221) | **Unit-I Physical Geography:** Geomorphology, climatology, oceanography, hydrology, bio-geography, Environmental Geography.  
**Unit-II: Human Geography:** Economic geography, political geography, Population geography, human ecology and human settlements  
**Unit-III: Regional Geography:** Regional geography of India- physiographic divisions, patterns and levels of development of agriculture and industries, growth of population, urbanization, and socio-culture diversity  
**Unit-IV: Cartographic Techniques, Remote Sensing & Geographic Information Science and Quantitative Statistical Methods**  
1. Maps & Cartography; Maps; Scales; Map Projections/ Survey of India Topographic maps, methods of data Representation  
2. Remote Sensing and Geographical Information System  
   Statistical Methods: frequency distribution, measures of central tendency and dispersion, Correlation |
| 7 | Centre for the Study of Social Systems (CSSS) | Sociology- SOCM (222) | **Applicants are expected to have a fair understanding of Social Sciences and Indian Society and Culture**  
**Broad themes**  
1. Thinkers: Karl Marx, Emile Durkheim, Max Weber, Georg Simmel, C. Wright Mills, George Herbert Mead, Claude Levi-Strauss  
3. Basic Concepts and Social Institutions  
4. Tools and Techniques Research and Research Methodology  
5. Social Structure and Social Change  
6. Social Stratification: Gender, Caste, Class, Tribe, Disability  
7. Economy and Society  
8. State, Politics and Society  
9. Family, Marriage and Kinship  
10. Sociology of Religion  
11. Environment and Society  
12. Social Movements  
13. Social Issues  
14. Understanding Indian society  
15. Modernization, Globalization and Development |
| 8 | Centre for Philosophy (CP) | Philosophy-SPHM (229) | **The entrance test will be based in a standard BA (major) Philosophy course taught in UGC accredited Indian universities. Students are expected to be familiar with the following problems, themes, and issues. There are five Sections in the syllabus. Each Section will have 20 percent representation (20%) in the total number of questions.**  
**Section: I**  
**Metaphysics**  
Questions will be from both Indian and Western philosophical perspective. Within this section, both the perspectives will have equal representation (50-50%) in terms of the number of questions.  
1. Proofs for Existence of God  
2. Free Will and Determinism  
3. Self and No-self  
4. Consciousness  
5. Personal Identity  
6. Substance and Qualities  
7. Being and Becoming  
8. Actuality and Potentiality  
9. Appearance and Reality  
10. Mind and Body Problem  
11. Universals  
12. Realism and Idealism |
13. Essence and existence

Section: II

Epistemology

Questions will be from both Indian and western philosophical perspective. Within this section, both the perspectives will have equal representation (50-50%) in terms of the number of questions.

1. Theories of Truth
2. Theories of Error
3. Gettier Problem
4. Definitions of Knowledge
5. Knowledge by acquaintance and Knowledge by Description
6. Sources of Knowledge
7. Skepticism
8. Justification of Knowledge: Foundationalism, Anti-foundationalism, and Coherentism
9. Knowledge that and knowledge How
10. Problem of Induction
11. Apriori Knowledge

Section: III

Ethics

Questions will be from both Indian and Western philosophical perspective. Within this section the Indian ethical perspective will have twenty five percent representation (25%) in terms of the number of questions.

1. Theories of Normative Ethics: Utilitarianism, Kantian Deontology, Virtue ethics, Social contract theory, care ethics
2. Theories of Metaethics: Relativism, Non-naturalism, Emotivism, Universal Prescriptivism
4. Thoughts of Indian ethical tradition: Nature of Dharma, Morksa, Purushartha, Rta, Rina, and themes from Buddhist and Jaina ethics

Section: IV

Symbolic Logic

Questions will be from both Indian and western philosophical perspective. Within the section, the area of Indian Logic will have twenty percent representation (20%) in terms of the number of questions.

1. Inductive Logic
   a. Analogical Reasoning
   b. Causal Reasoning
   c. Probability
2. Deductive Logic
   a. Categorical proposition
   b. Categorical syllogisms
   c. Symbolic Logic
   d. Methods of Deduction
   e. Quantification Logic
3. Informal Fallacies: Indian and Western
4. Types of Arguments
Section: V
Social and Political Philosophy

Questions will be from both Indian and Western philosophical perspective. Within this section, both the perspectives will have equal (50-50%) representation in terms of the number of questions.

1. Theories of Justice
2. Liberty and Equality
3. Democracy
4. Feminism
5. Global Justice
6. Marginalization and Discrimination
7. Gandhi: Non-violence, Satyagraha, Swaraj, Nationalism, State
8. Ambedkar: Genesis of Caste and Annihilation of Castes
9. Tagore: Nationalism, Education and Religion of Man
10. Amartya Sen: Justice (Niti and Niyaya)

9 Centre for Informal Sector and Labour Studies (CIS&LS) Development and Labour Studies- DLSM (231) The applicants for the M.A. programme will be examined in the light of their knowledge on themes and issues studied in a standard social science bachelor programme. The purpose of entrance exam is to test the candidates' general awareness on issues related to development and labour studies, their capacity to comprehend and reflect on academic articles, and their ability in analytical reasoning on the contemporary issues of informal sector. Students will be tested in the broad thematic areas of major social science disciplines: Political Economy, Theories and Contemporary History of Development, Development Economics, Indian Economy, Society and Politics in India, Sociological and Political Theories. The purpose of the test is to select candidates who demonstrate aptitude for analytical skills and ability for original thinking.

MPH

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<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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<tbody>
<tr>
<td>1</td>
<td>Centre of Social Medicine and Community Health (CSMCH)</td>
<td>Master of Public Health - MPHT (145)</td>
<td>Public health is an interdisciplinary field and shall require the candidates appearing for the MPH entrance examination to have basic knowledge about important health problems in the country, their determinants, and health interventions. Along with biomedical aspects of important health problems, understanding of social determinants of health and health care shall also be assessed.</td>
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<td>1. History of Public Health</td>
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<td>2. Concepts in Public Health</td>
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<td>3. Epidemiology</td>
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<td>4. Epidemiology of Specific Diseases</td>
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<td>5. Biostatistics</td>
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<td>6. Entomology</td>
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<td>7. Health planning, policy and Public Health Administration</td>
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<td>8. Health Management</td>
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<td>9. Health economics</td>
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<td>10. Nutrition</td>
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<td>11. Environmental Sanitation</td>
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<td>12. Demography and Family Planning</td>
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<td>13. Mental Health</td>
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<td>14. Application of Social Sciences in Health</td>
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<td>15. Impact of urbanisation on health and disease.</td>
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<td>16. School Health</td>
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<td>17. Urban health</td>
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<td>Sl. No.</td>
<td>Name of Centre</td>
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<td>Syllabus for Entrance Examination</td>
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<tr>
<td>1</td>
<td>Centre for Economics studies and Planning (CESP)</td>
<td>ECOH (865)</td>
<td>In the examination, the applicants will be examined in the topics covered by a standard M.A. Economics programme. These would broadly include Micro-economics, Macro-economics, Economic Development, Indian Economy and Statistical and: Mathematical Methods in Economics. The distribution of questions in the examination would be in conformity with UGC Regulations, 2016.</td>
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<tr>
<td>2</td>
<td>Centre for Historical Studies (CHS)</td>
<td>MODH (866)</td>
<td>The exam is structured to test the students on:</td>
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<td>3</td>
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<td>MEDH (867)</td>
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<td>ANCH (868)</td>
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<tr>
<td>5</td>
<td>Centre for Political Studies (CPS)</td>
<td>POLH (869)</td>
<td>Applicants for the programme will be examined for their analytical ability in topics covered by an M.A. programme in Political Science. These would broadly include Philosophy and Methods of the Social Sciences, Traditions of Political Inquiry, Key Concepts in Political Science, Contemporary Debates in Political Philosophy, Indian Politics (Institutions, Processes and Policies) Key Debates in Indian Politics, Issues in Comparative Politics, and International Relations. Questions in the entrance test will include recent political debates. In addition, questions based on the various Masters level courses will also be asked. Questions on the various quantitative and qualitative research methods commonly used in social science research will also feature in the entrance test. For more details about our programme and courses, please visit the website: <a href="http://www.jnu.ac.in/ssscps">http://www.jnu.ac.in/ssscps</a>.</td>
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<td>6</td>
<td>Centre for the Study of Regional Development (CSRD)</td>
<td>POPH (870)</td>
<td>Students will be tested on research methodology and the relevant areas pertaining to the streams they apply for. The syllabus for the JNUEE has been framed keeping in mind the post graduate programs taught in most Indian universities.</td>
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<td>7</td>
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<td>GEOH (871)</td>
<td>(i) Regional Development: Geography (code: GEO) Syllabus:</td>
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<td>8</td>
<td></td>
<td>ECNH (872)</td>
<td>(B) i. Physical Geography: Geomorphology, Oceanography, climatology, climate change, Hydrology, Biogeography, Ecosystems, Natural Resources and Natural Disasters (with special reference to India)</td>
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</table>
(ii) Regional Development: Population Studies (Code: POP)

(A) Research Methodology: Basic and advanced statistics, Quantitative methods in population analysis, basic demographic data in India, methods of demographic data analysis, population survey (primary and secondary) methodologies and designs.

(B) Nature and scope of population studies; sources of demographic data; Global and regional population trends, growth, distribution, and density; population composition; components of population dynamics namely fertility, mortality and migration; Population growth in relation to economic and social development, India’s population policy and family planning programme, population theories, Demographic methods (may need the use of scientific calculator), Population, environment and development, urbanization, Human habitat, human ecology, Food security, Programs related to Population Health and Development, gender and population.

(iii) Regional Development: Economics (Code: ECN)

(A) Research Methodology: Basic Statistics, Quantitative methods in Economics, Sources of Data on the Indian Economy.

(B) Economic theory and development theory (at the Master level); basic issues in Indian economy around themes like poverty, inequality, employment, banking, public finance, industry, agriculture, trade etc; India’s development and policy choices; made over the years to address those challenges.

| 9 | Centre of Social Medicine and Community Health (CSMCH) | Social Sciences in Health- CSMH (873) | PhD in Social Sciences and Health at the Centre of Social Medicine and Community Health is an interdisciplinary programme. The candidates are expected to have an understanding of diseases, health and wellbeing through the study of social, behavioural, economic, political, regional, spatial, cultural and environmental influences on health, health planning, policies and programmes and the application of social epidemiology and social science theories, concepts and methodologies for research in public health.

Basic concepts in Social Sciences and its relevance to public health
1. Social Stratification
2. Social Institutions and Groups
3. Culture
4. Characteristics of Rural and Urban Society
5. Sanskritisation
6. Social Capital and Cultural Capital
7. Poverty
8. Inequality
9. Globalization, liberalization, privatization
10. Motivation
11. Attitude, Perception and Behavior
12. Socialisation
13. Power
14. Conflict
15. Civil Rights, Democratic Rights and Human Rights
16. Social change
17. Social movements and civil society
18. Understanding Interconnections Between Economy, Polity And Society
19. Current Debates in Health

2. Application of Social Sciences to Health
1. Social Determinants of Health
2. Development and Health
3. Social inequalities and marginalisation in health
4. Climate change and its impact on health
5. Population and development
6. Social exclusion, discrimination and health
7. Importance of large data sets for public health
8. Health promotion and Illness prevention
9. Mental Health and Disability
10. Medical pluralism
11. Accessibility, Availability and Affordability of Health Care
<table>
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<tr>
<th>12. Universal Health Care</th>
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</thead>
<tbody>
<tr>
<td>13. Recent social issues and their implications for health</td>
</tr>
</tbody>
</table>

3. Research Methodology
1. Qualitative methods in Social Sciences
2. Quantitative methods in Social Sciences
3. Importance of Qualitative and quantitative research methods used in public health
4. Mixed methods
5. Ethics in Research
6. Statistical Methods

Public Health – PUBH (874)

PhD in Public Health at the Centre of Social Medicine and Community Health is an interdisciplinary programme. The candidates are expected to have an understanding of diseases, health and wellbeing through the study of Biomedical, social, behavioural, economic, political, regional, spatial, cultural and environmental influences on health, health policies and programmes and the application of public health and health systems research concepts and methodologies.

1. Basic concepts in public health
1. History of Public Health
2. Concepts in Public Health
3. Epidemiology
4. Epidemiology of Specific Diseases
5. Health planning, policy and Public Health Administration
6. Health Management
7. Health economics
8. Nutrition
9. Environmental Sanitation
10. Demography and Family Planning
11. Mental Health
12. Application of Social Sciences in Health
13. Impact of urbanisation on health and disease.
14. School Health
15. Urban health

2. Research Methodology
1. Qualitative methods in Social Sciences
2. Quantitative methods in Social Sciences
3. Importance of Qualitative and quantitative research methods used in public health
4. Mixed methods
5. Ethics in Research
6. Statistical Methods

Centre for the Study of Social Systems (CSSS)

Social Systems - SOCH (875)

Candidates are expected to display a good research aptitude, analytical skills and usage of social science perspectives in answering questions from the following list of themes.
1. Thinkers Classical Thinkers:
   a. Karl Marx, Emile Durkheim, Max Weber
   b. Advanced Social Theories: Postmodernism, Postcolonialism and Poststructuralism
   c. Study of Monographs: Evans-Pritchard, Bronislaw Malinowski, Edmund Leach, Margaret Mead, Clifford Geertz
2. Philosophical Foundation of Theories and Methodology
3. Social Research/Research Methodology: Quantitative and Qualitative, Positivism, Interpretivism
4. Social Structure, Continuity and Change
5. Theories of Culture
6. Social Stratification: Gender, Caste, Class, Tribe, Ethnicity, Disability
7. Kinship, Family and Marriage
8. Social Inequalities and Movements
9. Education and Society
10. Religion and Society
11. State, Polity and Society
12. Economy and Society
13. Social issues
14. Agrarian and Urban Sociology
15. Indian Sociology
| 12 | Zakir Husain Centre for Educational Studies (ZHICES) | Educational Studies - EDUH (876) | **Research Methodology:**
Research methods and research methodology - nature of the field and their distinct concerns; methods of the sciences, social sciences and humanities; qualitative and quantitative research methods, kinds of theories and the structure of theories, hypothesis, concepts and variables, sampling procedures, data gathering; testing and experimentation, procedures of validation; steps in the research process, research paradigms and frameworks.

Measures of Central Tendency and Dispersion (Mean, Median, Mode, Standard Deviation, Variance), Skewness and Kurtosis, Correlation Coefficient, Regression Analysis, Basic Probability Theory, Sampling Theory, Testing of Hypothesis, Data Interpretation, Sources of Data on the Indian Education.

**Zakir Husain Centre for Educational Studies** is a multi-disciplinary centre which approaches the field of education from four social science disciplines such as Economics, Sociology, History and Psychology. The students are expected to fit into any one of these disciplinary areas to carry out their research. The syllabus for the entrance examination under each of these areas of specialization is as follows (the list is only indicative, not exhaustive):

**A. History of Education**
Historical method and historiography; Modern Indian history; The educational database; Woods Despatch; The Revolt of 1857; Establishment of modern universities; The Hunter Commission; India's freedom movement; Imperialism and nationalism; European History; Enlightenment; Reformation; Revolutions; Global History of modernization; introduction of modern sciences and science education. Education and knowledge-systems in pre-colonial India.

**B. Sociology of Education**
Classical and contemporary sociological theory and thinkers; Themes and issues in the Indian society; Rural and urban Sociology; Sociology of backward classes and marginalized; Sociology of education; sociology of development; Methodology and methods in Sociological research.

**C. Psychology of Education**

**D. Economics of Education**
13 Centre for Studies in Science Policy (CSSP)  
Studies in Science Policy-SSPH (877)  
Question in the entrance test will be based on the current affairs on science, technology, innovations and related policy debates. To test the domain knowledge of students, questions based on the various Masters level courses will also be asked. Questions on the various quantitative and qualitative research methods commonly used in social science research will also feature in the entrance test. For more details about our programme and courses, Please visit: http://www.jnu.ac.in/sss/csssp-programme_of_study

The Centre is pursuing research in areas/fields such as:

a) Science and technology policies including various sectors of economy, S&T in government and S&T policies and development issues in India and other countries;

b) Sociological and Historical Studies on S&T; Social shaping of technology; Scientists in laboratories and organizations; Scientific communities and professionalization of science;

c) Frugal and Grassroots Innovations;

d) Responsible Research and Innovation (RRI);

e) Waste Management;

f) Law, Science and Technology; Cyber & Information Technology Law; Intellectual Property Rights; International S&T Treaties;

g) Economics of technological change and innovation studies; national, sectoral and regional innovation systems; clusters and technological change;

h) Technology Foresight and Assessment; Risk R&D and technology; Technology and hazards including disaster management related to technical change, innovation, methodologies, etc.;

i) Gender issues in S&T;

j) Globalisation and Emerging Technology; TNCs, FDI and impact on R&D; International affairs and relations in S&T for development; Area studies in science and technology policies and development covering developing and developed countries.

14 Centre for Philosophy (CP)  
Philosophy-SPHH (878)  
Questions would be based on the M.A syllabus taught at the Centre for Philosophy. Please visit http://www.jnu.ac.in/sss/cpph Each Unit will have 20 percent representation (20%) in the total number of questions.

Please note that as per admission policy 50% of questions in the entrance examination for the Ph.D. Program will be from Research Methodology and rest 50% from domain knowledge.

Apart from the above the candidate is expected to have sufficient knowledge of the following:

UNIT –I

Research Methodology:

1. Inductive, Deductive and probabilistic reasoning

2. Fallacies formal and informal

3. Logical postivism

4. Dialectics

5. Positivism

6. Hermeneutics

7. Deconstruction s

8. Pragmatism

9. Sceptical method

10. Linguistic analysis

11. Phenomenology and existentialism

12. Thought experiments

13. Principles of Verifiability and Falsifiability

14. Holism and methodological individualism

15. Types of arguments in Indian philosophy

16. Nature of inference (Anumāna) in Indian philosophy

17. Types of inferences
18. Nature of concomitance (vyāpli) according to different schools of Indian philosophy
19. Hypothetical reasoning (arthāpatti)

UNIT – II

Philosophical Theories and Concepts

1. Metaphysics
   i. Theories of mind and consciousness
   ii. Theories of meaning and truth
   iii. Realism and anti-realism
   iv. Freewill: Determinism, Indeterminism and Compatibilism
   v. Form and matter
   vi. Theories of Self
   vii. Theories of Causation
   viii. Problem of personal identity
   ix. Problem of other minds
   x. Problem of matter
   xi. Essentialism
   xii. Atomism
   xiii. Dualism
   xiv. Epiphenomenalism
   xv. Anomalous Monism
   xvi. Eliminative Materialism
   xvii. Behaviourism
   xviii. Substance Dualism
   xix. Nature of Relations
   xx. Critique of metaphysics

2. Epistemology
   i. Theories of perception
   ii. Theories of knowing
   iii. Theories of Justification: Internalism and Externalism
   iv. Gettier Problem
   v. Definition of knowledge (Pramā) in Classical Indian philosophy
   vi. Theories of Error in Classical Indian philosophy
   vii. Sources of knowledge Classical Indian philosophy
   viii. Theories of Justification in Classical Indian philosophy (pramānyavāda)

UNIT –III

Ethics

a. Normative Ethics
   i. Consequentialism
   ii. Kantian Deontology
   iii. Virtue Theoretical Ethics
   iv. Contractarianism and Contractualism
   v. Natural Rights Theory
   vi. Feminist Ethics

b. Theories of Metaethics
   i. Cognitivism and Non-cognitivism
   ii. Moore’s Non-naturalism
   iii. Error Theory
   iv. Prescriptivism
v. Relativism
vi. Moral Realism and anti-realism
c. Applied Ethics
   i. Bio-medical Ethics
   ii. Animal Ethics
   iii. Theories of Punishment
   iv. Environmental Ethics
   v. Business Ethics
d. Indian Ethical Tradition
   i. Mīmāṃsā Theory of Dharma, liṅkātavatābodha, artha and bhāvanā,
   ii. Buddhist Ethics
   iii. Jaina Ethics
   iv. Theory of Obligation in Bhagavad Gītā

UNIT - IV
Social and Political Philosophy
   b. Individual and State
   c. Democracy
   d. Socialism
   e. Marxism
   f. Secularism
   g. Sarvodaya
   h. Gender equality
   i. Contemporary theories and debates: Utilitarianism, Rawls’s Justice as Fairness,
   j. Libertarianism, Communitarianism, Political liberalism, Multiculturalism, Feminism

UNIT - V
Contemporary Indian Philosophy:
   i. Gandhi, Ambedkar, Tagore, Aurobindo, Vivekananda
   ii. Gandhi Tagore Debate
   iii. Gandhi Ambedkar Debate
   iv. Radhakrishnan
   v. K. C. Bhattacharyya
   vi. Jyotiba Phule
   vii. Mohammad Iqbal
   viii. Amartya Sen

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<th>Centre for Women Studies (CWS)</th>
<th>Women Studies –WSPH (879)</th>
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<td>Since Women’s Studies is interdisciplinary in nature, the entrance exam will expect candidates to bring their disciplinary and interdisciplinary training in historical, political, economic, sociological, cultural, literary and representational perspectives in the way women, gender, and sexuality have been constituted as objects of study. Students are expected to have a thorough understanding of the relationship between gender and other analytical categories like class, case, ethnicity, sexuality, community and nationality not only in a national, but also a cross cultural and transnational context. The candidates are expected to be broadly aware of different dimensions of women, gender and sexuality studies in Feminist Theory; Women’s Movements; Gender, Labour and Political Economy; Sexuality Studies; Law; Politics; Development; Globalization and its implications; Religion and Faith Practices; Caste, Ethnicity and Race; Gender and Space; Culture and Modernity; Literature, Art and Performance, and Visual Studies. Candidates are expected to have knowledge of feminist methodology, especially qualitative research methods such as ethnography, discourse analysis, oral history, archival research, and literary methods, but not just limited to these.</td>
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Centre for the Study of Social Exclusion and Inclusive Policy

Social Exclusion and Inclusive Policy - SEIH (880)

The examination will deal with topics which are covered in any standard Masters level course pertaining to History, Anthropology, Economics, Political Science and Sociology. In addition, the candidates are expected to have comprehensive understanding on the various dimensions of discrimination and exclusion faced by Scheduled Castes (SC), Scheduled Tribes (ST) and various Minority groups in India. The interpretation of these societal dimensions can only be understood through a proper knowledge of research methodology. The definition of research methodology in itself is a difficult task, divided in terms of approaches ranging from the qualitative to quantitative. In addition to research methods the candidate acquainted in their respective subject at the Master level, is also expected to be familiar with the methods and measurement of Discrimination and exclusion. The candidates are expected to be aware of analysis based on large datasets published periodically by the Government and non-governmental agencies. These would include, but not limited to, Decennial Census reports, National Sample Survey Organisation reports (NSSO), National Family and Health Surveys (NFHS), National Crime Records Bureau reports (NCRB) and other alternative reports covering issues of discrimination and exclusion like Sachar Committee Report, Indian Exclusion reports, International Organisational reports like UN, ILO etc. Further the candidates should be aware of reports published by National Commission for Scheduled Castes (NCSC), National Commission for Scheduled Tribes (NCST), National Commission for Backward Classes (NCBC), National Human Rights Commission (NHRC). The candidates should have an in-depth understanding of various facets of the Indian Constitution, Governmental policies for inclusion and developmental schemes addressing the issues of inter-sectionalities of Gender, SCs, STs, disabled and Minority groups.

Centre for Media Studies (CMS)

Media Studies- CMSH (881)

Envisaged primarily as a centre for research and academic study, the syllabus for the Entrance Examination will cover broader fields of media studies, which include: Histories of media, Political economy of Media, Media and issues of language, Media, democracy, and dimensions of rights and justice, Violence and media, Media, technologies and cultural industries, Media and the nature of connectivities, Visual culture, Theories and methods in media studies.

Ph.D.

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<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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<td>1</td>
<td>Group of Adult Education (GAE)</td>
<td>Adult Education- GAEH (883)</td>
<td>We insist that the student/candidates should have exposure, understanding and knowledge in wide ranging issues related to adult, continuing education and extension. The main thrust areas include ‘Literacy studies’ (e.g., basic literacy, adult literacy, digital literacy, financial literacy, consumer literacy, legal literacy, health literacy, media and citizen literacy etc.), adult, lifelong education, vocational/skill education, sustainable livelihood education, entrepreneurship education and other related continuing education in India and abroad. Moreover, GAE focuses on problems of contemporary youth &amp; their lifestyles; the impact of globalization and market practices on the local communities and society with special emphasis on consumer rights, movements and awareness. We try to enrol students who have interest do research in areas of formal/non-formal education, policy studies and practice in all these areas. GAE makes special efforts in enhancing learning, and improving professionalism among the students in social and education sectors to play constructive roles in nation-building.</td>
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<td>2</td>
<td>Centre for Informal Sector &amp; Labour Studies (CISL)</td>
<td>Informal Sector &amp; Labour Studies- ISLH (884)</td>
<td>The test is intended to evaluate the candidate’s general awareness in the following areas. The Ph.D. programme focuses on interdisciplinary research on Indian informal sector and labour scenario. The programme encourages to work on themes such as—Political Economy of State, Development and Underdevelopment in the contemporary world, Labour History, Globalization and the changing forms of Labour, Global Production Systems, Informalisation in various sectors, Labour Market, Forms of Employment, Poverty, Migration, Urbanisation, Labour Rights and Regulation, Workers’ Organizations and Politics, Trade Unions, Resistance, Peasant Production, Non-farm Economy, Agrarian Change and Rural Development, Political Economy of Care, Discrimination on the basis of Caste, Gender and</td>
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## 5. SCHOOL OF ENVIRONMENTAL SCIENCES

The pattern of JNU EE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

**Master of Science**

|--------|-----------------------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | School of Environmental Sciences (SES)              | Environmental Sciences – SESM  (223) | The questions will be of multiple choice type. The questions will be in two parts.  
**Part I:** This will have questions from the different areas of Science and Mathematics at the 10+2 level.  
**Part II:** This will have questions, in the areas of Physics, Chemistry, Mathematics, Geology, Botany and Zoology at the B.Sc. level.                                      |

**Ph.D.**

|--------|-----------------------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | School of Environmental Sciences (SES)              | Research Area I-ONEH (885)   | All questions would be of the multiple choice type. The questions will be divided into two parts.  
**Part-A**: This part will have questions on Research Methodology broadly covering the topics such as Judging the ability of Searching libraries, web-based information etc., Structuring of articles, referencing etc., Describing visual, audio or written images, Writing review of book/Report etc., importance of seminar/workshop/conference, General idea of plagiarism, Concept of logbook, workbook, field book etc., Names of journals, Important publishers, Site selection criteria, sample number criteria, sample storage methods, sample extraction and digestion methods, Mean, median, mode, standard deviation, standard error, correlation, time series, scatter plots, bars, line diagram, error bars, area plots, contours etc., Accuracy, precision, null hypothesis, errors, uncertainty, Knowledge about software: statistical, GIS and RS etc.  
**Part-B**: This part will have questions of M.Sc. level from Physics, Chemistry, Geology, Biology and Environmental Sciences. |
# 6. SCHOOL OF COMPUTER & SYSTEMS SCIENCES

The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

## MCA

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<td>1</td>
<td>School of Computer &amp; Systems Sciences (SC&amp;SS)</td>
<td>Master of Computer Applications-MCAM (224)</td>
<td>General Aptitude, Reasoning, Computer Science and Mathematics, as per the topics specified as under: <strong>Maths:</strong> Differential and Integral Calculus, Algebra, Trigonometry, 2D-3D Geometry, Probability &amp; Statistics, Matrices and Determinants <strong>Computer Science:</strong> Digital Systems Design, C Programming Language, Data structures, Discrete mathematics</td>
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## Ph.D.

The School will have two separate streams namely "Computer Science" stream and "Microsystems" stream in the JNU entrance examination for the admissions to the PhD programme. An applicant for the PhD programme should clearly mention only one stream in the application form. The candidature of those applying for both the streams is likely to be rejected. Therefore, the applicants are advised in their own interest not to apply for both the streams. Admission is offered to candidates based on their performance in the Computer Based Test (CBT) and the viva-voce examination, as per University rules. In the entrance examination, besides the common part (PART A), the applicants must answer questions only for the part meant for their choice of stream (PART B). On the basis of the candidates' performance in the entrance examination and as per University rules, the candidates would be called for the viva-voce examination. Separate viva-voce examination would be conducted for "Computer Science" stream and "Microsystems" stream. Admission to the PhD Programme will be based on the merit in entrance and viva-voce examination.

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<td>1</td>
<td>School of Computer &amp; Systems Sciences (SC&amp;SS)</td>
<td>Computer Science - SCSH (890)</td>
<td>50% of the questions will be from Research Methodology and remaining from the other specified topics. <strong>PART A:</strong> <strong>Common Syllabus for the Computer Science and Microsystems Stream:</strong> <strong>Research Methodology:</strong> Experimental Design; Fundamentals of Sampling; Data: types, quality measurement; Processing and Analysis of data; Hypothesis Testing (parametric, non-parametric), Theory of Probability. <strong>Mathematics:</strong> Integral and Differential Calculus, Linear Algebra, Numerical Analysis, Modern Algebra. <strong>PART B:</strong> <strong>Specific Syllabus for the Computer Science Stream:</strong> Data Structures and Algorithms, Programming Languages (C, C++), Operating Systems, Discrete Mathematics, Automata Theory, Computer Architecture, Computer Networks, Database Management System. <strong>Specific Syllabus for the Microsystems Stream:</strong> Digital logic, electronics in solids, energy band theory, charge carriers in semiconductors, drift-diffusion theory, p-n junctions, MOS transistor, Basics of CMOS analog circuits, Basics of CMOS digital VLSI circuits, Basics of MEMS and VLSI Technology.</td>
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MTech PROGRAMMES

There will be a common JNUEEE paper for admission to both M.Tech. Programme in “Computer Science and Technology” and M.Tech. Programme in “Data Science”. An applicant should clearly mention the order of preference amongst the two MTech programmes in the application form. The eligibility and syllabus for the JNU entrance examination for both M.Tech. Programme in “Computer Science and Technology” and M.Tech. Programme in “Data Science” would be the same. Further, admission to the M.Tech. Programme in “Computer Science and Technology” and M.Tech. Programme in “Data Science” will be based on the Computer Based Test (CBT) and the preference of the candidate. Separate merit lists for M.Tech. Programme in “Computer Science and Technology” and M.Tech. Programme in “Data Science” will be prepared. These two programmes are terminal degree programmes.

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<td>1</td>
<td>School of Computer &amp; Technology - MTCT (157)</td>
<td>General aptitude, reasoning and Bachelor’s/Master’s level Mathematics and Computer Science as per the topics as under: Maths: Differential and Integral Calculus, Linear Algebra, Numerical Analysis, Modern Algebra, Probability and Statistics.</td>
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7. SCHOOL OF PHYSICAL SCIENCE

The pattern of JNUEEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Master of Science

|---------|----------------|-------------------------------|----------------------------------|
Transmission and reflection coefficients (normal incidence only). Lorentz Force and motion of charged particles in electric and magnetic fields.


**Chemistry – CHEM (227)**

**PHYSICAL CHEMISTRY**

**Basic Mathematical Concepts:** Functions; maxima and minima; integrals; ordinary differential equations; vectors and matrices; determinants; elementary statistics and probability theory.

**Atomic and Molecular Structure:** Fundamental particles; Bohr’s theory of hydrogen-like atom; wave-particle duality; uncertainty principle; Schrödinger’s wave equation; quantum numbers; shapes of orbitals; Hund’s rule and Pauli’s exclusion principle; electronic configuration of simple homonuclear diatomic molecules.

**Theory of Gases:** Equation of state for ideal and non-ideal (van der Waals) gases; kinetic theory of gases; Maxwell-Boltzmann distribution law; equipartition of energy.

**Solid state:** Crystals and crystal systems; X-rays; NaCl and KCl structures; close packing; atomic and ionic radii; radius ratio rules; lattice energy; Born-Haber cycle; isomorphism; heat capacity of solids.

**Chemical Thermodynamics:** Reversible and irreversible processes; first law and its application to ideal and nonideal gases; thermochemistry; second law; entropy and free energy; criteria for spontaneity.

**Chemical and Phase Equilibria:** Law of mass action; Kp, Kc, Kx and Kn; effect of temperature on K; ionic equilibria in solutions; pH and buffer solutions; hydrolysis; solubility product; phase equilibria–phase rule and its application to one-component and two-component systems; colligative properties.

**Electrochemistry:** Conductance and its applications; transport number; galvanic cells; EMF and free energy; concentration cells with and without transport; polarography; concentration cells with and without transport; Debye-Hückel-Onsagar theory of strong electrolytes. **Chemical Kinetics:** Reactions of various order; Arrhenius equation; collision theory; transition state theory; chain reactions – normal and branched; enzyme kinetics; photochemical processes; catalysis.

**Adsorption:** Gibbs adsorption equation; adsorption isotherm; types of adsorption; surface area of adsorbents; surface films on liquids.

**Spectroscopy:** Beer-Lambert law; fundamental concepts of rotational, vibrational, electronic and magnetic resonance spectroscopy.

**ORGANIC CHEMISTRY**

**Basic Concepts in Organic Chemistry and Stereochemistry:** Electronic effects, resonance, inductive, hyperconjugation, aromaticity, tautomerism; organic acids and bases; optical isomerism in compounds with and without any stereocenters (allenes, biphenyls); conformation of acyclic systems (substituted ethane/n-propane/n-butane) and cyclic systems (mono- and di-substituted cyclohexanes).

**Organic Reaction Mechanism and Synthetic Applications:** Chemistry of reactive intermediates (carbocations, carbanions, free radicals, carbones, nitrenes, benzynes); Hofmann-Curtius-Lossen rearrangement, Wolff rearrangement, Simmons-Smith reaction, Reimr-Tiemann reaction, Michael reaction, Darzens reaction,
Wittig reaction and McMurry reaction; Pinacol-pinacolone, Favorskii, benzilic acid rearrangement, dienone-phenol rearrangement, Baeyer-Villiger reaction; oxidation and reduction reactions in organic chemistry; organometallic reagents in organic synthesis (Grignard, organolithium and organocopper); Diels-Alder, electrocyclic and sigmatropic reactions; functional group inter-conversions and structural problems using chemical reactions.

**Spectroscopic Analysis:** Identification of functional groups by UV, IR and 1H NMR spectroscopic techniques as tools for structural elucidation.

**Natural Products Chemistry:** Chemistry of alkaloids, steroids, terpenes, carbohydrates, amino acids, peptides and nucleic acids.

**Aromatic and Heterocyclic Chemistry:** Monocyclic, bicyclic and tricyclic aromatic hydrocarbons, and monocyclic compounds with one hetero atom: synthesis, reactivity and properties.

### INORGANIC CHEMISTRY

**Periodic Table:** Periodic classification of elements and periodicity in properties; general methods of isolation and purification of elements.

**Chemical Bonding and Shapes of Compounds:** Types of bonding; VSEPR theory and shapes of molecules; hybridization; dipole moment; ionic solids; structure of NaCl, CsCl, diamond and graphite; lattice energy.

**Concepts of Acids and Bases:** Bronsted and Lewis acids and bases; Gas phase versus solution phase acidity; solvent levelling effects; hardness and softness.

**Oxidation and Reduction:** Redox potentials; Nernst equation; influence of complex formation; precipitation; change of pH and concentration on redox potentials; analysis of redox cycles; redox stability in water; disproportionation/comproportionation.

**Main Group Elements (s and p blocks):** General concepts on group relationships and gradation in properties; structure of electron deficient compounds involving main group elements.

**Transition Metals (d block):** Characteristics of 3d elements; oxide, hydroxide and salts of first row metals; coordination complexes: structure, isomerism, reaction mechanism and electronic spectra; VB, MO and Crystal Field theoretical approaches for structure, color and magnetic properties of metal complexes; organometallic compounds having ligands with back bonding capabilities such as metal carbonyls, carbenes, nitroys and metalloccenes; homogenous catalysis.

**Bioinorganic Chemistry:** Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions, especially Fe2+, Fe3+, Cu2+ and Zn2+; structure and function of hemoglobin and myoglobin and carbonic anhydrase.

**Instrumental Methods of Analysis:** Basic principles; instrumentation and simple applications of conductometry, potentiometry and UV-vis spectrophotometry.

**Analytical Chemistry:** Principles of qualitative and quantitative analysis; acid-base, oxidation-reduction and complexometric titrations using EDTA; precipitation reactions; use of indicators; use of organic reagents in inorganic analysis.

### Mathematics – MATM (237)

**Set Theory and related topics:** Elementary set theory, Finite, countable and uncountable sets, Equivalence relations and partitions

**Real Numbers, Sequences and Series:** Real number system as a complete ordered field. Archimedean property, supremum, infimum, Sequence of real numbers, convergence of sequences, bounded and monotone sequences, convergence criteria for sequences of real numbers, Cauchy sequences, subsequences, Bolzano-Weierstrass theorem. Series of real numbers, absolute convergence, tests of convergence for series of positive terms - comparison test, ratio test, root test, Leibniz test for convergence of alternating series

**Real Analysis:** Interior points, limit points, open sets, closed sets, bounded sets, connected sets, compact sets, Power series (of a real variable), Taylor’s series, radius and interval of convergence, term-wise differentiation and integration of power series

**Functions of One Real Variable:** Limit, continuity, intermediate value property, differentiation, Rolle’s Theorem, mean value theorem, L’Hospital rule, Taylor’s theorem, maxima and minima

**Functions of Two and Three Real Variables:** Limit, continuity, partial derivatives, differentiability, maxima and minima

**Integral Calculus:** Integration as the inverse process of differentiation, definite integrals and their properties, fundamental theorem of calculus. Double and triple integrals, change of order of integration, calculating surface areas and volumes using double integrals, calculating volumes using triple integrals

**Vector Calculus:** Scalar and vector fields, gradient, divergence, curl, line integrals, surface integrals, Green, Stokes and Gauss theorems
**Ph.D.**

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<td>1</td>
<td>School of Physical Sciences (SPS)</td>
<td>Mathematical Sciences – MATH (897)</td>
<td>Analysis: The structure of the real numbers as an ordered field with the least upper bound property, archimedean property, Bolzano-Weierstrass theorem, Heine-Borel theorem, extended real number system, complex field, Euclidean spaces, Definition and examples of metric spaces, completeness, compactness, connectedness, continuous functions and related properties. Convergence of sequences in a metric space, subsequences, Cauchy sequences. Limits of functions, continuity of functions, uniform continuity, continuity and compactness, continuity and connectedness. Pointwise and uniform convergence, uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation, equicontinuity, Arzela-Ascoli theorem, Stone-Weierstrass theorem. Differentiation of functions of several real variables (directional derivatives, partial derivatives, differentiability and the total derivative, chain rule, Jacobian, higher derivatives, interchange of the order of differentiation, Taylor’s theorem), inverse function theorem, implicit function theorem, rank theorem, differentiation of integrals. Lebesgue measure and Lebesgue integral, convergence Theorems. Linear Algebra: Vector Spaces, subspaces, linear independence, bases, dimension, algebra of linear transformations, rank-nullity theorem, dual spaces, double dual, eigenvalues and eigenvectors, characteristic polynomial and minimal polynomial, Cayley-Hamilton theorem. Diagonalizability and digonalization, primary decomposition theorem, generalized eigenvectors, Jordan canonical form, rational canonical form. Bilinear forms, symmetric and skew-symmetric bilinear forms, groups preserving bilinear forms, reduction and classification of bilinear forms. Algebra: Definition and examples of groups - dihedral, symmetric and permutations groups, matrix groups such as GL(n), SL(n), abelian and cyclic groups, subgroups, normal subgroups, quotient groups, centralizer and normalizer of a group, Lagrange’s theorem, isomorphism theorems, group actions, class equation, counting orbits, Cayley’s theorem, Sylow’s theorems, simplicity of alternating groups. Rings and subrings, isomorphisms, ideals, prime and maximal ideals, quotient rings, polynomial rings, unique factorization domain, principal ideal domain, Euclidean domain, Gauss’s lemma, irreducibility criteria. Definition and examples of fields, extension of fields, finite and infinite extensions, algebraic and transcendental extensions, homomorphisms, isomorphisms and automorphisms, separable and normal extensions, splitting field of a polynomial, extending field morphisms, algebraic closure of a field, finite fields, cyclic of the multiplicative group of a finite field, Galois theory. Complex Analysis: Algebra of complex numbers, conjugates, modulus, argument, roots. Continuity and derivative of a function of one complex variable, holomorphic functions, Cauchy-Riemann equations, harmonic functions. Polynomial and rational functions, transcendental functions such as exponential, trigonometric and hyperbolic functions, logarithm. Paths and contours, contour integral, Cauchy’s theorem, Cauchy’s integral formula, Liouville’s theorem, fundamental theorem of algebra, maximum modulus principle, open mapping theorem, Schwarz’s lemma, Taylor series and Laurent series. Classification of singularities, orders or zeros and poles, winding number, meromorphic...</td>
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functions, Cauchy’s residue theorem, computation of definite integrals using residue theorem, argument principle. Linear fractional transformations, conformal mappings.

**Topology:**
Definition and examples of topological spaces, basis and subbasis of a topological space, subspace topology, limit points, closure and interior, continuous functions, homeomorphisms, product topology, metric topology, quotient map and quotient topology. Connectedness, path-connectedness, compactness, local compactness and one point compactification.


**Functional Analysis:**
Examples of normed spaces (sequence spaces: c, c0, lp spaces; function spaces: C(I, J), C(R), Lp ([0, 1]), Lp(R)), finite dimensional normed spaces, continuous linear maps, Hahn–Banach Theorem, Hilbert spaces, inner product, linear functionals, orthonormal sets.

**Research Methodology:**
Elementary set theory, finite, countable and uncountable sets, logic, relations and functions, axioms.

Elementary combinatorics, combinatorial probability, pigeon-hole principle, inclusion-exclusion principle.

**Miscellaneous Topics:**
Fundamental theorem of arithmetic, divisibility.

### Physical Sciences

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<th><strong>I. Mathematical Physics</strong></th>
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<th><strong>II. Classical Mechanics</strong></th>
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<th><strong>V. Thermodynamics and Statistical Physics</strong></th>
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<th><strong>VI. Atomic &amp; Molecular Physics</strong></th>
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| 2 | **VII. Condensed Matter Physics** |

VIII. Nuclear and Particle Physics

IX. Electronics
Semiconductor devices (diodes, junctions, transistors, and field effect devices), device characteristics. Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits).

X. Research Methodology and Experimental Methods
Data analysis. Error estimation. Measurement of electrical resistivity, Hall coefficient, magnetic susceptibility and thermal conductivity. Interference and diffraction experiments. Spectroscopic measurements such as Zeeman effect, Electron Spin Resonance, and Raman effect. Experimental determination of fundamental constants such as Planck’s constant, e/m, and Boltzmann constant.

3

Chemical Sciences – CHEH

Research Methodology
Analytical chemistry, chromatographic separation, crystallization, spectroscopic techniques, electro- and thermoanalytical methods. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Organic Chemistry
1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
13. Structure determination of organic compounds by IR, UV - Vis, 1H &13C NMR and Mass spectroscopic techniques.

Inorganic Chemistry
1. Chemical periodicity: Classification of elements and periodicity in properties.
2. Molecular Structure and Bonding: Valence bond theory, molecular orbital Theory, VSEPR theory.
5. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
6. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
7. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
8. Organometallic compounds: synthesis, bonding and structure, and reactivity, Organometallics in homogeneous catalysis.
9. Cages and metal clusters.
10. Bioinorganic chemistry; photosystems, porphyrins, metalloenzymes, oxygen transport, electron-transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques, activation analysis, principles of determination of age of rocks and minerals, and Radio-carbon dating.
12. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-Vis, NQR, MS, electron spectroscopy and microscopic techniques.

Physical Chemistry
1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell’s relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
12. Solid state: Crystal structures; Bragg’s law and applications; band structure of solids.
13. Polymer chemistry: Molar masses; kinetics of polymerization.
The pattern of JNU 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Post-Graduate Diploma in Big Data Analytics (PGD)

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<td>School of Computational Biology and Bioinformatics – Track 1 – TRDH (903); Track 2 – TRTH (909) &amp; Track 3 – TRDH (910)</td>
<td>Section 1: Physics: <strong>Mathematical Physics</strong>: Linear vector space; matrices; vector calculus; linear differential equations; elements of complex analysis; Laplace transforms, Fourier analysis, elementary ideas about tensors. <strong>Classical Mechanics</strong>: Conservation laws; central forces, Kepler problem and planetary motion; collisions and scattering in laboratory and Centre of mass frames; mechanics of system of particles; rigid body dynamics; moment of inertia tensor; noninertial frames and pseudo forces; variational principle; Lagrange's and Hamilton's formalisms; equations of motion, cyclic coordinates, Poisson bracket; periodic motion, small oscillations, normal modes; special theory of relativity – Lorentz transformations, relativistic kinematics, mass–energy equivalence. <strong>Electromagnetic Theory</strong>: Solution of electrostatic and magnetostatic problems including boundary value problems; dielectrics and conductors; Biot-Savart's and Ampere's laws; Faraday's law; Maxwell's equations; scalar and vector potentials; Coulomb and Lorentz gauges; Electromagnetic waves and their reflection, refraction, interference, diffraction and polarization, Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves; radiation from a moving charge. <strong>Quantum Mechanics</strong>: Physical basis of quantum mechanics; uncertainty principle; Schroedinger equation; one, two and three dimensional potential problems; particle in a box, harmonic oscillator, hydrogen atom; linear vectors and operators in Hilbert space; angular momentum and spin; addition of angular momenta; time independent perturbation theory; elementary scattering theory. <strong>Thermodynamics and Statistical Physics</strong>: Laws of thermodynamics; macrostates and microstates; phase space; probability ensembles; partition function, free energy, calculation of thermodynamic quantities; classical and quantum statistics; degenerate Fermi gas; black body radiation and Planck's distribution law; Bose-Einstein condensation; first and second order phase transitions, critical point. <strong>Atomic and Molecular Physics</strong>: Spectra of one- and many-electron atoms; LS and jj coupling; hyperfine structure; Zeeman and Stark effects; electric dipole transitions and selection rules; X-ray spectra; rotational and vibrational spectra of diatomic molecules; electronic transition in diatomic molecules, Franck- Condon principle; Raman effect; NMR and ESR; lasers.</td>
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**Section 2: Chemistry:**  
Organic Chemistry, Stereochemistry  
Properties of gases, kinetic theory  
Thermodynamics  
Chemical Bonding, Oxidation states, electrochemistry  
Molecular Structure, spectroscopy  
Chemical Kinetics  
Quantum Mechanics  
Statistical Mechanics  
**Section 3: Mathematics/Statistics:**  
Advanced Differential Equations: Existence and uniqueness theorem, Sturm comparison and separation theorem, homogeneous linear system, Non-homogeneous linear system, linear system with constant coefficient, Two-point boundary value problems, Green function, Construction of green function, Sturm-Liouville system, Non-linear Differential Equation, Solution of PDEs by method of integral transforms (Laplace and Fourier), Boundary value problem, Maxima and minimum principles, Uniqueness and continuity Theorem.

Special Function: Calculus of Variation-Functional and its properties, Variational problems with fixed boundaries, Legendre polynomial and functions, Christoffel's summation formula, Bessel's Function, Modified Bessel's function, Bessel's equations, Hermite polynomials, Laguerre polynomials.


Section 4: Computer Science and Programming

Computer Organization and Architecture
Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Programming and Data Structures
Programming in C, Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Algorithms
Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths.

Theory of Computation
Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.

Compiler Design
Lexical analysis, parsing, syntax-directed translation, Runtime environments. Intermediate code generation.

Operating System
Processes, threads, inter-process communication, concurrency and synchronization. Deadlock, CPU scheduling. Memory management and virtual memory. File systems.

Databases
ER-model. Relational model, relational algebra, tuple calculus, SQL, integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.
**Computer Networks**
Basics of Wi-Fi, Network security; authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

**Section 5: Life Sciences/Biotechnology**
Biomolecules & Cellular Organization, Fundamental Processes, Basic Concepts in Genetics & Immunology, Developmental Processes, Genome Structure & Organization, Gene Expression and Regulation, Basic Techniques in Molecular Biology and Recombinant DNA Technology

**Section 6: Bioinformatics**
Sequence analysis and alignment algorithms, Phylogenetic Analysis, Sequencing Technologies, Structural Bioinformatics, Advanced concepts in sequence analysis, Genomics and Transcriptomics

**Section 7: Electronics Engineering**
Networks, Signals and Systems
Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thévenin and Norton’s, maximum power transfer; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits, Laplace transform, Linear 2-port network parameters: driving point and transfer functions.
Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals, Z-transform, LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure.

**Electronic Devices**
Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and reactivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJTs, MOS capacitor, MOSFET, LED, photo diode, Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography.

**Analog Circuits**
BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and opamp configurations; Function generators, wave-shaping circuits and 555 timers.

**Digital Circuits**
Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates, arithmetic circuits, code converters, multiplexers, decoders, Sequential circuits: latches and flip-flops, counters, shift-registers. Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

**Communications**
Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, Information theory: entropy, mutual information and channel capacity theorem ; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

**Satellite communication**
Introduction, need, satellite orbits, advantages and disadvantages of geostationary satellites. Satellite visibility, satellite system - space segment, block diagrams of satellite sub systems, up link, down link, cross link, transponders (C-Band)

**Local area networks (LAN)**: Primary characteristics of Ethernet-mobile IP, OSI model, wireless LAN requirements-concept of Bluetooth, Wi-Fi and WiMAX.

**Electromagnetics**
Electrostatics; Maxwell’s equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection
and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

**Microwave and Antennas**

Introduction & Wave Propagation Review of Maxwell’s equations, Integral and Point forms; Boundary conditions; Power flow and Poynting vector; Propagation of uniform plane waves, Wave equation; Polarization, Scalar and Vector Potential functions, Retarded Potentials; Radiation phenomenon and equation, Basic antenna parameters, radiation resistance, Gain, directivity, Effective length, Radiation pattern; Radiation from short current loop, Radiation from arbitrary current distribution, half wave dipole antenna; Antenna impedance, Monopole antenna, Baluns, Antenna array: Broadside array and end-fire arrays, long wire antenna; Few antenna types: Folded dipole, Loop antenna, Yagi-Uda Antenna; Wave propagation, Travelling waves, Lossless and Lossy transmission lines, pulse propagation; Principle, construction and working of Microwave solid state devices: Transferred Electron devices: Gunn Diode (Gunn Effect), IMPATT diode, PIN diode Attenuators, Terminators, Directional couplers; Hybrid Circuits

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**9. SCHOOL OF ARTS & AESTHETICS**

The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

**Master of Arts**

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<tr>
<th>Sl. No.</th>
<th>Name of School &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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</table>
| 1      | School of Arts & Aesthetics (SA&A) Arts & Aesthetics-SAAM (235) | Note: Candidates attempting the entrance exam of the integrated MA should have a broad sense of the areas listed under all the three streams of the School – Visual Studies, Cinema Studies and Theatre and Performance Studies. Questions set by the School typically ask questions that assess the candidate’s ability to reflect upon and critically engage with themes and issues related to art.

**Visual Studies**

Broad knowledge of the history of world art in general, and of art in South Asia, from Indus Valley Civilization till the present, in particular. Candidates should have an understanding of formal, stylistic and iconographic aspects of South Asian art and be able to place them in their literary, cultural, historical, religious and liturgical context. In addition, a broad knowledge of the history of Western Art, from the Renaissance to the present day, and of the history of Asian art, including Far Eastern and Islamic art, are valuable. An awareness of current debates and new developments around art, heritage, museums and exhibitions is important, with an emphasis on the ability to critically engage with issues and themes related to art.

**Cinema Studies**

Broad knowledge of World Cinema, Film movements, Digital Media Cultures and, Film/Media Practice. There should be awareness of film media’s status as an aesthetic practice, a mass cultural form and an instigator of public debates. Candidates should display their knowledge of the public presence of cinema/media and the way certain film practices get linked to political controversies, festival bans, censorship debates and vandalism at exhibition venues. Some knowledge of the role of film criticism and writing about cinema in the popular press will be helpful.

**Theatre and Performance Studies**

Broad knowledge of the history of theatre and dance including classical Greek theatre, Elizabethan theatre, classical Indian theatre, music, dance and performance
cultures, bhakti performance traditions in India, modern theatre and contemporary performance practices. Some familiarity with dance in the larger context of Indian dance history, relationship of dance and society. Likewise, an engagement with musical traditions, both classical and popular. Some awareness of basic concepts like rasa and catharsis, the dynamics of body, space and time in different theatrical and dance traditions, the role of the actor/performer and spectator. Basic knowledge of the theoretical writings of Bharata, Bhatkhande, Kapila Vatsyayan, Susan Foster, Stanislavski, Brecht, Augusto Boal, Badal Sircar. An ability to see performances critically with an awareness of their social and political contexts. Emphasis on the capacity to describe the performances of everyday life, including festivals, rituals and ceremonies experienced at a local level within specific regional contexts.

**Ph.D.**

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<td>Ph.D. : Visual Studies – VSAH (900)</td>
<td>Note: The programme is suited for students who come from a background in Visual Studies/ Art History and related disciplines. Candidates are expected to already be familiar with the discipline of art history and its theoretical concerns in general and with the development of Indian art and architecture in particular. To appear for the entrance exam, prospective candidates should have a broad understanding of the intellectual history of the discipline and key philosophical concerns of image theories. They should be familiar with the topics listed below which are areas covered by Masters-level programmes. Questions set by the School are designed to assess the candidate’s ability to reflect upon and critically engage with themes and issues related to art and visual culture.</td>
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**School of Arts & Aesthetics (SA&A)**

- Candidates appearing for the entrance examination should be familiar with the following:
  - Contribution of theorists whose work has shaped/ impacted art historical, critical and anthropological discourse on the visual arts and visual culture.
  - Research: Methodology and Historiography of the discipline: art criticism and art history writing and archival structures as subjects of inquiry and meta-critical practices.
  - Artworks as modes of symbolic communication and methodologies of decipherment of visual codes and visual language systems.
  - Methodological approaches to interpreting the visual: iconography, semiotics, formalism, cultural materialism, psychoanalysis, narratology, phenomenology, affect theory, theories of gender, feminist and post-colonial critiques.
  - The entanglements of ethno-nationalism and art history
  - The interrelationship of textual and visual traditions in Indian art.
  - The social and political conditions that govern the agency of art and artists and impact visual representations.
  - The relationship between political, economic and liturgical institutions and monumental built forms.
  - Current debates about the agency and representation of caste, class and gender in pre-modern arts.
  - Capitalism, individualism and the relationship with artistic authorship.
  - Debates around authorship in Indian art.
  - Concepts of space and place in architecture and spatiotemporal understanding of built form including relationships between architecture and ritual performance.
  - The network of institutional agencies in which art works are embedded. Institutional critique and its own institutionalization.
  - Iconophilia, iconopraxis and iconoclasm.
  - Sectarian competitiveness and the “clash of icons.”
  - Technologies of art-making, intentionalties of choice and theoretical understanding of creative labour.
  - Interactivity, community art and relational aesthetics in contemporary visual culture.
  - The construction of heritage vis a vis national and global framework.
  - Photography theory, digital convergence and “remediation.”
| 2 | Ph.D.: Theatre & Performance Studies - TPSH (901) | Note: Theatre and Performance Studies covers a wide range of subjects, including the history of theatre, dance and music with a particular focus on the study of embodied performance. Students appearing for the entrance exam for the Theatre and Performance Studies stream should have some broad knowledge of the intellectual concerns and issues linked to the discipline. They should be familiar with the topics listed below which are areas covered by Masters level programmes. Questions set by the School are designed to assess the candidate’s ability to reflect upon and critically engage with themes and issues related to theatre and performance. 

Candidates appearing for the entrance examination should be familiar with the following:

- Concepts related to performance and aesthetics, such as rasa, dhvani, catharsis, tragedy, alienation, corporeality, embodiment, liminality, efficacy;
- Basic knowledge and understanding of the discourse around primary texts such as Natyasastra, Dvanyaloka, Abhinaya Darpana and The Poetics;
- Institutions of performance such as National School of Drama, Sangeet Natak Akademi, Ninasam, Kalakshetra, Kalamandalam;
- Sufi and bhakti performing arts traditions;
- Regional culture and performance practices (theatre, dance, music, puppetry and others) in India;
- Histories and theories of political theatre;
- Histories of Indian musical traditions;
- Histories of traditions and transitions in dance;
- Feminism, gender and performance;
- Comic traditions in performance;
- Nation, nationalism and performance;
- Post-colonial performances;
- Debates in modern Indian theatre, music and dance.
- Applied theatre and performance;
- Street theatre;
- Globalisation and performance;
- Performance art
- Discourses, theories and research methodologies around the emergence of disciplines of theatre and performance studies, dance studies, music studies. |

| 3 | Ph.D.: Cinema Studies - CNSH (902) | Note: The programmes draw students either from a background in Cinema/Film Studies or from other disciplines with an interest in the subject. Students appearing for the entrance exam for the Cinema Studies stream should have some broad knowledge of the intellectual concerns and issues linked to the discipline. They should be familiar with the topics listed below which are areas covered by Masters level programmes. Questions set by the School are designed to assess the candidate’s ability to reflect upon and critically engage with themes and issues related to cinema including:

- Indian Cinema History
- Globalization and Indian Cinema
- National Cinema Debates
- International Film Movements (Added)
- Issues and Debates in Research Methodology
- Media and Cultural Studies
- Sound and Colour in the History of Cinema (Added)
- Authorship Debates
- Theories of Genre
- Melodrama: Forms and Histories (Added)
- Film Stardom and Celebrity Culture
- Early Debates and Discourses on Film
- Modernism, Mass Culture and Cinema
- Media Aesthetics
- Space, Architecture and Cinema (Added)
- Film/Media: Sound and Colour (changed from Sound and Colour in the History of cinema)
- Theories of the Cinematic Avant Garde
- The Cinematic Apparatus
- Cinema and the Postmodern
- Television and Video Theory
- Post Cinematic and Post Celluloid Debates
- Media Sensorium and Media Archaeology Debates |
## 10. SCHOOL OF BIOTECHNOLOGY

The pattern of JNU-2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

**Ph.D.**

|--------|----------------|-----------------------------|----------------------------------|
| 1      | School of Biotechnology | Biotechnology – SBTH (904) | **Biophysical Chemistry:**  
1. **Interactions in Biological Systems:** Intra and inter molecular forces, electrostatic interactions and hydrogen bonding interactions; van der Waals and hydrophobic interactions; Disulfide bridges; Role of water and weak interactions  
2. **Structure of Proteins:** Conformational properties of polypeptides; Primary and secondary structure (α-helix and β-sheet structures etc.); Tertiary and quaternary structure; Structural features of membrane proteins; Secondary and tertiary structure prediction of protein conformation  
3. **Multiple equilibrium:** Titrations of proteins to evaluate net and total charge; Scatchard and Hill plots; Folding-unfolding equilibrium and denaturation of proteins; Effect of temperature and solvent conditions on the thermodynamics of protein folding-unfolding equilibrium and Kinetics of protein folding.  
4. **Techniques for the study of Macromolecular structure:** Analytical Ultracentrifugation; Sedimentation velocity and equilibrium, determination of molecular weights; Microcalorimetry (DSC and ITC) and its applications; Circular Dichroism spectroscopy; UV, Visible and Fluorescence spectroscopy; X-ray diffraction; Nuclear Magnetic Resonance (NMR) and Mass Spectrometry.  

**Biochemistry & Enzymology**  
1. **Enzyme Kinetics and Inhibition:** Introduction about enzymes, classification, activity, cofactors; Chemical Kinetics; Regulation of enzyme activity by various factors such as pH, temperature etc.; Enzyme Inhibition- various types with examples; Kinetics of enzyme inhibition; Enzyme activity and purification-subcellular fractionation and specific activity  
2. **Enzymes:** **Mechanism, Structure and Regulation:** Substrate specificity of enzymes; Functional Groups Essential for Catalysis; Reaction Mechanism of Enzyme Active sites; Regulatory Enzymes; Allosteric Enzymes; Covalently modulated regulatory enzymes; Covalent Activation of Zymogens; Isozymes  
3. **Regulatory Strategies of Enzymes:** Aspartate Transcarbamylase, Protein Kinase A, Myosin, Restriction Enzymes, Lactate Dehydrogenase, Ser/Thr Kinases, Tyr Kinases; Proteolysis Activation, Blood clotting Factors  
4. **Glycobiology:** Sugars, glycoproteins, glycoconjugates, glycosylation of biomolecules, disorders associated with glycosylation defects  
5. **Introduction to Metabolism:** Metabolic Pathways; Organic Reaction Mechanisms;
6. **Carbohydrate Metabolism**: Glycolysis; Fermentation: The Anaerobic Fate of Pyruvate; Metabolism of Hexoses Other than Glucose; Glycogen; Breakdown & Synthesis; Gluconeogenesis; Pentose Phosphate Pathway; Metabolic Regulation and Control

7. **Citric Acid Cycle**: Cyclic Overview; Metabolic Sources of Acetyl; Coenzyme A; Enzymes of the Citric Acid Cycle; Regulation of the Citric Acid Cycle

8. **Electron Transport and Oxidative Phosphorylation**: The Mitochondrion; Electron Transport; Oxidative Phosphorylation; Control of ATP Production

9. **Lipid metabolism**: Lipid Digestion, Absorption and Transport; Fatty Acid Oxidation & Biosynthesis; Ketone Bodies; Regulation of Fatty Acid Metabolism

10. **Amino Acid Metabolism**: Role of essential amino acids; Amino Acid Deamination; The Urea Cycle; Metabolic Breakdown of Individual Amino Acids; Amino Acids as Biosynthetic Precursors; Amino Acids Biosynthesis; Nitrogen Fixation

11. **Nucleotide Metabolism**: Synthesis of Purine Ribonucleotides; Synthesis of Pyrimidine Ribonucleotides; Formation of Deoxyribonucleotides; Nucleotide Degradation; Biosynthesis of Nucleotide Coenzymes

**Bio-organic Chemistry:**

1. **Introduction to organic compounds**: Classification of organic compounds
   To familiarize the students with the basic notations used in organic chemistry to describe the name, structural representation, and orientation of organic compounds.
   To familiarize the students with the basic understanding of the various functional groups those are present in many organic compounds, their synthesis and properties.
   **Stereochemistry of organic compounds**: To understand the perspective and spatial orientation of atoms in an organic molecule, to compare and contrast the different arrangement of atoms or groups around carbon.

2. **Reaction Mechanisms**: To understand the mechanistic pathways of organic reaction.
   To understand the importance of steric and electronic influences of both reactant and reagents on the product formation or distribution.
   The aim of this unit is to provide detailed exposure to some of the key areas of organic chemistry namely aliphatic and aromatic nucleophilic and electrophilic substitution reactions, elimination reactions, and free radical reactions. The students will be able to recognize the direction of electron flow (use of curvy arrows) in reaction mechanisms and knowledge of the relative stability of intermediates, prediction and/or explaining the products of reactions.

3. **Name reactions and Spectroscopy**: To understand the importance of specific reagents for a specific transformation.
   To understand how the organic compounds can be characterized.
   To understand how to identify the various functional groups those are present in organic compounds.
   To enhance the working knowledge and understanding of some of the synthetic reactions that are widely used in organic chemistry.
   Name reactions will be very much useful to help them gain insights into the numerous approaches that are used in various complex synthetic transformations.

4. **Heterocyclic Chemistry of Bioorganic Compounds**: To identify and name the mono cyclic and bicyclic systems containing hetero atoms (atoms other than C and H); To understand how different heterocycles can be prepared from simple starting materials; To study how heterocycles can be interconverted.
   The study of heterocycles (their nomenclature, synthesis, and reactions) will allow the students to learn the reactions that are useful for designing and interconverting therapeutically important compounds.
5. **Chemical Synthesis of Biomolecules**: To identify and draw the carbohydrates structure using Fischer, Haworth and chair projection and their inter conversions; To understand how glycosylation reactions occurs and neighboring group participation effects; To study how Glucose structure was elucidated by Fisher (Kiliani-Fisher synthesis, Ruff degradation, osazone formation, oxidation); Nucleic acid synthesis (phospho diester, triester methods, phosphoramidite chemistry, protection-deprotection strategies, modification of 2’ OH); Peptide synthesis (SPPS), Protein synthesis.

Mathematics and Statistics:

1. **Basic study of Calculus**: Functions and Graphs, Limits and Continuity, Introduction to Differential equations and Integrations, definite and indefinite integrals, Integration by parts
2. **Basic Algebra and Trigonometry**: Determinant and Matrix, Arithmetic and geometric Progressions, Compound, Multiple and sub multiple angles
3. **Basic coordinate Geometry**: Straight line, circle, ellipse, parabola
4. **Basic concept of computer Programming**: Logical operations, Simple mathematical algorithms, Looping and Concept of rows and column operations
5. **Introduction to MATLAB**: Basic syntaxes, Analysis of Matrix using MATLAB, Analysis of the Data obtained from simple biological experiments using self-written programs (Data from UV-Vis spectra, Fluorescence spectra) Image analysis using simple microscopic images, analysis of basic mathematical models (radioactive decay functions, logistic growth etc.).

Bioinformatics:

1. **Biological data**: Nature of biological data and its structure; High-throughput data, it's generation and analysis basics.
2. **Biological database**: Bioinformatics basics, Introduction to Unix and Linux systems and basic commands; Database concepts; Protein and nucleic acid databases; Sequence file formats; databases and search tools: searching of databases similar sequence; NCBI; publicly available tools; resources at EBI; resources on web; database mining tools.
3. **Sequence Analysis**: Introduction to sequence alignment; substitution matrix; pairwise alignment; Scoring matrices, FASTA, BLAST; Statistical significance of alignment; motif discovery and gene prediction
4. **Multiple Sequence Alignment**: Multiple sequence alignment, CLUSTAL, MUSCLE, MAFFT, T-Coffee, distance matrix
5. **Phylogenetic Analysis**: Phylogenetic analysis; tree building methods, UPGMA, NJ; Maximum Parsimony; Maximum Likelihood; Software for phylogenetic analysis
6. **Structural Biology**: Structural databases; PDB File format; Peptide Bond, Phi-psi and chi torsion angles; Ramachandran Plot; Introduction to force field methods; Structural Classification; fundamental of protein modelling; homology modelling; ab initio modelling
7. **Biological Data security, privacy, safety and sharing**: Need for data security, Data privacy, Responsible sharing of biological data, Data ownership, Socio-legal issues around biological data.
8. **Future of Biological Data**: Where is the field going? Data size implications and its implications in future biological science research, New methods to deal with biological data complexity.

Molecular Biology of Prokaryotes:

**Brief introduction to molecular biology & processes**: Denaturation and renaturation of DNA. Tm, GC content from Tm. Renaturation kinetics of DNA and complexity of DNA. Cot curves. DNA-DNA hybridization-relatedness of difference genes and species.

**Bacterial Genome organization**: Evolution of genome, Genome content, C-value paradox,
### Packing ratio, density of genome

Bacterial genome. Short- and long range organization, Proteins associated with bacterial genome & their function.


**Replication:** Elucidation of DNA structure and lead to copying mechanism. Models for DNA replication, Meselson and Stahl experiment 1957. Replication of the E. coli genome: John Cairns experiments: Single origin of replication, and bidirectional replication, Ross Inman's experiment- denaturation mapping studies. Mechanism of replication: Theta, rolling circle (sigma), D-loop, Semi discontinuous replication; Pulse chase experiment, Okazaki’s experiment on T4 bacteriophage DNA. Use of T4 ligase mutants. Origin of replication— Commonality among E. coli, yeast and SV40 origin of replication


**Mutations and Repair:** Mutants, Mutations and Mutagenesis: definition, reasons, measuring mutagenicity. Classifications of mutations: On the basis of location, structure, function and phenotype. Conditional, spontaneous and induced mutations. Missense, nonsense, frameshift mutations, Reversions. Mutagenic agents_ high energy, chemical and natural. Suppressor RNA, missense repressors, frameshift suppressors

Repair: DNA repair: Mismatch repair, Base excision repair, nucleotide excision repair, direct repair, enzyme of repair, Error prone repair, SOS response

## Immunology:

1. **Introduction to the Immune System**: Historical background, cellular and molecular components of immune system
2. **Innate Immunity**: Innate immune cells, Pathogen associated molecular pattern (PAMP), Pathogen recognition receptors (PRR), Type 1 IFN, Interferon Stimulated Genes (ISGs), Complement system.
3. **The Recognition of Antigen**: Structure of a typical antibody molecule, Antigen recognition by T cell and B cells, Generation of lymphocyte antigen receptors, TCR gene rearrangement, Antigen presentation to lymphocytes, MHC/HLA complex.
4. **The Development and Survival of Lymphocyte**:
The development of T lymphocytes in the thymus, Development of B lymphocytes, Positive and negative selection of T cells, Maturation of lymphocytes in peripheral lymphoid tissue.
5. **The Adaptive Immune Response**: T cell mediated immunity, Entry of naive T cells and APCs into peripheral lymphoid organs, Naive T cells priming by pathogen-activated dendritic cells, T cell-mediated toxicity, Macrophage activation by TH1 cells, humoral immune response, Immunological memory, Cytokines.
6. **Immune system in Disease**: Self-tolerance, autoimmune diseases, transplant rejection, allergy and anaphylactic shock, AIDS immunology
7. **Immune aging**: Immunosenescence, Immune-exhaustion during aging and chronic infection, Mucosal Immunology
8. **NK cells and Cancer**: Inhibitory receptors, KIR receptors, CTL responses in cancer, Immunotherapy
9. **Characterization of lymphocytes specificity, frequency and function**: Lymphocyte isolation, ELISPOT assay, Multicolor flow cytometry, HLA-tetramer assay
10. **Vaccines**: History of vaccinology, attenuated vaccine, heat killed vaccine, subunit vaccine, recombinant vaccine, DNA vaccine, dendritic cell based vaccine, VLPs, T-cell based vaccine, edible and therapeutic vaccines. Vaccine against cancer, Adjuvants and their role in vaccine.

### Plant biotechnology:

1. **Prologue to Plant’s World**: Plant and human society; Growth and development; Plant hormones; Photosynthesis
2. **An Introduction to Plant Genetics**: Plant genome organisation; Organellar Genome, Polyploidy; Genetic diversity; Molecular markers and mapping;
Phylogenetics and genomics; Breeding and methods; Forward vs. reverse genetics; Discussion;

3. **Basic Aspects/Techniques of Plant Tissue Culture:** Introduction; Totipotency and Regeneration; Nutritional media and growth regulators; Haploid production, Problems in plant tissue culture; Discussion.

4. **Transgenic Crops:** Plant Transformation methods, Agrobacterium Biology, Molecular characterization of transgenic plants, Global status of transgenic crops; Traits under development; Case Studies; Challenges; Discussion

5. **Applications:** Crop improvement; Plant Molecular farming (Bioreactors); Renewable energy; Bio-fortification for Human Health; Discussion

6. **Safety and Regulations:** Understanding issues encountered in plant biotechnology; Risk assessment; Environmental impact and gene flow; Regulation and labelling; Discussion.

**Microbiology:**

1. **Bacterial diversity**
   How to classify Bacteria; Chemical/Biochemical reactions; Nutrient preference and other biochemical properties; 16s rRNA base classification; Three domains of microorganisms.

2. **Diversity of bacterial flora in humans**
   Diversity of microorganisms associated with different anatomical areas in humans; Alterations in microbiome diversity with diseases.

3. **Structure and functions of the prokaryotic cells**
   Peptidoglycan structure and biosynthesis; Cell surface proteins and their role in bacterial pathogenesis; Structure and biosynthesis of cell surface organelles; Chaperone— usher pil in gram negative bacterial; Covalent anchorage of cells surface proteins in gram positive bacteria.

4. **Bacterial host pathogen interaction**
   Mechanisms of bacterial pathogenesis; Bacterial structure in relation to pathogenicity; Bacterial proteins toxins/endotoxins.

5. **Antimicrobial agents used in the treatment of infectious diseases**
   Mechanism of antibiotic actions; Antibiotic resistance.

6. **Basic concepts of virus structure**
   Helical Symmetry; Icosahedral Symmetry.

7. **Origin of viruses**
   Different hypothesis; Viral eukaryogenesis.

8. **Emerging and re-emerging viral diseases**
   Emerging viral infections as public health threats; Factors effecting re-emergence of viruses.

9. **Viral genome replication**
   Double stranded DNA virus; Single stranded DNA virus; Single stranded RNA virus; Double stranded RNA virus; Retrovirus.

10. **Molecular genetics of viruses**
    Mutation rates and outcomes; Phenotypic variations by mutations; Recombination

11. **Molecular pathogenesis**
    Animal models; Methods for the study of viral pathogenesis

12. **Viral immune evasion strategies**
    Innate immunity; Adaptive immunity.

13. **Antiviral chemotherapy- Mechanism of action**
    Viral genome replication inhibitors; Viral entry, exit and maturation inhibitors

14. **Modern approaches to virus control**
    Antisense RNA, siRNA, ribozymes and miRNA

15. **Construction of recombinant viruses for therapeutic purpose**
Eukaryotic Molecular biology and Genetics:

1. **Introduction to molecular genetics**: Basic concepts for gene, gene analysis, gene-function and genome of different model organisms (Archaea to Human). General genome characteristics of the model organisms, Comparative genome structure analysis of the prokaryotes and eukaryotes.

2. **Fundamentals of human genetics**: Physical structure of the gene, Mendel’s laws, alleles & genotypes, Segregation patterns, Deviations from mendelian principles, Penetrance and Expressivity, Statistical methods used in genetics, Organization of the human genome, Techniques to study human chromosomes, DNA methylation and histone code.


4. **Genes in pedigrees and population**: General concepts of the genetics and gene inheritance, interdisciplinary (e.g. Mathematical, statistical, computational approaches etc). Inherited disease symptoms to genetic analysis. Early days of gene hunting; Use of microsatellite markers for identifying disease genes for monogenic diseases such as haemophilia and cystic fibrosis, Mendelian pedigree patterns, Factors affecting gene frequencies, Hard-Weinberg relationship.

5. **Genomics**: The mapping and sequencing of genomes: Approaches and milestones in genetic and physical mapping of the human genome, Disadvantages of advantageous previous gene hunting methods for complex disorders such as type 2 diabetes, Human genome project, HapMap project 1000 genome project, linkage disequilibrium, Role of genome wide association studies (GWAS) in understanding complex disease genomics, Advantages and limitations of association studies, Genomic libraries, DNA sequencing and analysis of DNA, Comparative genomics: Tools and applications.

6. **Genetic models for studying mammalian development and diseases**: Study of model organisms, comparative genomics and evolution, Concept of G-value paradox, Selection, Invertebrate model & vertebrate model (one each example).

7. **Basics human epigenetics and its applications**: Basic concepts, Chromatin conformations: DNA methylation and the histone code, Epigenetic memory & imprinting in humans, ENCODE project, Different available methods and their comparisons.

8. **Pharmacogenetics, personalized medicine and population screening**: Pharmacogenetics, Pharmacogenomics, Genetic differences affecting metabolism of drugs taking warfarin as an example, Personalized medicine, Testing for susceptibility to complex diseases, Population screening.

9. **Introduction to Eukaryotic Molecular Biology**: How to read a paper. The evolution of a Cell with Nucleus, Hypothesis vs speculation in science, Rationalization of hypothesis, Experimental tools, Eukaryotic genome, gene expression and cell fate.

10. **Dynamic genome – 3 D cell, dynamic genome architecture in nuclear space, chromatin movement, microscopes, microarrays and chromosome capture assays chromatin mobility and principle of nuclear organization, Nuclear architecture and gene-gene interaction, gene kissing, transcription factories, structural constraints on chromatin mobility (5L)**

11. **Nuclear Matrix and gene regulation**: Nuclear matrix, nuclear matrix proteins, nuclear-matrix, structure and function, DNA Binding Properties of the Nuclear Matrix
12. **Association of chromosome territories with the nuclear matrix**: Disruption of human chromosome territories correlates with the release of a subset of nuclear matrix proteins, nuclear matrix targeting, signal, higher order chromatin structure and unclear matrix, transcriptional repression & nuclear lamina, nuclear matrix & expression of globin gene.

13. **Principle of eukaryotic Gene regulation**: gene regulating sequences, promoter, enhancers, regulatory elements, locus control region, gene activation and gene repression, transcription activators and repressors, TBP, GTFs, TBP associated factors (TAFs), RNA polymerases I,II,III, structure and function, mediators, general transcription factors, classes of transcription factors, structure and function, DNA-protein recognition in genome, Transcriptional regulatory networking, gene expression and Cancer progression

14. **Programmed cell death**: Apoptotic and necrotic cell death, apoptotic and anti-apoptotic genes, tumour suppressor genes, cell fate through decision between cell cycle arrest and apoptosis.

15. **Gene regulation and disease**: Order vs disorder in transcriptional regulation, network disfunction and disease, transcriptional therapeutics in diseases control.

**Cell Biology**:

1. **Composition and organization of biological membranes**: Membrane lipids: Types, properties and how they affect the curvature and fluidity of the membrane; lipid rafts: composition, a platform for organization of signalling complexes
   Membrane proteins: Properties and orientation in biological membranes; membrane composition and curvature, Membrane asymmetry, methods to study diffusion in membranes.

2. **Cellular transport mechanisms**: Principles of transport of small molecules across membrane: Organization and functioning of carriers and channels, membrane potential, action potential and membrane excitability
   Protein transport across membranes: Transport across the nuclear pore; Transport across ER and from ER to other organelles by vesicular transport; Post-translational modifications of proteins and their role in protein transport; Endocytosis, phagocytosis, exocytosis.

3. **Cell Cycle**: Components of cell cycle regulatory mechanisms: Cyclin-CDK complexes, CKIs and ubiquitin ligases in cell cycle regulation; Cell Cycle control mechanisms: Checkpoints, Regulation and maintenance of G1, control of genome replication, DNA damage and cell cycle regulation; Cell cycle defects and cancer; Key defects in cell cycle regulation and transformation.

4. **Cell Signaling and Crosstalk**: Introduction: General Principles of cell communication, cell surface receptors and nuclear receptors, intracellular signalling and mechanisms.
   Cell Surface Receptors: regulation and signaling of G-protein-coupled receptors, G-proteins, cAMP dependent & c-GMP dependent pathways,
   Receptor Tyrosine kinase mediated signalling pathways- EGFR and IGF1 mediated cell signalling and effects to cell apoptosis and cell proliferation. The pathway involving Ras and MAPK will be discussed in detail.
   Phosphoinositol & PI3Kinease- AKT signalling pathway, Ser/Thr Kinase mediated signalling, His-Kinase mediated signalling pathway and two component signalling pathway.
   Proteolysis based signaling (Wnt, Notch, Hedgehog): Structural and functional basis for normal and abnormal signalling.
   Cross-Talk Between Different Intracellular Pathways: Interactions between GPCRs and tyrosine kinase receptors; cross-cascade signaling of proteins involved in gene transcription. (Example: Cross talk between pattern-recognition receptors and Toll-like receptors.

Cytoskeletal Protein Signaling network affecting cell adhesion and migration phenomenon of the cell.

6. **Cellular Mechanisms:** Pathways of cell apoptosis, intrinsic and extrinsic, pathways for cell proliferation; Pathways for autophagy; ER stress and UPR pathways; Effect of glycosylated proteins on cellular Mechanisms of cell.

**Genetic Engineering and its Applications:**

1. **Methods, Tools and Molecular Strategies in Genetic Engineering:** Introduction to genetic engineering, general workflow, potentials and its limitations; Host, vector and steps in cloning; Cloning of cDNA, and construction of cDNA library; Analysis of a cloned DNA fragment using restriction digestion and DNA sequencing; Concept, strategies, general workflow and variant of the PCR; The use of PCR in gene recombination, deletion, insertion and site directed mutagenesis; PCR in molecular diagnostics: Detection of the pathogens, and its potentials; PCR based diagnostics of the minimum residual disease (MRD) with case study; Application of real time (RT) PCR in the study of gene expression; Use of genetic engineering for recombinant protein technology; Expression of foreign gene in E. coli, Baculovirus and Pichia expression systems; Strategies for the production of soluble proteins; Role of integrated OMICS in the genetic engineering; Importance of computational tools and system biology for genetic engineering.

2. **Animal Genetic Engineering:** Methods of introduction of DNA into mammalian cells and Cell synchronization and its importance in the genetic engineering; Transient and stable integration of foreign DNA into mammalian cells; The viral vectors and their use in gene delivery and packaging of retroviral vectors and helper cells for gene therapy; The Adeno viral vector, unarmed Herpes and vaccinia viral vectors and their importance; Principles and methods of the gene targeting for model organism; Strategies for Gene knockouts in animals; Gene disorder and Gene therapy; Development of animal models for gene therapy; Detection of mutations in neoplastic diseases; Immuno - Suicide gene therapy in neoplastic diseases; Somatic and germ line gene therapy in vivo and ex-vivo experiments, Bioethics: Use of genome wide screening in the functional genomics; Recent breakthrough and advances in the genome engineering; Recent trends and development in the gene therapy.

3. **Plant Genetic Engineering:** Introduction to plant tissues culture, Plant transformation (Agrobacterium-mediated, Microprojectile bombardment-mediated and Floral-dip method of plant transformation), cointegrate and binary vector system, CRISPR/Cas9-based precise genome engineering, Transgenic Selection and Regeneration, optimization of transgenic expression, Applications of plant genetic engineering, understanding issues encountered in plant biotechnology, Discussion.

**Downstream Processing:**

1. **Thermodynamic requirements of separation:** Classification of separation processes-equilibrium and non-equilibrium processes. Chief characteristics of bio-separation processes. RIPP: removal of in-solubles, isolation of products, purification and polishing.


3. **Product isolation:** Extraction, principle of extraction, partition coefficient, extraction factor, batch extraction, cascades, idealized stage operation, differential extraction, height of a transfer unit, number of transfer units, adsorption, adsorption isotherms, batch adsorption, adsorption in a CSTR. Aqueous Two Phase Extraction, Supercritical extraction, Foam based separation.

4. **Product Purification:** Chromatography, yield and purity and resolution, Principles of elution chromatography, ion-exchange, hydrophobic interaction, reverse-phase chromatography, gel-filtration chromatography. The concept of resolution, plate height. Protein purification. Synthesis of chromatography trains. Scaling-up
chromatography using PAT/QbD approach.

5. **Membrane filtration**: Tangential flow filtration, micro-filtration, ultra-filtration, reverse osmosis.

6. **Polishing**: Crystallization – separation, purity, nucleation, crystal growth, characteristic length, crystal size distribution, dominant crystal length.

7. **Lyophilisation and drying**

8. **Case study of Monoclonal antibody purification**

**Bioprocess Engineering:**

1. **Basics of bioprocess engineering**: Introduction to bioprocess engineering, Microbial growth and death kinetics; Strain improvement strategies; Ideal and non-ideal reactors; Residence Time Distribution; Elements in bioreactor design – overview of bioreactor, specialised bioreactors, Construction materials, types of bioreactors, components of bioreactors and importance.

2. **Stoichiometry and Models**: Stoichiometry of cellular reactions, reaction rates, dynamic mass balance, yield coefficient and linear rate equations; Material balances and data consistency (the Black box model, elemental balances, heat balance, over determined systems); Metabolic Flux Analysis and Metabolic control analysis: concept and applications.

3. **Bioreactor design and analysis**: Upstream processing: media formulation and optimization; sterilization (medium and air)-thermal death kinetics of microorganisms; aeration, agitation in bioprocess; Analysis of batch and continuous culture; Multi-phase bioreactor system; Scale-up, scale-down. Developments using microbial processes (SmF and SSF), mammalian cell culture, plant cell culture, photobioreactor and CART-cell culture; Gas fermentation: Overview of conversion of gasified biomass and industrial gaseous into value added chemicals.


**Emerging Technologies:**

1. **Systems Biology**: Bimolecular network models, virtual cells, cytoscape

2. **Synthetic Biology**: Standards in biology, logic gates, oscillators, synthetic genes & proteins, synthetic cells

3. **Neurosciences**: Brain computer interface and consciousness: basic concepts & technological review

4. **Photoreceptor Biotechnology**: Development of climate-smart crops with photoreceptor biotechnology, Photoreceptor biotechnology for carbon sequestration and biorefinery, value added products, Artificial illumination for increasing yield and nutritional index of the crops.

5. **Optobiology**: Photoimmunology, Photodynamic therapy, optogenetics therapy, opto-pharmacology and optogenetics for controlling neural networks, behavioral and neuropathies

6. **Genome Biology**: Introduction to Next Generation Sequencing technologies, Whole Genome Assembly and challenges, Sequencing and analysis of large genomes, Gene prediction, Functional annotation, Comparative genomics, Human genome project, Human Genomics Databases, Functional genomics case studies

7. **Data in biology**: Usefulness of data in biology, emerging technology like machine learning and artificial intelligence

8. **Introduction to Microfluidics**: Importance of low volume measurement, Design and fabrication of microfluidic devices, Applications in biomedical sciences

9. **Biosensors and Bioelectronics**: Different types of sensors, optical and electronic biosensor, Nanoparticle plasmonic based optical sensing, fabrication of electronic sensors for impedimetric detection of biomolecules, cyclic voltammetry and immobilization of biomolecules on electrodes for electronic sensing
10. Nanotechnology and its Application: What is Nanotechnology? Different types of Nano materials; their synthesis and characterization; applications in biotechnology and other fields.

Bioentrepreneurship:

1. Innovation and entrepreneurship in bio-business: Introduction and scope in Bio-entrepreneurship. Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g., pharmaceuticals vs. Industrial biotech). Strategy and operations of bio-sector firms: Factors shaping opportunities for innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities. Alternatives faced by emerging bio-firms and the relevant tools for strategic decision. Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

2. Bio markets - business strategy and marketing: Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.


4. Technology management: Technology – assessment, development & upgradation, managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).


Intellectual Property Rights, Bioethics and Biosafety:

1. Introduction to IPR: Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to biotechnology and few case studies; introduction to history of GATT, WTO, WIPO and TRIPS; concept of ‘prior art’: invention in context of “prior art”; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.

2. Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application-forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and conventional patent applications; international patenting-requirement, procedures and costs; financial assistance for patenting introduction to existing schemes; publication of patents-gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; licensing – outright sale, licensing, royalty; patenting by research students and scientists-university/organizational rules in India and abroad, collaborative research - backward and forward IP; benefit/credit sharing among parties/community, commercial (financial) and non-commercial incentives.
3. **National & International Regulators:** International regulations – Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations – EPA act and rules, guidance documents, regulatory framework – RCGM, GEAC, IBSC and other regulatory bodies. Draft bill of Biotechnology Regulatory authority of India - containments – biosafety levels and category of rDNA experiments; field trials – biosafety research trials – standard operating procedures - guidelines of state governments; GM labelling – Food Safety and Standards Authority of India (FSSAI)

4. **Biosafety:** Biosafety and Biosecurity - introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; risk – environmental risk assessment and food safety assessment; problem formulation, risk characterization and development of analysis plan; risk assessment of products derived from RNAi, genome editing tools

5. **Bioethics:** Introduction, ethical conflicts in biological sciences – interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare

**Animal Biotechnology:**

1. **Culture media for animal cell culture:** Media and supplements, serum, serum free media, natural media, feeder layer on substrate, Gas Phase for tissue culture, source of tissue, primary culture; Stages of commitment and differentiation, proliferation and malignancy

2. **Subculture and cell lines:** Cross contamination, terminology, naming and choosing cell line and its maintenance. Criteria for subculture, growth cycle and split ratio, propagation in suspension and attached culture.

3. **Cloning and Hybridoma technology:** Vectors and cloning, somatic cell fusion, hybridomas, HAT selection, Medium suspension fusion, selection of hybrid clones, organ culture

4. **Cell separation and quantitation:** Separation techniques based on density, size, sedimentation velocity, antibody based techniques- immuno panning, magnetic sorting, fluorescence activated cell sorting; Quantitation-cell counting, cell weight, DNA content, protein, rate of synthesis, measurement of cell proliferation.

5. **Cell characterization and differentiation:** Lineage and tissue markers, cell morphology, karyotyping, chromosome banding; Differentiation-commitment, terminal differentiation; Lineage selection, proliferation and differentiation, commitment and lineage, markers of differentiation, induction of differentiation, cell interaction-homotypic and heterotypic; Cell-matrix interaction.

6. **Application of animal biotechnology:** Artificial animal breeding, cloning and transgenic animals, medicines, vaccines, diagnosis of diseases and disorders, gene therapy, forensic application.

**Advances in Protein Chemistry:**

1. Protein Engineering
2. Thermodynamics of protein stability using calorimetry
3. Protein-ligand interaction
4. Mechanisms of protein folding
5. Protein aggregation and amyloid fibril formation.
6. Protein dynamics by Hydrogen-Deuterium(H-D) exchange
7. Fluorescence polarization and fluorescent probes for conformational studies
8. Application of mass spectrometry in sequencing and conformation

9. Protein structure determination by NMR spectroscopy

**Advances in Human Molecular Genomics:**


**Chemical Biology:**

1. **Design of molecules:** Rational Design- Principles of rational design of small molecules for therapeutic and biotechnological purposes; Principles of rational and combinatorial design of macro molecules like designer enzymes/aptamers/DNA origami.

   Combinatorial design- Design of small molecule libraries (organic compounds, peptides) through scaffold design, bio-isostere searching and fragment-based approaches; Design of macromolecular libraries, random mutagenesis and combichem approaches.

2. **Mechanistic enzymology:** Enzymatic red-ox reactions. Baeyer-Villiger oxidation; Polyketide synthesis; Stereo chemical aspects of the conversion of oxaloacetate to citrate Protease (any two); Enzymatic epimerization/racemization reactions (PLP).

**Computational Biology:**

1. **Computational biology basics and biological databases:** Computers in biology and medicine; Overview of biological databases, nucleic acid & protein databases, primary, secondary, functional, composite, structural classification database, Sequence formats & storage, Access databases, Extract and create sub databases, limitations of existing databases.


3. **Genome analysis:** Polymorphisms in DNA sequence. Introduction to Next Generation Sequencing technologies, Whole Genome Assembly and challenges, Sequencing and analysis of large genomes, Gene prediction, Functional annotation, Comparative genomics, Probabilistic functional gene networks, Human genome project, Genomics and crop improvement. Study available GWAS. ENCODE, HUGO projects, extract and build sub databases; Visualization tools including Artemis and Vieta for genome comparison; Functional genomics case studies.

4. **Molecular modelling:** Significance and need, force field methods, energy, buried and exposed residues; side chains and neighbours; fixed regions; hydrogen bonds; mapping properties onto surfaces; RMS fit of conformers and protein chains, assigning secondary structures; sequence alignment: methods, evaluation, scoring; protein curation: backbone construction and side chain addition; different types of protein chain modelling: ab initio, homology, hybrid, loop; Template recognition and alignments; Modelling parameters and considerations; Model analysis and validation; Model optimization; Substructure manipulations, annealing, protein folding and model generation; loop generating methods; loop analysis; Analysis of active sites using different methods in studying protein–protein interactions.

high throughput screenings.

Environmental Biotechnology:

1. **Introduction to Environment**: Introduction to environment; pollution & pollution indicators; waste management: domestic, industrial, solid and hazardous wastes; biodiversity and its conservation; microbiology of water, air and soil: types, importance and diseases; microorganisms and biogeochemical cycles; Role of microbes in biogeochemical cycles - Carbon cycle; Sulphur cycle; Nitrogen cycle and Phosphorus cycle.

2. **Biotrexslation**: Biotrexslation: Fundamentals, methods and application; bioaugmentation; biotrexslation of heavy metals & organic pollutants like pesticides. Polycyclic aromatic hydrocarbons etc. Biodegradation: types, microbial basis and role in environment.

3. **Role of microorganisms in bioremediation**: Application of bacteria & fungi in bioremediation: White rot fungi vs specialized degrading bacteria: examples, uses and advantages vs disadvantages; Phytoremediation: Fundamentals, methods (phytoaccumulation, phytovolatilization, rhizofiltration, phytostabilization) & applications.

4. **Biotechnology and Agriculture**: Bioinsecticides: Bacillus thuringiensis, Baculoviruses, etc; genetic modifications, applications and safety in their use; Biofertilizers: Symbiotic systems between plants – microorganisms (nitrogen fixing symbiosis, mycorrhiza fungi symbiosis); Plant growth promoting rhizobacteria (PGPR) - classification, PGPR and plant root interactions; mechanism of action, applications & challenges; Biofungicides: Description of mode of actions and mechanisms.

5. **Biofuels**: Environmental Biotechnology and biofuels: biogas, bioethanol, biodiesel, biophydrogen; Biomass resources: lignocellulosic and algae; genetic engineering for feedstock improvement; microorganisms and biotechnological interventions; Improvement of biological strains.

Infectious Disease Biology:

1. **Microbial mechanisms of establishment and persistence (Strategies of pathogens to establish acute and chronic infections)**: Role of key microbial proteins and metabolic functions in persistence (bacterial toxins, secretion systems and virulence), Microbial variability and persistence: sub-typing of pathogens (including WGS), genetic regulation and exchange of virulence determinants, emerging infections, the microbiome, antibiotics and resistance, Biofilm formation and microbial intercellular communication

2. **Principles of Molecular Biology, Pathogenesis, & Control of Human Viruses**: Basic principles of infection, transmission, tropism of human viruses, Biology of individual pathogenic human viruses, including influenza, HIV, Herpes, Polio, Hepatitis, RSV and Dengue viruses. Evolution of viruses and viral strategies for the evasion of the natural and adaptive immune system.

3. **Host response to infection and microbial modulation of host responses**: Host genetic susceptibility (Co-evolution and coadaptation), Cellular responses to persistent infection (interaction with array of host receptor). Escape of pathogens from innate and adaptive immunity (microbial manipulation of host inflammatory responses)

4. **Virus-host interaction in Infectious diseases**: Co-evolution and adaptation between viruses and hosts. (post-entry viral inhibitors, natural versus non-natural hosts), Resident viruses and their interaction with host immune system: Significance of “host-virobiota” interaction and “Virome” study., Early Virus-Host Interaction: How they predict the course of a persistent infection.

5. **Epigenetic modifications and viral infection**: Epigenetic remodelling of host genes in human viral infection. Methods of Epigenetic Analysis (DNA methylation, Amplification of Inter-Methylated Sites, Methylated DNA Immunoprecipitation (MeDIP), NSG., Endogenous retroviruses and their association with diseases: PERV and Xenotransplantation. Host epigenetic/cellular responses to control the
expression of endogenous retroviruses in the cell.

6. **New Threats: Emerging Viral Diseases**: Epidemiology and cross species viral infection, Virus fitness and host switching., Virus and Nervous system: Debut of Zika virus in the Medical science., Computational approach to predict virus resistance, immunogenic epitopes, and vaccine design. (Introduction to Los Alamos HIV Database, and NetCtI), Severe Acute Respiratory Syndrome (SARS) and Human Coronavirus (HCoVs): Transmission and disease pathogenesis.

7. **Systems analysis of host-pathogen interactions (introduction to PHI database)**: Host - Pathogen Interaction Database, Hi-Jack: A novel computational framework for pathway-based inference of host-pathogen interactions, Host-Pathogen Interactions Alignment (HPIA) algorithm

8. **Viruses and Human Cancers**: Viral mechanisms of transformation and tumorigenicity, Interactions between human cancer viruses and the immune system, Use of high-throughput genomics in Tumour virology. Oncolytic viruses (OVs) and can

**Molecular and Cell Biology of Viral Oncogenesis:**

1. **Genomic Integrity and development of cancer**: Replication errors, mutagens, inherited defects in DNA repair mechanisms, alterations in chromosomal structure

2. **Oncogenes**: Activation by endogenous retroviruses, changes in structure and expression leading to oncogene activation

3. **Tumor suppressor genes**: Role in cancer development and prevention, epigenetic regulation of expression of TSGs

4. **Hallmarks of cancer**: Different cell types in cancer, progression, characteristics of cancer cells

5. **Signaling receptors and cancer**: Growth factors and signaling proteins as oncogenes (e.g. Src, EGFR, Integrin receptors), alteration of cell signaling in cancer (Ras, Akt,PKB, JAK-STAT, Wnt/β)

6. **Cell cycle and cancer**: Role of p53 and retinoblastoma in cell cycle regulation, interplay between phosphorylation, dephosphorylation and ubiquitylation in regulation of cell cycle and aberrations in these mechanisms

7. **Cell Biology of Invasion and metastasis**: Epithelial to mesenchymal transition (ETM), TFs in ETM, role of Ras-like GTPases in cell adhesion, shape and motility, factors affecting metastasis

8. **Viral carcinogenesis**: Discovery of oncogenic viruses; The origin and nature of transforming gene; Functions of viral transforming genes

9. **Molecular biology of RNA and DNA tumor viruses**: Direct acting and indirect acting tumor viruses

10. **Activation of cellular signal transduction pathways by viral oncogene**: Viral mimics cellular signaling molecules; Altering the activity of signal transduction proteins

11. **Disruption of cell cycle control pathway by viral oncogene products**: Abrogation of restriction point control exerted by Rb proteins; Production of virus specific cyclins; Inactivation of CDK inhibitors

12. **How viruses counteract the barriers of tumor growth**: Telomerase activity; Cell polarity and attachment; Epigenetic control

13. **Viruses as novel cancer therapeutic agents**: Generation of recombinant viruses to selectively target and lyse the cancer cells; Various strategies to arm the recombinant virus to enhance its oncolytic ability.

**Nanobiotechnology:**

1. **Introduction to Nanotechnology**: Current status, Different types of nano materials their importance and applications, Different methods for the synthesis of nanomaterials and characterization processes including basic instrumentation.

2. **Nano Biotechnology**: Role in nanomedicine including toxicity, ethical & regulatory issues, nanoparticle-based drug delivery strategies, advantages & disadvantages of
3. **Nanotechnology for diagnostics:** Optical diagnostics, Fabrication of electrodes, Applications of Biosensor, role of nanomaterials and nanostructures in the enhancement of sensitivity

4. **Light induced nanostructures:** Light induced nanostructures formation and their biomedical applications

5. **Biosynthesis of nanoparticles:** Molecular machinery of biosynthesis of metal Nanoparticles by microorganisms and their use. Green biosynthesis of nanoparticle and sustainable development. Bio-Inspired nanotechnology and its importance

### 11. SCHOOL OF SANSKRIT AND INDIC STUDIES

The pattern of JNU EE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

**SYLLABUS**

**I. REGULAR COURSES**

**B.Sc.-M.Sc. Integrated program in Ayurveda Biology**

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<tbody>
<tr>
<td>1</td>
<td>School of Sanskrit and Indic Studies (SSIS)</td>
<td>Ayurveda Biology - AYBU (411)</td>
<td>Syllabus: The syllabus is 10+2 level CBSE for Sanskrit, Science and General Aptitude questions.</td>
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</table>

**M.A.**

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<tbody>
<tr>
<td>1</td>
<td>School of Sanskrit and Indic Studies (SSIS)</td>
<td>Sanskrit – SANM (228)</td>
<td>Syllabus: Test may cover the following areas: Vedic &amp; Agamic Studies, Sanskrit language and literature, Indian Philosophical Systems, Sanskrit Poetics and Aesthetics, Sanskrit and Modern Indian Languages, Sanskrit Linguistics including Computational Linguistics, Indian Intellectual and Cultural Traditions, Social thought, Polity, Economy, Architecture, Fine Arts, Environmental Awareness, Sanskrit Grammar, Indian Logic, Astronomy and Mathematics, Science and Technology, Argumentation and Interpretation, and Role and Place of Sanskrit in Indo European Studies.</td>
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**Ph.D.**

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<tbody>
<tr>
<td>1</td>
<td>School of Sanskrit and Indic Studies (SSIS)</td>
<td>Sanskrit Studies – SANH (906)</td>
<td>Syllabus: The test will cover the following areas: Indian Philosophical Systems; Traditions of Yoga &amp; Sādhanā, Sanskrit literature and Poetics, Sanskrit Grammar and Grammatical Theory; Modes of Disputation and Interpretation of Texts; Sanskrit Linguistics including Computational Linguistics; Vedic, Agamic and Purānic Studies; Pali and Prakrit Studies; Indian Social Thought, Religious Studies; Sanskrit Manuscriptology; Issues in Sanskrit Studies and Researches; Research Methodology &amp; Research Aptitude.</td>
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II. Part-time Courses

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<tbody>
<tr>
<td>1</td>
<td>School of Sanskrit and Indic Studies (SSIS)</td>
<td>Pali – PALC (705)</td>
<td>Candidates seeking admission shall be examined on the basis of the Computer Based Test (CBT). The questions shall be objective type and shall be within the broad spectrum of General Knowledge, general aptitude for the subject and English Language.</td>
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<tr>
<td>2</td>
<td>Sanskrit Computational Linguistics – SCLC (706)</td>
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<td>3</td>
<td>COP in Yoga Philosophy – YOPC (707)</td>
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<td>4</td>
<td>COP in Vedic Culture – VECC (708)</td>
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<td>5</td>
<td>COP in Sanskrit – SANC (709)</td>
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12. School of Engineering

The pattern of JNU EE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

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<tr>
<th>S. No</th>
<th>Program</th>
<th>Branch</th>
<th>Syllabus</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Ph.D.</td>
<td>Computer Science and Engineering</td>
<td>Syllabus: 50% of the questions will be from research methodology and remaining 50% from bachelor's/master’s level computer science engineering. Research Methodology: Experimental design; fundamentals of sampling; data types, quality measurement; processing and analysis of data; hypothesis testing (parametric, nonparametric), theory of probability. Computer Science: Engineering mathematics, Digital logic, Computer organisation and architecture, Programming and data structure, Algorithms, Theory of computation, Compiler design, Operating system, Database, Computer networks.</td>
</tr>
<tr>
<td>2</td>
<td>Ph.D.</td>
<td>Electronics and Communication Engineering</td>
<td>Syllabus: 50% of the questions will be from research methodology and remaining 50% from bachelor’s/master’s level electronics and communication engineering. Research Methodology: Experimental design; fundamentals of sampling; data types, quality measurement; processing and analysis of data; hypothesis testing (parametric, nonparametric), theory of probability. Electronics and Communication: Engineering mathematics, Networks, Signal and systems, Electronic device, Analog circuits, Digital circuit, Control systems, Communications, Electromagnetics.</td>
</tr>
</tbody>
</table>
13. ATAL BIHARI VAJPAYEE SCHOOL OF MANAGEMENT AND ENTREPRENEURSHIP (ABVSME)

The pattern of JNUCEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Ph.D.

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

14. SPECIAL CENTRE FOR STUDY OF NORTH EAST INDIA

The pattern of JNUCEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Ph.D.

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<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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</thead>
</table>
| 1      | Special Centre for the Study of North East India (SCSNEI) | North East India Studies- NESH (882) | • Understanding North East India and its neighbouring areas: history, culture, society, politics, economic development, ecology and contemporary policies  
• Research Methodology: Various interdisciplinary methods such as approaches to social sciences, qualitative, quantitative, interpretative and historical methods  
• In addition to the above, the syllabus covers themes pertaining to North East India, such as religion and society, tribes and ethnicity, government and politics, economic development, frontiers and borderlands, and cultural histories. |
The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.Sc. Programme

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<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
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<th>Syllabus for Entrance Examination</th>
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Ph.D.

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<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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<tbody>
<tr>
<td>1</td>
<td>Special Centre for Molecular Medicine (SCMM)</td>
<td>Molecular Medicine-CMMH (905)</td>
<td><strong>Section A</strong>; General Aptitude/Research Methodology&lt;br&gt;<strong>Section B</strong>; Different Subject Areas of Molecular Medicine&lt;br&gt;<strong>Section A</strong>&lt;br&gt;Aptitude / Research Methodology&lt;br&gt;Basic Maths: geometry, statistics, Arithmetics, Log, Basic knowledge of Computer science.&lt;br&gt;Chemistry: Concept of Molarity, Normality, Related to Periodic Table, Organic Chemistry, Synthesis, Thermodynamics, Entropy, Enthalpy, Free energy, Law of Mass action, Reaction kinetics Physics: Newton’s law, radioactivity, Electricity, capacitance, optics, sound, gravity, spectroscopy. Basic Biology: Zoology/Botany - classification/Evolution Biology/Population Biology, General Aptitude and reasoning.&lt;br&gt;<strong>Section B</strong>&lt;br&gt;Biochemistry: Metabolism, Nutrition, Biomolecules, Hormones, Enzymes, Omics. Microbiology: Bacterial genetics, Antibiotics mode of action, Infectious disease, Industrial</td>
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Entrance test will contain questions on research methodology/experimental techniques in the relevant areas.

## 16. CENTRE FOR THE STUDY OF LAW & GOVERNANCE

The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Ph.D.

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<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
<th>Syllabus for Entrance Examination</th>
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</table>
| 1      | Centre for the Study of Law & Governance (CSL&G) | Law & Governance – CLGH (907) | The test will have a 50% weight for social science research methods and 50% weight for domain knowledge covering the disciplines of Economics, Political Science, Sociology, Public Administration, Anthropology, and Law. The questions will be at the level of an advanced Masters and all candidates will be required to attempt questions from all these disciplines. The broad coverage of the subject areas of these disciplines are as follows:

- **Political Science**: concept and theories of governance; theories of the State, democracy and development; decentralisation; global governance; politics of identity; multilevel governance; civil society and social capital; neoliberalism and globalisation; social justice; gender, development and governance; and, public administration.
- **Law**: Constitution and administrative law, criminal law, law and technology, environmental law, corporate laws and labour laws.
- **Economics**: Microeconomics, macroeconomics, development economics, political economy, basic of institutional economics and law and economics with particular focus on transactions costs and property rights, Economic Policy.
- **Sociology**: Sociological Theory, Kinship, Sociological Perspectives on Caste, Gender and Race; Sociology of Law; Culture and Society, Visual Culture. New Social Movements, Urban studies. |
# 17. SPECIAL CENTRE FOR NANO SCIENCES

The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.Tech Programme in Nanoscience (NNST-182) & Nanoelectronics (NNET-190)

<table>
<thead>
<tr>
<th>Length</th>
<th>Special Centre for Nano Sciences</th>
<th>Nanoscience – NNST (182)</th>
<th>NNST (182) Nanoscience</th>
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<td>Chemical Sciences:</td>
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<td>Physical Sciences:</td>
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<td>Biological Sciences:</td>
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<td>Cell Biology: Membrane structure and function; Cell organelles; Cell division and cell cycle. Microbes, infectious disease biology and microbial diseases.</td>
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<td>Fundamental Processes: DNA replication, repair and recombination, RNA synthesis and processing and Protein synthesis</td>
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<td>Immunology: Innate and adaptive immunity, antigens, antibody, antigen-antibody interactions, immune responses, congenital and acquired immune deficiencies, vaccines.</td>
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<td>Genetics: Mendelian principles, Gene: Allele, multiple alleles, mutation types and cause.</td>
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<td>Human Physiology: Blood, coagulation, blood groups, Heart, Endocrine glands, Hormones and diseases.</td>
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Nanoelectronics – NNET (190)

Unit-I

Unit-II

Unit-III

Unit-IV
Microprocessor: INTRODUCTION TO 8085, Basic Concepts of Microprocessors, CENTRAL PROCESSING UNIT: CPU, I/O devices, clock, memory, bussed architecture, tristate logic, address bus, data bus and control bus. Development of semiconductor memory, internal structure and decoding, memory read and write timing diagrams, MROM, ROM, EPROM, EEPROM, DRAM: Intel 8085 microprocessor.

Ph.D.

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<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code Number</th>
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<tr>
<td>1</td>
<td>Special Centre for Nano Sciences</td>
<td>Nano Sciences – NNSH (908)</td>
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</table>

NNSH (908) Nanoscience

Part-A: Research Methodology (Common for all)
1. General Science: General appreciation and understanding of science including matters of everyday observation and experience.
2. Environmental awareness: Pollution and its impacts, climate change, sustainable development. 3. Current events: Knowledge of significant national and international events.
4. General mental ability and reasoning: Reasoning and analytical abilities.
5. Elementary Computer Science: Basic computer awareness and its uses.
6. Interactive English: Grammar, vocabulary, sentence completion, usage, synonyms, antonyms, one word substitute, idioms/phrases, error detection and comprehension.
7. Information and Communication Technology (ICT): Terminology and abbreviations used in ICT, applications of ICT in academics and research.
8. Research aptitude: Basic Concepts- 1. Meaning, nature, significance and types of research. 2. End to end process of research, Formulation of research problem, Design strategies in Research- Descriptive Studies, Analytic Studies, Experimental studies, Intervention trials etc., research proposal, Synopsis, Hypothesis, Data collection, Literature survey, Sampling, Interviewing, questionnaire, Data processing, Interpretation, Report writing, Bibliography, Data presentation and summarization, Graphical presentation of data.
Research Ethics. 3. Thesis/ Dissertation writing. 4. Article, research paper, seminar, conference, symposium, workshop etc. 5. Role of governing bodies/research organizations like UGC, CSIR, ICAR, ICSSR, ICFRE, ISRO, DRDO etc. in research and development. 6. Role and use of computers in research.

9. Basic concepts of Statistical methods for research (Probability, Test of significance, Standard deviation, Measures of central tendency, Measures of variability, Measures of Relationship – Correlation, Hypothesis Testing – parametric and non-parametric tests., Proportions, Relative risk, Odds ratio, Student t test, Anova, Error bars)

**Part-B: Subject Specific**

In Part-B, candidate can choose any one of the Subject Streams: (Physical Sciences) or (Biological Sciences) or (Chemical Sciences) or (Engineering Sciences) for appearing in the Entrance Exam

### Physical Sciences


### Biological Sciences

**Biomolecules and their relevant interactions**: Biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation and isozymes.


**Fundamental Processes**: DNA replication, repair and recombination. RNA synthesis and processing. Protein synthesis.

**Immunology**: Innate and adaptive immunity, antigens, antibody, antigen-antibody interactions, immune responses, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

**Genetics**: Gene, Allele, mutation types, cause and inheritance biology.

**Human Physiology**: Blood, coagulation, blood groups, haemoglobin. Endocrine glands, hormones and diseases, neuroendocrine regulation.

### Chemical Sciences

**Stereochmistry**: IUPAC nomenclature, Configuration, Chirality, Isomerism. Conformational analysis and its effect on reactivity. Organic Reaction mechanisms, Free radicals, mechanism of nucleophilic substitution (SN1 and SN2) and elimination (E1 and E2). Addition to carbon-carbon multiple bonds, addition to alkenes and alkyne, transition metal organometallics. Addition to carbon-hetero multiple bonds. Oxidation and Reduction.

**Spectroscopy**: Structure elucidation using UV-VIs, IR, 1H and 13C NMR. Photochemistry and pericyclic reactions: Features, classification. Natural Products and drugs of natural origin. Solutions: Ideal and non-ideal, methods of expressing concentrations of solutions, activity and activity coefficient, Raoult’s law, relative lowering of vapour pressure, molecular weight determination, Osmotic pressure, Elevation of boiling point and depression of freezing point.

**Theory of Gases**: Kinetic theory of gases, Maxwell-Boltzmann distribution law. Chemical Thermodynamics: Reversible and irreversible processes, First, second and third laws of thermodynamics, Ideal and non-ideal gases, Gibbs and Helmholtz energy, Free energy
change and spontaneity. **Chemical and Phase Equilibria:** Law of mass action, Effect of temperature on K, Ionic equilibria in solutions, pH and buffer solutions, Hydrolysis, Solubility product; Phase equilibria–Phase rule. **Electrochemistry:** Conductance, Transport number, Galvanic cells, EMF and Free energy. **Chemical Kinetics:** Reactions of various order, Arrhenius equation, Collision theory, Theory of absolute reaction rate, Chain reactions, Enzyme kinetics, Catalysis.

**Periodic Table:** Periodic classification of elements and periodicity in properties. **Chemical bonding and shapes of compounds:** Types of bonding; VSEPR theory and shapes of molecules, hybridization, dipole moment, lattice energy. **Main group elements (s and p blocks):** Group relationship and gradation in properties. **Transition metals and inner transition metals (d and f block):** Characteristics of 3d elements, oxide, hydroxide and salts of first row metals, coordination complexes, metal complexes.

**Analytical Chemistry:** Principles of qualitative and quantitative analysis, acid-base, oxidation reduction and precipitation reactions, use of indicators and organic reagents in inorganic analysis, radioactivity, nuclear reactions, applications of isotopes.

**Engineering Sciences**

**Unit-I:** Electronic Transport in semiconductor, PN Junction, Diode equation and diode equivalent circuit. Breakdown in diodes, Zener diodes, Tunnel diode. Semiconductor diodes, characteristics and equivalent circuits of BJT, JFET, MOSFET, IC fabrication-crystal growth, epitaxy, oxidation, lithography, doping, etching, isolation methods, metallization, bonding, Thin film active and passive devices.


**Unit-III:** Rectifiers, Voltage regulated ICs and regulated power supply, Biasing of Bipolar junction transistors and JFET. Single stage amplifiers, Multistage amplifiers, Feedback in amplifiers, oscillators, function generators, multivibrators, Operational Amplifiers (OP AMP) -characteristics and Applications, Computational Applications, Integrator, Differentiator, Wave shaping circuits, F to V and V to F converters. Active filters, Schmitt trigger, Phase locked loop.

**Unit-IV:** Logic families, flip-flops, Gates, Boolean algebra and minimization techniques, Multivibrators and clock circuits, Counters-Ring, Ripple, Synchronous, Asynchronous, Up and down shift registers, multiplexers and demultiplexers, Arithmetic circuits, Memories, A/D and D/A converters.

**Unit-V:** Modulation index, frequency spectrum, generation of AM (balanced modulator, collector modulator), Amplitude Demodulation (diode detector Other forms of AM: Double side band suppressed carrier, DSBS generation (balanced modulator), Single side band suppressed carrier, SSBSC generation (filter method, phase cancellation method, third method), SSB detection. Frequency and Phase modulation, modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM (direct and indirect methods), FM detector (slope detector)
## 18. SPECIAL CENTRE FOR DISASTER RESEARCH

The pattern of JNUEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

**M.A. Programme**

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<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code (Number)</th>
<th>Syllabus for Entrance Examination</th>
</tr>
</thead>
</table>
| 1      | Special Centre for Disaster Research (SCDR)       | Disaster Studies - DSSM (239)  | • Social Science Perspectives of Disasters, Constitution, Law, Governance and Sustainable Development Goals (SDGs)  
|        |                                                   |                               | • Definition, Concepts and Theories around the key terms in disaster studies [Understanding of 'Disaster', 'Risk', 'Hazard', 'Vulnerability', 'Resilience']  
|        |                                                   |                               | • Development and Disasters, Geography of Disasters and GIS Application [Regional Imbalance, Health Issues, Fragile areas and Critically Endangered Zones]  
|        |                                                   |                               | • Computer, Information and Communication Technologies, Artificial Intelligence, Database Systems [Application of modern scientific tools in early warning systems, relief, rehabilitation and appropriate measurement of damages and losses]  
|        |                                                   |                               | • Ecology and Environment [Dams, Pollution, Climate Change, Effluent Discharges, Human Consumption as cause of environmental destruction and increased vulnerability of ecosystems]  |

**Ph.D.**

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<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code (Number)</th>
<th>Syllabus for Entrance Exam:</th>
</tr>
</thead>
</table>
| 1      | Special Centre for Disaster Research (SCDR)       | Disaster Studies - DSSH (911)  | **PART A:**  
|        |                                                   |                               | Research Methodology in Disaster Studies, Surveys, Statistical Tools & Analysis, Data Management, Techniques of pre and post-disaster needs assessment (PDNA), Comparative Case Study Methods for evaluating governance and community capacity for last mile service delivery.  
|        |                                                   |                               | **PART B:**  
|        |                                                   |                               | 2. Social Sciences and Anthropology of Disasters; Vulnerable communities in fragile environmental and ecological regions; Geography, Environment and Disasters; Geospatial Mapping and human security.  
|        |                                                   |                               | 3. Disaster Economics, Planning and Preparing against economic losses, Role of Macro and Micro level economic institutions.  
|        |                                                   |                               | 4. Database, Artificial Intelligence and Early Warning Systems in the management of rescue and relief operations.  
19. Special Centre for National Security Studies (SCNSS)

The pattern of JNU EEE 2021-22 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Ph.D.

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<tr>
<th>Sl. No.</th>
<th>Name of Centre</th>
<th>Sub. Code &amp; Sub. Code (Number)</th>
<th>Syllabus for Entrance Examination</th>
</tr>
</thead>
</table>
| 1       | Special Centre for National Security Studies (SCNSS) | National Security Studies – NSSH (916) | 1. Domestic/Internal Security Studies of India  
   a. Insurgencies in the North East  
   b. Left Wing Extremism  
   c. Terrorism in Heartland  
   d. Coastal Security  
   2. External Security Studies of India  
   a. India-Pakistan-China Military Balance  
   b. International Terrorism  
   c. Maritime Security  
   d. Geopolitics & Geoeconomics and National Security  
   e. Nuclear doctrine, regime & security  
   3. Indian Strategic Thoughts and Military History of India  
   a. Kautilya’s Arthashastra  
   b. The Kural  
   c. Kama Sutra’s Nitiashastra  
   d. Panchatantra and Hitopadesa  
   e. India-Pakistan War of 1965, 1971, 1999  
   f. India-China Border War of 1962  
   4. Emerging Technology and National Security  
   a. Science and Technology and National Security  
   b. Science Diplomacy  
   c. Biological Warfare, Chemical Warfare, Cyber warfare  
   d. Artificial Intelligence, Genetic Engineering, Quantum Computing, Nanotechnology, Unmanned Aerial Vehicles  
   5. Studies of External Border of India  
   a. Frontiers & Boundaries  
   b. Border disputes  
   c. India-Pakistan border  
   d. India-Bangladesh border  
   e. India-China border  
   f. India-Myanmar border  
   g. India-Nepal border  
   h. Maritime border  
   6. Non-traditional Security Studies of India  
   a. United Nation and Human Security  
   b. Contemporary Non-Traditional Security Discourses  
   c. Environmental Security (Health, Food and Water Security)  
   d. Terrorism and Transnational Crime  
   e. Migration and Demography  
   7. Research Methodology for National Security Studies of India  
   a. Research Methods, Types and formulation of Research Design  
   b. Hypotheses: Functions, Characteristics and Types; Formulation of Research Problem; Review of Literature; Concepts and Variables  
   c. Sampling: Types of sampling; Data Collection-Primary and Secondary sources; tools of data collection  
   d. Introduction to Basic Statistics  
   e. Research ethics and plagiarism  
   8. Remote sending and GIS |