XXVII. SYLLABUS FOR JNU ENTRANCE EXAMINATION 2020-21

1. SCHOOL OF INTERNATIONAL STUDIES

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Master of Arts

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of International Studies	Politics (with specialization in International Studies) – PISM (201)	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.
2		International Relations and Area Studies – IRAM (234)	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.
3		Economics (with specialization in World Economy) – EILM (202)	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.

M.Phil & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Canadian, US and Latin American Studies (CCUS&LAS)	Canadian Studies – CANP (101) & CANH (826)	**Section I** **RESEARCH METHODOLOGY** 1. Social science research vs. natural science research 2. Inter-disciplinary research 3. Variables in research 4. Types of research: descriptive; empirical; analytical; historical and doctrinal 5. Questionnaires and interviews; participant and non-participant observation 6. Survey research 7. Content analysis 8. Case study research 9. Managing and reviewing literature for research 10. Research proposal, research questions and hypothesis formulation 11. Primary and secondary sources; use of libraries and archives Research ethics/ ethical practices in research **Section II** **US Studies** 1. Bill of Rights – American Constitution
2		Latin American Studies – LAMP (103) & LAMH (828)	2. Federalism 3. Media, political parties and elections 4. Congress, judiciary and judicial review

3		United States Studies – USSP (102) & USSH (827)	5. Power and role of the US President and domestic factors in Foreign Policy. 6. US Policy towards South Asian Countries 7. US Foreign policy during Cold War (Containment Policy, Marshall Plan, Alliance Politics, Truman Doctrine) 8. Foreign Policy trends and patterns in Post-Cold War America (UN, Middle East, Europe, Asia, international institutions). 9. American ideals: liberty, equality, republicanism, individualism, democracy, faith-neutrality 10. Waves of immigration to America: old, new and newest 11. Ethnicity, race, religion and gender in America 12. Social problems: Gun violence, racism, abortion, teenage pregnancy, homelessness, drugs and alcoholism 13. Terrorism **Latin American Studies** Government and politics in Latin America: executive, legislature, judiciary Political parties and political movements Role of Labour, peasantry and middle class Domestic and foreign capital Church Military Environmental issues Indigenous communities Independence movements and ideas Social movements Latin America in world affairs Relations with US; Asia, Africa and Europe India and Latin America Latin American and Caribbean regionalism Contemporary political, social and economic issues in major Latin American and Caribbean countries **Canadian Studies** Multiculturalism and ethnicity in Canada Immigration policies and integration Environmental issues Canada and India relations Regional Economic Integration Inter-American relations Federalism and Provincial Government Quebec and issues of regionalism Political party system and electoral politics Foreign Policy approaches and trends Canada and United Nations; Peace-keeping, peace-building and peace-enforcement Contemporary political, social and economic issues in Canada
4	Centre for European Studies (CES)	European Studies – EUPP (104) & EUPH (829)	The test is divided into two sections, research methodology and area studies. 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, 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.**
5	Centre for International Legal Studies (CILS)	Int. Legal Studies – ILGP (105) & ILGH (830)	The entrance examination will contain multiple choice questions covering subject-specific knowledge. The syllabus will include the following themes: 1) The history, nature and subjects of International Law; Statehood and International Legal Personality; Individuals, indigenous communities,

			corporations; national liberation movements, etc. 2) The sources of International Law: custom, treaties; 'Hard Law' and 'Soft Law' debate, etc. 3) 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. 4) Institutions of International Law: the United Nations system; World Trade Organization; functional/sectoral international organizations; regional organizations. 5) Responsibility and Enforcement in International Law; peaceful settlement of disputes; world court and other international tribunals. 6) War and Peace in International Law: the UN Charter, International Humanitarian Law; International Criminal Law; international military tribunals; International Criminal Court.
6	Centre for International Trade & Development (CITD)	Int. Trade & Development – ITDP (106) & ITDH (831)	The entrance examination will contain multiple choice questions covering research methodology and subject-specific knowledge. The syllabus will include Mathematical Economics, Statistics, Econometrics, Microeconomics, Macroeconomics, International Trade, Development Economics, Public Economics and Environmental Economics taught at the Master's level.
7	Centre for East Asian Studies (CEAS)	Chinese Studies – CHIP (107) & CHIH (832)	The syllabus for the examination include subjects related to broader East Asian/Global developments; China's Foreign, Economic, Political & Social Issues; Japan's Foreign, Economic, Political & Social Issues; Korea's Foreign, Economic, Political & Social Issues. Major developments in East Asia are highlighted to test the candidates capabilities in conducting research in these areas.
8		Japanese – JPIP (108) & JPIH (833)	
9		Korean – KOIP (109) & KOIH (834)	
10	Centre for International Politics, Organisation and Disarmament (CIPOD)	International Politics – INPP (110) & INPH (835)	**(A) International Politics (INP)** 1. Classical Realism 2. Non-Western Realism: Thucydides, Sun Tzu, Kautilya 3. Neorealism and the difference between Classical Realism and Neorealism 4. Variants of Neorealism: Defensive, Offensive, Neoclassical Realisms 5. Liberal International Theory including Complex Interdependence, Neoliberal Institutionalism, Democratic Peace Theory, Trade and Commercial Liberalism 6. Constructivist International Theory 7. Marxist and Gramscian International Political Theory 8. Theories of International Society, Especially the British School 9. Feminist International Theory 10. Modern Non-Western International Theory 11. Great Debates in International Theory 12. Theories of Nonalignment
11		International Organisation – ORGP (111) & ORGH (837)	
12		Diplomacy and Disarmament – DADP (112) & DADH (838)	
13		Political Geography – POGP (113) & POGH (836)	**(B) Political Geography (POG)** 1. Nature and scope of political geography 2. Political Geography Approaches: Functional, Unified Field theory, Laws of Spatial Growth of States 3. Political Geography Concepts: Space, Place, Scale, Region, Core Areas and Capital Cities, State, Sovereignty, Nation 4. Environment, Development and Geography 5. Geographical and Geopolitical Imaginations 6. Theories of geopolitics: traditional, critical, postmodern, feminist 7. Geo-strategy 8. Geopolitics Concepts: Territory, Border, Frontier, Boundaries, Empire 9. Issues and Concerns: Geopolitics of Resources; Geopolitics of Wars; Laws of the Sea; Cold War Geopolitics and multi-polar Geopolitics; Geopolitical hotspots; 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. Negotiations: theory and practice
5. Climate change and environmental negotiations
6. Nuclear politics including arms control, non-proliferation and disarmament
7. Theories of deterrence
8. Chemical and biological weapons
9. War: concept, theory and evolution
10. Peace: concept and theory in mainstream and critical-theoretical perspectives
11. Revolution in military affairs
12. Conflict management and resolution
13. Security: concept, theory and evolution
14. National security
15. Terrorism including nuclear terrorism and counter-terrorism
16. Non-traditional security including human security
17. Environmental security
18. Technology and global politics
19. Critical theory and Critical Security Studies including the Copenhagen, Paris and aberystwyth schools of thought
20. Critical Terrorism Studies
21. Critical Military Studies

(E) Research Methodology (Common)
1. Inductive and deductive reasoning
2. Preliminary ideas about philosophy of science including the contribution of Karl Popper
3. Positivism and post-positivism: basic ideas
4. Qualitative method: characteristics and application
5. Case study research: single case study and multiple case studies
6. Comparative study
7. Content analysis
8. Sources in research: primary and secondary
9. Archival research: major archives for international research in India
10. Quantitative method: characteristics and application
11. Statistics: descriptive and inferential statistics
12. Sampling: concept, logic and types
13. Correlation and causation
14. Measures of central tendency
15. Measures of variation or dispersion
16. Observation including participant and non-participant observation
17. Ethnography

			18. Interview
			19. Basic ideas about mixed methods
			20. Research ethics including plagiarism
14	Centre for Russian and Central Asian Studies (CR&CAS)	Russian & Central Asian Studies – RCAP (114) & RCAH (839)	The syllabus will broadly cover an overview of the History, Politics, Economic 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 following thematic areas comprise the central focus of the syllabus: 1. Comparative Politics and Theories of International Relations 2. Research Methods in Social Sciences 3. Bolshevik Revolution, Soviet Politics, industrialization debates, collectivization, Five-year planning, Soviet Economy, Social System and Foreign Policy 4. Glasnost, Perestroika, Nationalist Movements in the late 1980s', disintegration of USSR, end of Cold War 5. The post-Soviet Transition: Socio-political, Economic Developments, Nation and State-building Processes in the former Soviet Space 6. Globalisation, liberalization and impact 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 10. New Regionalism in the post-Soviet Space.
15	Centre for South Asian Studies (CSAS)	South Asian Studies – SASP (115) & 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. 9. Research methods in Social Sciences.
16	Centre for Indo-Pacific Studies (CIPS)	Indo-Pacific Studies – IPSP (116) & 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. 6) Regionalism multilateralism and institutional mechanisms.
17	Centre for Inner Asian Studies (CIAS)	Inner Asian Studies – IASP (117) & 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. 6. Human Security and Gender Issues. 7. China's Nationalities Policy in Xinjiang, Tibet and Inner Mongolia. 8. Nation-building process in Central Asia, Mongolia and Afghanistan. 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

18	Centre for African Studies (CAS)	African Studies – AFSP (118) & 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
			    Democratisation 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
			    Structural adjustment programmes in Africa-an evaluation
			    Problem of poverty in Africa
			    Africa's debt crisis
			    Globalisation and its impact of Africa
			    Regional economic cooperation and development (ECOWAS, SADC, COMESA, EAC and AEC)
			
			Social Aspects:
			    Problems of nation-building in Africa
			    Role of education
			    State of Human Rights in Africa
			    Role of civil society and women
			    Problem of AIDS in Africa
			    Ethnic conflicts in Africa
			    Social change and structural transformation
			
			Africa and the World:
			    Africa and the emerging International System
			    Africa and European dominance
			    Africa and the Cold War
			    Post-Cold War scenario in Africa

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
			Africa and the New World Order Africa and the United Nations Inter-regional Cooperation Role of the Organization of African Unity (OAU) Africa and the Non-aligned Movement (NAM) The Role and Relevance of the African Union (AU) 2001 India-Africa Relations
19	Centre for West Asian Studies (CWAS)	West Asian Studies – WASP (119) & WASH (844)	Syllabus for Entrance Examination covers research methodology and domain knowledge of West Asia and North Africa (WANA) region including its geographical area ; Political and Social Systems; Military and Politics; Arab Nationalism, Turkish Nationalism; Zionism; Islamism & Islamist Movement; Political Economy of GCC States, Rentier Economy, Inter and Intra-State Conflicts; Regional Conflicts; Intellectual Traditions in Arab World and Iran; Foreign Policy analysis of major regional powers of the area, notably Egypt, Turkey, Syria, Israel, Saudi Arabia and Iran will be covered. In addition, the syllabus will also focus on the role of global powers in the region along with India's West Asia Policy, its interests and objectives.
20	Centre for Comparative Politics and Political Theory (CCPPT)	Comparative Politics and Political Theory – CPTP (120) & CPTH (845)	Questions are set keeping in mind the MA syllabi of disciplines in the Social Sciences and Humanities from which candidates may apply to the Centre. Questions are broad enough for candidates to apply their knowledge of the discipline in which they have their MA degree. It is expected that candidates are widely read in their respective disciplines.

Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of International Studies	Energy Studies Programme – ESPH (847)	**1) Energy Security: A Conceptual Study** **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** **13) Methodology of Energy Security Studies: Comparative, Historical and Mixed Method Research, quantitative and qualitative variable analysis in Energy Security.**

2. SCHOOL OF LANGUAGE, LITERATURE AND CULTURE STUDIES

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through

Computer Based Test (CBT)

Part-time courses

CERTIFICATE OF PROFICIENCY

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Korean Studies (CKS)	COP-Mongolian – MONC (702)	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.
2	Centre for Chinese, South East Asian Studies (CCSEAS)	COP-Bhasha Indonesia – BHAC (703)	
3	Centre for Indian Languages (CIL)	Urdu – URDC (704)	
4	Centre for Persian and Central Asian Studies (CPCAS)	COP in Pashto – PUSC (701)	
5	Centre for Arabic and African Studies (CAAS)	COP in Hebrew – HEBC (710)	

ADVANCE DIPLOMA OF PROFICIENCY

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Indian Languages (CIL)	ADOP-Mass Media in Urdu – URDA (502)	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: a. Types of Mass Media b. Language of Mass Media c. Social relevance of Mass Media d. Journalism e. Origin and development of Print Media f. Origin and development of Electronic Media/Social Media g. Major Mass Media Genres

B.A. (Hons.) 1st year

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Persian and Central Asian Studies (CPCAS)	Persian – PERU (401)	
2		Pushto – PUSU (410)	
3	Centre for Arabic and African Studies (CA&AS)	Arabic – ARBU (402)	
4	Centre for Japanese Studies (CJS)	Japanese – JAPU (403)	
5	Centre for Korean Studies (CKS)	Korean – KORU (404)	
6	Centre for Chinese, South East Asian Studies (CCSEAS)	Chinese – CHNU (405)	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).
7	Centre for French and Francophone Studies (CFFS)	French – FRNU (406)	
8	Centre for German Studies (CGS)	German – GERU (407)	
9	Centre for Russian Studies (CRS)	Russian – RSNU (408)	
10	Centre for Spanish, Portuguese, Italian and Latin American Studies (CSPI&LAS)	Spanish – SPNU (409)	

Master of Arts

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Persian and Central Asian Studies (CPCAS)	Persian – PERM (203)	1. Translation based on the vocabulary of newspapers, journals and magazines. 2. Essays, short stories, novels from the different authors 3. (a) History of Persian Language with special reference to Avesta, Old Persian and Pahlavi scripts and Literature. (b) Literary History of Persian starting from Arab Invasions up to the end of - Pahlavi period with special reference to Samanid, Ghaznavid, Saljuk, Mongol, Safavid, Qajar and Pahlavi periods. (c) A special study of Persian Literature produced in India. 4. Geography and systems of Government in the Persian speaking world (i.e. Iran, Afghanistan, Tajikistan.) 5. (a) A detailed account of new trends in Modern/Contemporary Persian Prose

			and Poetry.
			(b) Comparison between classical and Modern Persian Poetry.
			(c) Selection of poems from Modern/Contemporary Persian Literature.
			6. A Comparative study of the contemporary Persian dialects with a special reference to Modern Persian, Dari and Tajik.
			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.
2		Pashto - PUSM (236)	The test is conducted in Pashto and objective type questions pertaining to Afghanistan & Pashto speaking countries, Pashto Language and literature, Pashto history, culture and tradition, Pashto grammar, Translation, Pashto terminologies and general awareness on Indo- Afghan relations.
3	Centre for Arabic and African Studies (CA&AS)	Arabic – ARBM (204)	1. History of Arabic literature – pres-Islamic, Islamic, Umayyid, Abbasid and modern periods 2. Modern prose and poetry 3. Arabic studies in India 4. Criticism 5. Major Arab and Indian writers 6. Advanced Arabic grammar 7. Translation (Arabic-English-Arabic)
4	Centre for Japanese Studies (CJS)	Japanese – JAPM (205)	**1. General Awareness on topics such as Japan's** • Geography • History • Society and Culture • Famous Works of Literature • Current affairs (Course list for B.A. programme given below for reference) http:/ www.jnu.ac.in/SLL/CJS/BACoursesJapanese.asp **2. Language ability in Japanese**
5	Centre for Korean Studies (CKS)	Korean – KORM (206)	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.
6	Centre for Chinese, South East Asian Studies (CCSEAS)	Chinese – CHNM (207)	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.
7	Centre for French and Francophone Studies (CFFS)	French and Francophone Studies – FRNM (208)	The test will be conducted in French. Questions on French & 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.
8	Centre for German Studies (CGS)	German Literature – GRLM (209)	**1. Common for both:** • German history from 1750 till 1914 • German history after 1945. (Two German states; Reunification) • Basic Linguistics (Word Formation in German; Dependenzgrammatik; IC-analysis; speech act theory etc.)
9		German Translation – GRTM (230)	**2. For candidates opting for German literature:** • Trends in German Literature post 1945 till 2000 • History of German Literature from 1750 till 1900. Representative authors and texts - an overview of the different periods from the Enlightenment to Realism • An overview of the main genres in German literature • The ability to interpret given texts from these periods.

			3. For candidates opting for German translation: • Good knowledge of German and English
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 (CSPI&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.
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.

M.Phil & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Persian and Central Asian Studies (CPCAS)	Persian – PERP (121) & 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 works 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	Centre for Arabic and African Studies (CA&AS)	Arabic – ARBP (122) & ARBH (849)	1. History of Arabic literature - pre-Islamic, Islamic, Umayyid, Abbasid and modern periods, literature of Al Maghreb, emigrant literature. 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 – JAPP (123) & 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 – KORP (172) & 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.

5	Centre for Chinese, South East Asian Studies (CCSEAS)	Chinese – CHNP (124) & 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.
6	Centre for French and Francophone Studies (CFFS)	French – FRNP (125) & 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.
7	Center for German Studies (CGS)	German Literature – GERP (126) & 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
8	Centre for Indian Languages (CIL)	Hindi – HNDP (127) & HNDH (855)	Syllabus covers the courses prescribed in • 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 • Basics of Research Methodology & Hindi Literary Traditions & Criticism. Sanskrit & Western poetics.
9		Urdu – URDP (128) & URDH (856)	Syllabus will cover by and large the curriculums/ Syllabus as prescribed of M.A. (Urdu) level in various Universities all over the country, comprising the following topics: • Basics of Research Methodology • Basics of 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 (dabistan) of Urdu.
10		Tamil – TAMP (129) & TAMH (857)	• 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 Grammar: Tolkaappiyam, Yapprugklakarigai, Iriyanar Akaporull, Thandiyalgram, Nannul, Purapporul venpaa, Maalai, Pannirupaattiyal. • 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. • History of Tamil Nadu and Culture: Sangam Period to Post Colonial Period. • History of Fine Arts in Tamil Nadu: Painting, Music, Sculptures.
11		Hindi Translation – HTLP (130) & HTLH (858)	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 – RSNP (181) & RSNH (860)	The Entrance Examination for this level is Computer Based Test (CBT) in Russian Language. The questions will be based on Research Methodology, Linguistics, Stylistics, Theory of Translation, Theory of Literature, 19th & 20th Century Russian Literature. Candidates who qualify the CBT will appear for a viva-voce, which will be conducted in Russian.
13	Centre for Spanish, Portuguese, Italian and Latin American Studies (CSPI&LAS)	Spanish – SPNP (132) & 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		Portuguese – PRTP (133)	The questions for the exam will cover research methodology, Portuguese and Brazilian literature, Socio political literary movements, history and culture, Discovery of America, Brazilian history culture and civilization, language and translation studies. The examination will be conducted in Portuguese language.
15	Centre for Linguistics (CL)	Linguistics – LINP (134) & 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.
16	Centre for English Studies (CES)	English – ENGP (135) & 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 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.Sc.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
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 under graduate 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.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Life Sciences (SLS)	Life Sciences – Group-I GONH (892) Life Sciences Group-II – GTWH (893) Life Sciences Group-III – GTRH (894) Life Sciences Group-IV – GFOH (895) Life Sciences Group-V – GFIH (896)	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.

4. SCHOOL OF SOCIAL SCIENCES

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Master of Arts

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Economics studies and Planning (CESP)	Economics-ECOM (216)	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) Macro-economics (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.
2	Centre for Historical Studies (CHS)	Modern History-MODM (217)	The MA exam is structured to test the students on: A. General comprehension B. A broad understanding of the social sciences and 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.
3		Medieval History – MEDM (218)	
4		Ancient History – ANCM (219)	
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 require to show familiarity with each Unit.

6	Centre for the Study of Regional Development (CSRD)	Geography- GEOM (221)	**Unit I** 1. Geomorphology, climatology, oceanography and biogeography. 2. Human geography, economic geography, political geography, Population geography, human ecology and human settlements. 3. Regional geography of India- physiographic divisions, patterns and levels of development of agriculture and industries, growth of population, urbanization, and socio-culture diversity. 4. Geographical information System, Remote Sensing, Cartography, Quantitative Techniques/Statistics. **Unit II -** Questions on Physical, human regional geography and geography of India. **Unit III -** Question on Cartography, scale and map projections, topographical maps of India, Methods of data representation **Unit IV - Question on** 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 o Karl Marx, Emile Durkheim, Max Weber, Georg Simmel, C. Wright Mills, George Herbert Mead, Claude Levi-Strauss o G.S. Ghurye, M. N. Srinivas, Iravati Karve, Yogendra Singh, Andre Beteille, T.K. Oommen 2. Basic Concepts and Social Institutions 3. Tools and Techniques of Research Methodology 4. Social Structure and Social Change 5. Social Stratification o Gender, Caste, Class, Tribe, Disability 6. Economy and Society 7. State, Polity and Society 8. Family, Marriage and Kinship 9. Religion 10. Environment and Society 11. Social Movements 12. Social Issues 13. Understanding Indian society 14. 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.** **Section: I** **Metaphysics** Questions will be from both Indian and Western philosophical perspective. 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.

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

Section: III

Ethics

Questions will be from both Indian and Western philosophical perspective.

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,
3. Themes of Applied Ethics: Abortion, Euthanasia, Surrogacy, Capital punishment, Animal and Environment ethics
4. Thoughts of Indian ethical tradition: Nature of Dharma,Morksa,Purusharthas, Rta, Rina, and themes from Buddhist and Jaina ethics

Section: IV

Symbolic Logic

Questions will be from both Indian and western philosophical perspective.

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.

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 Nyaya)

| 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

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre of Social Medicine and Community Health (CSMCH)	Master of Public Health - MPHT (145)	**A. History of Public Health** 1. History of different systems of Medicine 2. Primary Health Care **B. Concepts in Public Health** 1. Definition of health; appreciation of health as a relative concept; determinants of health. 2. Characteristics of agent, host and environmental factors in health and disease and the multifactorial etiology of disease. 3. Understanding of various levels of prevention with appropriate examples. 4. Indices used in measurement of health. 5. Health situation in India: demography, mortality and morbidity profile and existing health facilities in health services. 6. Measurement of health events. **C. Epidemiology** 1. Use of epidemiological tools to make a community diagnosis of the health situation in order to formulate appropriate intervention measures. 2. Epidemiology - definition, concept and role in health and disease. 3. Definition of the terms used in describing disease transmission and control. 4. Natural history of a disease and its application in planning intervention. 5. Modes of transmission and measures for prevention and control of communicable and non-communicable disease. 6. Principal sources of epidemiological data. 7. Definition, calculation and interpretation of the measures of frequency of diseases and mortality. 8. Common sampling techniques, simple statistical methods for the analysis, interpretation and presentation of data frequency distribution, measures of central tendency, measures of variability, statistical tests of significance and their application. 9. Need and uses of screening tests. 10. Accuracy and clinical value of diagnostic and screening tests (sensitivity, specificity, & predictive values). 11. Epidemiology of communicable and non-communicable diseases of public health importance and their control. 12. Epidemiological basis of national health programmes.

				13.	Awareness of programmes for control of non-communicable diseases.

13. Awareness of programmes for control of non-communicable   diseases.
(a) Planning and investigation of an epidemic of communicable diseases in a community setting.
(b) Institution of control measures and evaluation of the effectiveness of these measures.
14. Various types of epidemiological study designs.
15. The derivation of normal values and the criteria for intervention in case of abnormal values.
16. Planning an intervention programme with community participation based on the community diagnosis.
17. Applications of computers in epidemiology.
18. Critical evaluation of published research.

D.   Epidemiology of Specific Diseases
1. Extent of the problem, epidemiology and natural history of the   disease.
2. Relative public health importance of a particular disease in a   given area.
3. Influence of social, cultural and ecological factors on the epidemiology of the disease.
4. Control of communicable and non-communicable disease by:
a. Diagnosing and treating a case and in doing so demonstrate   skills in:
(i) Clinical methods
(ii) Use of essential laboratory techniques
(iii) Selection of appropriate treatment regimes.
(iv) Follow-up of cases.
b. Principles of planning, implementing and evaluating control measures for the diseases at the community level bearing in mind the relative importance of the disease.
5. Institution of programmes for the education of individuals and communities.
6. Investigating a outbreak/epidemic.
7. National Health Programmes.

E.   Biostatistics
a. Collection, classification and presentation of statistical data.
b. Analysis and interpretation of data.
c. Obtaining information, computing indices (rates and ratio) and making comparisons.
d. Apply statistical methods in designing of studies.
e. Choosing of appropriate sampling methods and sample size.
f. Applying suitable test of significance
g. Use of statistical tables.

F.   Entomology
1. Role of vectors in the causation of diseases.
2. Mode of transmission of vector borne diseases.
3. Methods of vector control with advantages and limitations of   each.

G.   Health planning and Public Health Administration

H.   Health Management

I.   Health economics

J.   Nutrition
1. Role of nutrition in Health and Disease.
2. Nutritional problems of the country
3. Common sources of various nutrients and special nutritional requirement according to age, sex, activity, physiological conditions.
4. Nutritional assessment of individual, families and the community by selecting and using appropriate methods such as : anthropometry, clinical, dietary, laboratory techniques.
5. Compare recommended allowances of individual and families   with   actual intake.
6. Common nutritional disorders: protein energy malnutrition, Vitamin A

deficiency, anemia, iodine deficiency disorders, fluorosis, food toxin diseases and their control and management.
7. National Nutritional Policy.
8. National programmes in nutrition and their evaluation.
9. Food adulteration: prevention and control.

K. Environmental Sanitation
1. Awareness of relation of Environment to Health.
2. Awareness of the concept of safe and wholesome water.
3. Awareness of the requirements of sanitary sources of water.
4. Understanding the methods of purification of
5. Various biological standards.
6. Concepts of safe disposal of human excreta.
7. Physical, chemical standards; tests for assessing quality of   water.
8. Disposal of solid waste, liquid wastes both in the context of urban and rural conditions in the community.
9. Problems in the disposal of refuse, sullage and sewage.
10. Sources, health hazards and control of environmental pollution.
11. Influence of physical factors – like heat, humidity, cold, radiation and noise – on the health of the individual and community.
12. Standards of housing and the effect of poor housing on health.

L. Demography and Family Planning
1. Definition of demography and its relation to Community Health.
2. Stages of the demographic cycle and their impact on population.
3. Definition, calculation and interpretation of demographic indices like birth rate, death rate, growth rate, fertility rates.
4. Reasons for rapid population growth in the world, especially in India.
5. Need for population control measures and the National   Population Policy.
6. Identify and describe the different family planning methods and their advantages and shortcomings.
7. Principles of Counselling; Client satisfaction.
8. Medical Termination of Pregnancy Act.
9. Organisational, technical and operational aspects of the National Family Welfare Programme and participation in the implementation of the Programme. Target Free Approach.
10. MTP and infertility services.
11. National Population Policies.

M. Mental Health
1. Public health importance of mental health
2. Public health approach to mental health problems: types, diagnosis and management of mental health problems in the community.

N. Application of Social Sciences in Health

O. Impact of urbanisation on health and disease.

P. School Health

Q. Urban health

M.Phil & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Economics studies and Planning (CESP)	Economics-ECOP (136) & ECOH (865)	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.
2	Centre for Historical Studies (CHS)	Modern History- MODP (137) & MODH (866)	The exam is structured to test the students on: A. Historical methods B. Historiographical debates and discussions C. Themes related to political, economic and social history and on aspects of religion and culture pertaining to Indian history for the ancient, medieval, modern and contemporary periods (including World history).
3		Medieval History – MEDP (138) & MEDH (867)	
4		Ancient History – ANCP (139) & ANCH (868)	
5	Centre for Political Studies (CPS)	Political Science – POLP (140) & POLH (869)	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.
6	Centre for the Study of Regional Development (CSRD)	Population Studies- POPP (141) & POPH (870)	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. **(i) Regional Development: Geography (code: GEO)** Syllabus: (A) **Research Methodology**: Recent trends in geographical thought and research concerns in the field; Cartographic methods; descriptive statistics; sampling techniques; correlation and regression analysis, geographical information system, Remote sensing, and GPS; Morphometric techniques in areal and liner analysis, hydrograph and runoff estimation, evapotranspiration, methods of soil analysis, ground water mapping and estimation, RS in LU-LC and biodiversity mapping, magnitude-frequency classification of natural disasters, methods of graphical representation of economic loss of disasters, age estimation of landforms. Methods of landscape surveying and mapping; socio-economic field survey methods. (B) **i. Physical Geography :** Geomorphology, Oceanography, climatology, climate change, Hydrology, Biogeography, Ecosystems, Natural Resources and Natural Disasters (with special reference to India) **ii. Human Geography:** Population distributed and growth: human settlements, urbanization, migration rural and agricultural geography: Spatial structure and temporal trends of economic activity; Social groups and communities, tourism; (with special reference to India) iii. **Regional Development:** Concepts, strategies of regional development regional imbalances and levels of development in India; inclusive exclusions and exclusive inclusions, Globalization, natural resources and changing spatial division of labour. **(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)
7		Geography- GEOP (142) & GEOH (871)	
8		Economics- ECNP (143) & ECNH (872)	

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- CSMP (144) & CSMH (873)	**Basic concepts in Social Sciences and its relevance to public Health** 1. Social Stratification -Caste, Class, Gender, Religion, Ethnicity Exclusion, discrimination, marginalization, humiliation and stigma, Diversity, Social cohesion—comparison with other societies 2. Social Institutions and Groups: Family, Kinship and Household, Village, Urban Settlements. 3. Culture- Norms, values, role and status, culture shock, taboos, ethnocentrism, cultural relativism. 4. Characteristics of Rural and Urban Society -rural society; agrarian class structure, urban, urbanism and urbanization 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 -Nature of State in India, Welfare state and public health, State and public policy 19. Current Debates in Health **2. Application of Social Sciences to Health** 1. Social Determinants of Health 2. Development and Health -Primary Health Care Approach &Selective Health Care Approach 3. Social inequalities and marginalisaltion 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 12. Universal Health Care 13. Recent social issues and their implications for health **3. Research Methodology** 1. Qualitative methods in Social Sciences- observation, life history, case

			study, narratives, ethnography
			2. Quantitative methods in Social Sciences – survey methods, research instruments
			3. Importance of Qualitative and quantitative research methods used in public health
			4. Mixed methods
			5. Ethics in Research
			6. **Statistical Methods**
			• Mean, Median, Mode and standard deviation
			• Sampling methods
			• Measures of social disparities and spatial variation
			• Basic statistics for public health- birth rate; crude death rate; Infant mortality; child mortality; life expectancy at birth; sex ratio; dependency ratio; morbidity rate; population growth rate; standardisation
10	Centre for the Study of Social Systems (CSSS)	Social Systems - SOCP (146) & 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 o Classical Thinkers: Karl Marx, Emile Durkheim, Max Weber o Advanced Social Theories : Postmdernism, Postcolonialism and Poststructuralism o Study of Monographs: Evans-Pritchard, Brownislaw Mallinowski, 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 16. Industrial/Corporate Sociology 17. Modernization, Globalization and Development 18. Media Studies
11	Zakir Husain Centre for Educational Studies (ZHCES)	Educational Studies-EDUP (147) & EDUH (876)	**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 studies. The syllabus for the entrance examination under each of these areas of specialisation is as follows (the list is only indicative, not exhaustive): **A. History of Education** Historical method and historiography; Modern Indian history; The educational debates; 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 modernisation; 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 marginalised; Sociology of education; Sociology of development; Methodology and methods in Sociological research. **C. Psychology of Education** 1. Fundamental Psychological Processes: Attention, Perception, Learning, Perception, Memory, Thinking and Problem Solving, Emotion and motivation; Intelligence: Theories and Measurement; Personality Theories; Theories of Human

			Development: Cognition, Emotion, Moral, Social; 2. Social Psychology: Social Influence Process, Social Cognition, Group Processes, Intergroup Relations; Research Methods in Psychology: Survey, Experiment, Case Study, Qualitative Approach: Narrative, Discourse Analysis, Interview; Cross-cultural indigenous, and critical perspectives in Psychology.
			D. Economics of Education
			1. Microeconomics: Theory of Consumer Behaviour- price effect and substitution effects; theory of revealed preference, elasticity of demand; Theory of Production- production function, short run and long run, isoquants, cost functions. Theory of the Market Structure: various forms of market and price-output decisions (perfect competition, monopoly, monopolistic competition, oligopoly); Neo-classical theory of distribution, Welfare Economics and General Equilibrium 2. Macroeconomics: National Income Accounting- national income as a measure of welfare and economic progress; Theories of consumption and investment- Models of income determination; Simple Keynesian model, IS-LM model; Theories of supply and demand for money; Phillips curve and theories inflation; Open economy macroeconomics and Balance of Payments; Theories of growth and international trade. 3. Theories of Development and the Indian Economy: Employment and labour; Income Inequality; Globalisation and Internationalisation; New Economic Policy and its impact on social sector and physical infrastructure in the context of India.
12	Centre for Studies in Science Policy (CSSP)	Studies in Science Policy-SSPP (148) & 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/cssp-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 Resarch 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 countires.
13	Centre for Philosophy (CP)	Philosophy-SPHP (149) & 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/cop-mphil
			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 positivism

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 (*vyāpti*) 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 Compatibalism
      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.   Mīmāmsā Theory of *Dharma*, *itikartavyatābodha*, *artha* and *bhāvnā*,
- ii.   Buddhist Ethics
- iii.   Jaina Ethics
- iv.   Theory of Obligation in Bhagvad Gītā

UNIT- IV

Social and Political Philosophy

- a.   Political Ideas: Equality, Justice, Liberty, Freedom, Rights
- 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

14	Centre for Women Studies (CWS)	Women Studies – WSPP (176) & WSPH (879)	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 oter 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 Visuality 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.
15	Centre for the Study of Social Exclusion and Inclusive Policy	Social Exclusion and Inclusive Policy - SEIP (152) & 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 indepth 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.
16	Centre for Media Studies (CMS)	Media Studies-CMSP (173) & 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.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Group of Adult Education (GAE)	Adult Education-GAEH (883)	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 family, media, citizenship 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 & 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 enrole 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.
2	Centre for Informal Sector & Labour Studies (CISL)	Informal Sector & Labour Studies- ISLH (884)	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 Community, Common Property Resources, Public Policies in the Unorganised Sector, and Sustainable Development. The objective of the programme is to enable students to understand the linkages between the formal and the informal sectors and between theory and empirical investigations in research work.

5. SCHOOL OF ENVIRONMENTAL SCIENCES

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Master of Science

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
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.

M.Phil & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Environmental Sciences (SES)	Research Area I- ONEP (153) & 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.
2		Research Area II- TWOP (154) & TWOH (886)	
3		Research Area III- THRP (155) & THRH (887)	
4		Research Area IV- FORP (156) & FORH (888)	

6. SCHOOL OF COMPUTER & SYSTEMS SCIENCES

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

MCA

Sl. No.	Name of Centre	Sub. Code & Sub. Code (Number)	Syllabus for Entrance Examination
1	School of Computer & Systems Sciences (SC&SS)	Master of Computer Applications- MCAM (224)	**Syllabus:** General aptitude, reasoning and 10+2 and Bachelor's level mathematics and Computer Science as per the topics specified as under: **Maths:** Differential and Integral Calculus, Vector Algebra, Trigonometry, 2D-3-D Geometry, Modern Algebra, Numerical Analysis, Probability & Statistics, Real Analysis, Theory of Real Function, Matrices and Determinants **Computer Science:** Digital Systems Design & Architecture, Programming Languages (C), Data structures, Discrete mathematics.

M.Phil. & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code (Number)	Syllabus for Entrance Examination
1	School of Computer & Systems Sciences (SC&SS)	M.Phil - SCSP (158) & Ph.D. - SCSH (890)	**Syllabus:** 50% of the questions will be from Research Methodology and remaining 50% from Bachelor's/Master's level Mathematics and Computer Science. The topics for both are specified as under: **Research Methodology:** Experimental Design; Fundamentals of Sampling; Data: types, quality measurement; Processing and Analysis of data; Hypothesis Testing (parametric, nonparametric), Theory of Probability. **Maths:** Integral and Differential Calculus, Linear Algebra, Numerical Analysis, Modern Algebra. **Computer Science:** Data Structures and Algorithms, Programming Languages (C, C++), Operating Systems, Discrete Mathematics, Automata Theory, Computer Architecture, Computer Networks, Database Management System.

M.Tech. (Computer Science and Technology)

Sl. No.	Name of Centre	Sub. Code & Sub. Code (Number)	Syllabus for Entrance Examination
1	School of Computer & Systems Sciences (SC&SS)	M.Tech – MTCT (157)	**Syllabus:** 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. **Computer Science:** Data structures, Programming Languages (C, C++), algorithms, Operating Systems, Database Management System, Computer Architecture, Computer Network, Discrete Mathematics, Automata Theory.

M.Tech. (Statistical Computing)

Sl. No.	Name of Centre	Sub. Code & Sub. Code (Number)	Syllabus for Entrance Examination
1	School of Computer & Systems Sciences (SC&SS)	Statistical Computing (Data Science) - MTST (183)	**Syllabus:** General aptitude, reasoning and Bachelor's/Master's level mathematics, Statistics and Computer Science as per the topics specified below: **PART A** **Maths and Stats:** Probability, Statistics, Operations Research, Real Analysis, Linear Algebra, Modern Algebra. **Computer Science:** Data structures, Programming Languages (C, C++), Operating Systems, Automata Theory, Discrete Mathematics, Digital Systems Design. **PART B**
		Statistical Computing (Data Communication) – MTDT (189)	**Syllabus for Data Science Stream**: Databases, Artificial Intelligence and Machine Learning, Data Warehousing, Data Mining. **Syllabus for Data Communication Stream**: Computer Networks, Network Security, Network Programming, Mobile Computing, Wireless Communication.

7. SCHOOL OF PHYSICAL SCIENCE

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Master of Science

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Physical Sciences (SPS)	Physics- SPSM (226)	**Mathematical Methods:** Calculus of single and multiple real variables. Fourier and Laplace transforms. Vector Calculus, Divergence theorem, Green's theorem, Stokes' theorem. First order and linear second order differential equations with constant coefficients. Matrices and determinants. Complex numbers.
			Mechanics and General Properties of Matter: Newton's laws of motion and applications. Motion under a central force, and Kepler's laws. Elastic and inelastic collisions. Rigid body motion. Principal moments and axes. Kinematics of fluids. Bernoulli's theorem.
			Oscillations, Waves and Optics: Simple harmonic motion. Damped and forced oscillators. Resonance. Wave equation. Group and phase velocities. Sound waves in media. Doppler Effect. Interference and diffraction. Diffraction gratings. Polarization: linear, circular and elliptic polarization. Double refraction and optical rotation.
			Electromagnetism: Coulomb's law. Gauss's law. Electric field and potential. Solution of Laplace's equation for simple cases. Conductors, capacitors, dielectrics. Electrostatic energy. Biot-Savart law, Ampere's law, Faraday's law of electromagnetic induction. LCR circuits. Maxwell's equations and plane electromagnetic waves, Poynting's theorem. Transmission and reflection coefficients (normal incidence only). Lorentz Force and motion of charged particles in electric and magnetic fields.
			Thermal and Statistical Physics: Maxwell-Boltzmann distribution. Equipartition of energy. Ideal gas law. Specific heat. van-der-Waals gas and equation of state. Laws of thermodynamics. First law and its consequences. Isothermal and adiabatic processes. Second law and entropy. Maxwell's thermodynamic relations. Thermodynamic potentials. Fermi-Dirac and Bose-Einstein distributions.
			Modern Physics: Basics of special relativity. Length contraction. Time dilation. Relativistic velocity addition theorem. Mass-energy equivalence. Blackbody radiation. Photoelectric effect. Compton effect. Bohr's atomic model. Pauli exclusion principle. Wave-particle duality. Uncertainty principle. Superposition principle. Schrödinger equation. Particle in a box problem in one, two and three dimensions. Solution of the Schrödinger equation for one dimensional harmonic oscillator. Structure of atomic nucleus, mass and binding energy. Radioactivity.
			Solid State Physics, Devices and Electronics: Crystal structure, Bravais lattices and basis. Miller indices. X-ray diffraction and Bragg's law. Intrinsic and extrinsic semiconductors, variation of resistivity with temperature. Fermi level. p-n junction diode, I-V characteristics, Zener diode and its applications. Transistor characteristics. R-C coupled amplifiers. Operational Amplifiers: Inverting and non-inverting amplifier. Boolean algebra: Binary number systems; binary addition and subtraction. Conversion from one number system to another.
			Logic Gates AND, OR, NOT, NAND, NOR, X-OR. Truth tables. Combination of gates.

2		Chemistry – CHEM (227)	**PHYSICAL CHEMISTRY**

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; K_p, K_c, K_x and K_n; 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; Debey-Huckel-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, carbenes, nitrenes, benzynes); Hofmann-Curtius-Lossen rearrangement, Wolff rearrangement, Simmons-Smith reaction, Reimer-Tiemann reaction, Michael reaction, Darzens reaction, Wittig reaction and McMurry reaction; Pinacol-pinacolone, Favorskii, benzilic acid rearrangement, dienone-phenol rearrangement, Baeyer-Villeger 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, nitrosyls and metallocenes; homogenous catalysis.

*Bioinorganic Chemistry***:** Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions, especially Fe^{2+}, Fe^{3+}, Cu^{2+} and Zn^{2+}; structure and function of hemoglobin and myoglobin and carbonic anhydrase.

Instrumental Methods of Analysis: Basic principles; instrumentations 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.

3		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

Group Theory: Groups, subgroups, Abelian groups, non-Abelian groups, cyclic groups, permutation groups, normal subgroups, Lagrange's Theorem for finite groups, group homomorphism and basic concepts of quotient groups, Cayley's theorem, class equations

Linear Algebra: Finite dimensional vector spaces, linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem. rank and inverse of a matrix, determinant, solutions of systems of linear equations, consistency conditions, eigenvalues and eigenvectors for matrices, Cayley-Hamilton theorem, Inner product spaces, Orthonormal basis

Miscellaneous: Logical reasoning, elementary combinatorics, divisibility in Integers, Congruence, Chinese remainder theorem, Euler's φ-function

Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Physical Sciences (SPS)	Mathematical Sciences – MATH (897)	**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 meausre 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, homomorpshims, isomorphisms and automorphisms, separable and normal extensions, splitting field of a polynomial, extending field morphisms, algebraic closure of a field, finite fields, cyclicity of the mulitplicative 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 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.

First and second countable spaces, separable spaces, separation axioms, Urysohn lemma, Tietze extension theorem, Tychonoff theorem and Stone-Čech compactification.

Functional Analysis:

Examples of normed spaces (sequence spaces: c, c0, lp spaces; function spaces: C[0, 1], 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, congruences, Chinese remainder theorem, Euler's totient function, primitive roots.

| 2 | | Physical Sciences – PHYH (898) | I. **Mathematical Physics**
Linear vector spaces. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order. Special functions. Partial differential equations. Green's function. Fourier and Laplace transforms. Complex analysis: analytic functions, poles and residues, series expansion, and evaluation of integrals.

II. **Classical Mechanics**
Lagrangian and Hamiltonian formalism. Equations of motion. Central force problem. Conservation laws. Small oscillations and normal modes. Special theory of relativity.

III. **Electromagnetic Theory**
Gauss's law. Laplace and Poisson equations, boundary value problems. Ampere's law. Electromagnetic induction. Maxwell's equations. Scalar and vector potentials. Gauge invariance. Conservation laws for electromagnetic fields. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction of electromagnetic waves. Dynamics of charged particles in static and uniform electromagnetic fields.

IV. **Quantum Mechanics**
Wavefunctions and operators. Heisenberg uncertainty principle. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, hydrogen atom). Tunneling. Orbital and spin angular momenta. Addition of angular momenta. Time-independent perturbation theory. Variational method. Time dependent perturbation theory: Fermi's golden rule and selection rules. Identical particles and indistinguishability.

V. **Thermodynamics and Statistical Physics**
Laws of thermodynamics and their consequences. Thermodynamic potentials. Legendre transformation. Maxwell relations. Chemical potential, phase equilibria. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Blackbody radiation and Planck's distribution. First- and second-order phase transitions.

VI. **Atomic & Molecular Physics**
Quantum states of electrons in an atom. Relativistic corrections of atomic energy levels. LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Magnetic resonance. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation.

VII. **Condensed Matter Physics**
Bravais lattices. Reciprocal lattice. Diffraction and structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory of metals and electronic specific heat. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Magnetism: types of magnetic ordering and Curie-Weiss law.

VIII. Nuclear and Particle Physics
Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nuclear force. Single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, |

beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.).

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 (899)	**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: Benzenoid and non - benzenoid compounds – generation and reactions. 4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. 5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways. 6. Common named reactions and rearrangements – applications in organic synthesis. 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. 8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups. 9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic. 10. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry. 11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S). 12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty

acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.

13. Structure determination of organic compounds by IR, UV - Vis, ^{1}H & ^{13}C 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.

3. Acids and Bases: Lewis acids and bases, HSAB concept, Gas phase versus solution acidity, Solvent levelling effects, Surface acidity.

4. Oxidation and Reduction: Analysis of redox cycles, Redox stability in water, Disproportionation/Comproportionation, Frost, Latimer and Pourbaix diagrams.

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; tunnelling.

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.

8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities–calculations for model systems.

9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.

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.

8. SCHOOL OF COMPUTATIONAL AND INTERGRATIVE SCIENCES

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.Sc. Programme

Sl. No.	Name of Centre	Sub. Code & Sub. Code (Number)	Syllabus for Entrance Examination
1	School of Computational and Integrative Sciences (SC&IS)	Computational and Integrative Sciences - Track 1 – TROM (232) & Track 2 – TRTM (238)	**Section 1: Physics** **Mathematical Physics:** Linear vector space; matrices; vector calculus; linear differential equations; Fourier analysis. **Classical Mechanics:** Conservation laws; central forces, Kepler problem and planetary motion; mechanics of a system of particles; rigid body dynamics; moment of inertia tensor; special theory of relativity – Lorentz transformations, mass-energy equivalence. **Electromagnetic Theory:** 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; Electromagnetic waves and their reflection, refraction, interference. Poynting vector, Poynting theorem. **Quantum Mechanics:** Physical basis of quantum mechanics; uncertainty principle; Schrodinger equation; one, two and three dimensional potential problems -- particle in a box, harmonic oscillator, hydrogen atom. **Thermodynamics and Statistical Physics:** Laws of thermodynamics; macrostates and microstates; phase space; free energy, calculation of thermodynamic quantities; black body radiation and Planck's distribution law; classical statistics. **Atomic and Molecular Physics:** Spectra of one- and many-electron atoms; LS and jj coupling; Zeeman and Stark effects; X-ray spectra; lasers. **Section 2:Chemistry:** General Topics(Inorganic and Basic Organic) Properties of gases, kinetic theory Thermodynamics Chemical Bonding Molecular Structure Chemical Kinetics **Section 3: Mathematics/Statistics:** General topics at the B.Sc. level. Specific focus will be on the following topics: **Linear Algebra:** Vector spaces, Sub spaces, linearly dependent & linearly independent vectors, Basis, Dimension, linear transformation, Matrix representation of a linear transformation, Rank & Nullity theorem. Finite dimensional vector spaces, Existence theorem for basis, Quotient space and its dimension. Rank of a matrix, Eigen values & Eigen vectors. **Abstract Algebra:** Divisibility in the set of integers, congruence, Groups, Sub groups, Permutation groups, Cyclic groups, Lagrange's theorem and its consequences, Normal subgroups, Quotient groups, Group homomorphism, Kernel of a homomorphism, Fundamental

theorem of homomorphism of groups, Group isomorphism, Cayley's theorem.

Optimization: Introduction to Linear Programming. Problem formulations. Linear independence and dependence of vectors. Convex sets. Extreme points. Hyperplanes and Half spaces. Directions of a convex set. Convex cones.

Polyhedral sets and cones. Theory of Simplex Method. Simplex Algorithm. Assignment and Transportation.

Calculus, Differential Calculus, Vector Calculus, Numerical Analysis, Mechanics, Mathematical Methods, Real Analysis

Probability and Statistics: Measures of central tendency and dispersion, Skewness and kurtosis, Probability, Conditional probability, Theorem of total probabilities, Bayes theorem, Random variables, Probability mass and density functions, Mathematical expectation and its properties, Moment generating functions, Binomial, Poisson, Geometric, Exponential and Normal distributions and their properties, Method of least squares, Correlation and regression.

Section 4: <u>Computer Sciences and Programming:</u>

Questions will be set at the B.Tech/M.Tech Level. Special Focus will be on the following topics

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 Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Section 5: Life Sciences

Biomolecules & Cellular Organization, Fundamental Processes: Replication, Transcription and Translation, Basic Concepts in Genetics & Immunology, Genome Organization & Regulation, Basic Techniques in Molecular Biology and Recombinant DNA Technology

Section 6: Biotechnology/ Bioinformatics

Sequence analysis and alignment algorithms, Phylogenetic Analysis, Fundamentals of Genomics, Structural Bioinformatics, Basic concepts in molecular biology, genetics and biochemistry.

Post-Graduate Diploma in Big Data Analytics (PGDT)

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Computational and Integrative Sciences (SC&IS)	Post-Graduate Diploma in Big Data Analytics – PGDT (191)	(Separate merit lists of students for Track 1 (Non-biological sciences) and Track 2 (Biological sciences) will be used for final admissions. The categorization in Tracks will be based on students' choice in the application form irrespective of his/her academic background and section of questions he/she attempts. Total number of seats will be equally divided into the two tracks) PG Diploma course will have a single entrance test of **Data Science Aptitude (Biological data)** with the following break up. General reasoning, Computer programming in Python and C, Basic statistics, Bioinformatics/ Life Science, **The syllabus for respective sections is as follows:** **1. General Reasoning** This section is designed to assess the analytical and quantitative skills of the students acquired throughout their academic career. **2. Computer programming in Python and C** Fundamentals of Programming in Python: File handling. Basic python libraries. Functions. Loops. Numerical functions in python. Basic operations in Python for matrices, algebra, numerical and string manipulations. Regular expressions and text processing. Fundamentals of C programming: Loops. Data types. Arrays. Libraries. Functions. I/O functions. Pointers and Structures. **3. Basic statistics** General aspects: Randomness. Randomization. Random number generation. Statistical dispersion. Observational error. Central tendencies. Mean, median, mode. Relative frequency. Variance. Standard deviation. Maximum likelihood. Bayesian probability. Information entropy. Foundations of probability theory. Probability theory. Standard probability space. Normalizing constant. Event and Complementary event. Mutually exclusive events. Probability density function. Cumulative distribution function. Bayes theorem. Prior probability. Posterior probability. Random variables, Statistical independence. Conditional independence. Pairwise independence. Covariance and Correlation. Theory of probability distributions. Probability distribution. Probability distribution function. Probability density function. Quantile. Moment about the mean. Standardized moment. Skewness. Kurtosis. Properties of probability distributions. Normal distribution. Poisson distribution. Binomial distribution. **4. Bioinformatics/Life Sciences** Sequence analysis and alignment, Phylogenetic Analysis, Database Management System, Structural bioinformatics & drug designing, Databases and tools for biological data mining and pathway analysis, Biomolecules & Cellular Organization, Fundamental Processes: Replication, Transcription and Translation, Gene structure, Transcriptional and post-transcriptional Gene Regulation, Genome Organization, Metabolic engineering and Systems Biology, gene regulatory networks, Basic Techniques in Molecular Biology, Fundamentals of Genomics, transcriptomics, proteomics and metabolomics, Next Generation Sequencing Technologies and data analysis

Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Computational and Integrative Sciences (SC&IS)	Computational Biology and Bioinformatics – Track 1 – TROH (903); Track 2 – TRTH (909) & Track 3 – TRDH (910)	**Section 1: Physics:** **Mathematical Physics:** Linear vector space; matrices; vector calculus; linear differential equations; elements of complex analysis; Laplace transforms, Fourier analysis, elementary ideas about tensors. **Classical Mechanics:** 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. **Electromagnetic Theory:** 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. **Quantum Mechanics:** Physical basis of quantum mechanics; uncertainty principle; Schrodinger 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. **Thermodynamics and Statistical Physics:** 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. **Atomic and Molecular Physics:** 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. **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:** **Hydrodynamics:** Classification of fluids, the continuum model, Lagrangian and Eulerian approach of description. Lagrangian and Eulerian methods. Equation of continuity. Boundary surface. Stream lines. Path lines and streak lines. Velocity potential. Irrotational and rotational motions. Vortex lines, vorticity vector, equi-potential surface streamlines, pathlines, Mass flux density, conservation of mass leading to equation of continuity, conservation of momentum and its mathematical formulation, Lagrange's and Euler's equations of motion, Bernoulli's theorem, Equation of motion by flux method. Equations referred to moving axes Impulsive actions, Stream function. Viscous flow, stress and strain analysis, stokes hypothesis, The Navier-stokes equation of motion, Poiseuille flow. **Advanced Differential Equations:** Existence and uniqueness theorem, Sturm comparison and separation theorem, homogeneous linear system, Nonhomogeneous 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.

Linear Algebra: Vector spaces, Sub spaces, linearly dependent & linearly independent vectors, Basis, Dimension, linear transformation, Matrix representation of a linear transformation, Rank & Nullity theorem. Finite dimensional vector spaces, Existence theorem for basis, Quotient space and its dimension. Rank of a matrix, Eigen values & Eigen vectors. Change of basis, Canonical forms, Diagonal forms, Triangular forms, Jordan forms, Quadratic forms, reduction and classification of quadratic forms, Orthogonal transformations, Unitary transformations, Positive semi definite matrices, Semi definite matrices.

Operational Research and Networking: Introduction to Linear Programming. Problem formulations. Linear independence and dependence of vectors. Convex sets. Extreme points. Hyperplanes and Half spaces. Directions of a convex set. Convex cones. Polyhedral sets and cones. Theory of Simplex Method. Simplex Algorithm. Transportation problem. Assignment problem.

Graph Theory and Petri nets: Selected topics in graph theory: basic definitions and notions, characterization of trees, vector vacuum of a graph, planarity of graphs, Hamiltonian and Eulerian cycles. Edge – and vertex colourings of graphs: chromatic number, chromatic index, map colour theorem, four – colour problem. Independence theory in combinatory. Directed digraphs. Flow networks. Applications. Petri nets and their types.

Probability and Statistics: Measures of central tendency and dispersion, Skewness and kurtosis, Probability, Conditional probability, Theorem of total probabilities, Bayes theorem, Random variables, Probability mass and density functions, Mathematical expectation and its properties, Moment generating functions, Binomial, Poisson, Geometric, Exponential and Normal distributions and their properties, Method of least squares, Correlation and regression.

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 contex-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
Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key

cryptography, digital signatures and certificates, firewalls.

Section 5: <u>Life Sciences/Biotechnology</u>
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: <u>Bioinformatics</u>
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, Thevenin 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 resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, 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 element, Radiation from small 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

9. SCHOOL OF ARTS & AESTHETICS

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Master of Arts

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
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, and Film/Media Practitioners. There should be awareness of cinema/ 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. |

M.Phil & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Arts & Aesthetics (SA&A)	**M.Phil** : Visual Studies – VSAP (163) **Ph.D. :** Visual Studies – VSAH (900)	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. 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 and 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 competetiveness and the "clash of icons." Technologies of art-making, intentionalities 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 frameworks. Photography theory, digital convergence and "remediation".
2		**M.Phil :** Theatre & Performance Studies- TPSP (164) **Ph.D. :** Theatre & Performance Studies- TPSH	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

		(901)	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*, *Dhvanyaloka, 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		**M.Phil :** Cinema Studies- CNSP (165) **Ph.D. :** Cinema Studies - CNSH (902)	<u>Note</u>: 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 Issues and Debates in Research Methodology Media and Cultural Studies Sound and Colour in the History of Cinema Authorship Debates Theories of Genre Film Stardom and Celebrity Culture Early Debates and Discourses on Film Modernism, Mass Culture and Cinema Theories of the Cinematic Avant Garde The Cinematic Apparatus Cinema and the Postmodern Television and Video Theory

			The Post Cinematic and Post Celluloid Debates
			Media Sensorium and Media Archaeology Debates
			Embodiment and Affect in Film/Media
			The Cultural Politics of Speed, Surveillance and Forensics in Cinema/Media
			The Archive Effect and Memory
			Digital Culture and the Internet

10. SCHOOL OF BIOTECHNOLOGY

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Biotechnology	Biotechnology – SBTH (904)	*Chemistry* *Chemical periodicity, Structure and bonding, Concepts of acids and bases, Properties and functions of metals and non-metals, Transition elements and coordination compounds, Characterisation of inorganic compounds, Analytical chemistry, Nuclear chemistry, Polymer chemistry, Molecular spectroscopy, Chemical thermodynamics, Electrochemistry, Chemical kinetics, Colloids and surfaces, numerical problems related to mole concept, pH, dissociation constants, emf, rate constant etc.* *IUPAC nomenclature of organic molecules, isomerism, Principles of stereochemistry, Aromaticity, Organic reactive intermediates, Organic reaction mechanism, Common named reactions and rearrangements, Organic transformations and reagents: Functional group interconversion, Asymmetric synthesis, common heterocyclic compounds containing one or two heteroatoms (O, N, S), Chemistry of natural products: (Carbohydrates, proteins and peptides, fatty acids, nucleic acids etc.), Structure determination of organic compounds.* *Physics, Chemistry and Mathematics* *Class XIIth Syllabus (As per CBSE)* *Biochemistry* *Biomolecules* *Amino Acids, Peptides and Proteins* *Nucleic Acids , Carbohydrates and Lipids* *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-sub cellular fractionation and specific activity* *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

Introduction to Metabolism
  Metabolic Pathways
  Organic Reaction Mechanisms
  Experimental Approaches to the study of Metabolism
  Thermodynamics of Phosphate compounds
  Oxidation-Reduction Reactions

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

Citric Acid Cycle
Cyclic Overview
Metabolic Sources of Acetyl Coenzyme A
Enzymes of the Citric Acid Cycle
Regulation of the Citric Acid Cycle

Electron Transport and Oxidative Phosphorylation
The Mitochondrion
Electron Transport
Oxidative Phosphorylation
Control of ATP Production

Lipid metabolism
Lipid Digestion, Absorption and Transport
Fatty Acid Oxidation& Biosynthesis
Ketone Bodies
Regulation of Fatty Acid Metabolism

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

Nucleotide Metabolism
Synthesis of Purine Ribonucleotides
Synthesis of Pyrimidine Ribonucleotides
Formation of Deoxyribonucleotides
Nucleotide Degradation
Biosynthesis of Nucleotide Coenzymes

Glycoproteins & Glycolipids

Hormones & Vitamins

Metabolic disorders and diseases

Integration of Metabolism & Organ Specialization
Major Pathways and Strategies of Energy Metabolism: A Summary
Organ Specialization & Metabolic Homeostasis

Structural Biology and Biophysical Chemistry

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

Structure of Proteins
Conformational properties of polypeptides
Primary and secondary structure (α-helix and β-sheet structures etc.)
Tertiary and quarternary structure
Structural features of membrane proteins
Secondary and tertiary structure prediction of protein conformation

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
Kinetics of protein folding

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)
Mass Spectrometry

Microbiology
Bacterial diversity
How to classify bacteria
Chemical/Biochemical reactions
Nutrient preference and other biochemical properties
16S rRNA based classification
Three domain classification of microorganisms
Microbial ecology
Carbon and Nitrogen cycles
Phosphorus and Sulfur cycles
Manganese and Mercury cycles
Interaction between elemental cycles
Biogeochemical cycles in relation to climate change
Diversity of bacterial flora in humans
Diversity of microorganisms associated with different anatomical aras in humans
Alterations in microbiome diversity with disease
Structure and Function of the Prokaryotic cell
Peptidoglycan structure and biosynthesis
Cell surface proteins and their role in bacterial pathogensis
Structure and biosynthesis of cell surface organelles
Chaperone – Usher pili in Gram negative bacteria
Covalent anchorage of cell-surface proteins in gram positive bacteria
Ultrastructure and assembly of motility structures: Type IV pili and bacterial flagellum
Atomic structure of the bacterial ribosome
Bacterial Host-Parasite relationships

Mechanism of bacterial pathogenesis
Bacterial structure in relation to pathogenicity
Bacterial protein toxins/endotoxins
Antimicrobial agents used in the treatment of infectious disease
Mechanism of antibiotic action
Antibiotic resistance
Virology
Basic concepts of virus structure
Helical, Icosahedral and Complex structures
Viral genome replication
Viral entry to exit from the infected cells with reference to VSV, adenovirus and retrovirus
Cellular defences against virus infections
Strategies devised by viruses to escape the innate and adaptive immune responses
Antiviral chemotherapy
Antiviral drugs targeting attachment to release of virus particles and their mechanism of action
Modern approaches of virus control
Antisense RNA,siRNA,ribozymes, miRNA
Introduction to feukaryotic viral vectors

Industrial Microbiology
Isolation and Presentation of Microorganism
Improvement of strains
Primary metabolism
Secondary Metabolism
Recombinant proteins
Sterilization
Media Design
Scale up principles
Prokaryotic Molecular Biology

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 and their function.

Bacteriophages: Genome and infection and Biology
Bacteriophage T4: Unique properties of genome, Presence of modified bases. Terminal redundancy and Circular permutation. Genetic map of T4 is circular. T4 life Cycle. Transcription: Temporal expression of genes. Replication: Degradation of host genome and generation of modified cytosine for its own perpetuation in T even phages. Assembly of Phage particles. T4 DNA polymerase and regulation of transcription Bacteriophage T7: Gene organization and Infection Controlled Injection of DNA. Transcriptional regulation. Classes of genes. Taking over the cells and production of T7 Polymerase. Differential Affinity with Class II and III promoters. Bacteriophage ϕX174: Genome. Circularity of genome. Infection and Growth. Conversion of single stranded circular DNA viruses into double stranded RF form. Synthesis of viral plus strand from RF DNA. Packaging of genome in phage head. Transcriptional regulation, Overlapping genes.

Plasmids:
Microscopic and Genetic-F plasmid first plasmid to be detected. Counter - selection, Transfer accompanied by replication, Purification of plasmids. Mobilizable and non-mobilizable plasmids. Incompatibility- reasons of incompatibility. Copy number control. Replication of Plasmids: Use of host and plasmid encoded proteins. Uni- and Bi directional replication, Butterfly mode of replication. Replicon. Control of plasmid replication- Iteron regulated and RNA regulated replication. Antisense RNA for primer RNA and replicase protein. Role of replication on incombatibility in Iteron regulated. Drug-resistance plasmid: R- and RTF determinant. Colicin plasmid: Types of plasmids.

Action of colicins. Colicin genes. Immunity and Lysis proteins. Export and Action

Insertion sequences and Transposons
Significance of moving elements of the genome. Bacterial transposable element: General organization of Simple insertion sequence and transposable elements Mechanisms of transposition: Non-Replicative and Replicative transposition, IS transposition a regulated event? Bacteriophage Mu: Replication by transposition.

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, Mechansims 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

Enzymes of DNA replication: DNa polymerases: DNA polymerase I not the primary enzyme: Its other role in maintenance of DNA integrity. Processivity,direction of DNA polymerization, fidelity, E. coli DNA polymerase I and its components, Klenow fragment and other domains.

DNA polymerase II and its function in DNA replication and repair DNA polymerase III: subunit structure and function: core and holoenzyme. DNA polymerase IV and V. Stages of DNA replication: Initiation- role of DNA methylases, types of E. coli methylases; elongation and proteins involved in elongation, termination. Priming: Mechanisms of priming. RNA primed DNA synthesis – experimental evidences, E. coli primase, Types of primosomes _ E. coli type and PhiX174 type, PAS sequences, Prepriming proteins Endonucleolytic priming: PhiX 174 gene A protein dual activity. Terminal protein priming. Other proteins of replication. DNA helicase, SSB protein and its effect on replication, DNA ligase, topoisomerases Types I & II, Nick translation.

DNA recombination.
Definition, applications of natural recombination, Classification of recombination, Various possibilities of recombination, Models of homologous recombination, Steps involved in homologous recombination, Recombination events during Single and double strand breaks,Holliday Junction and resolution, Protein machinery of recombination, branch migration and resolution

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 tRNA, 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

Transcription
Flow of information from DNA to protein. Organization of genes in bacteria. Colinearity of genes and proteins. Operon concept. Process of transcription: RNA polymerase subunit structure and function role of sigma factor in differential expression of genes in bacteria. Transcription units and Cis elements. Promoter: Consensus sequences affecting the promoter function. Constitutive and inducible promoters. Operator sequences as regulatory cis sequences. Initiation : Interaction of polymerase with the promoter and control at initiation. Attenuation. Elongation. Termination : Rho dependent and Rho independent termination. Control at termination : Attenuation. Antitermination. Processing of primary transcripts in prokarytoes :

Processing of tRNA and rRNA. Cleavage of T7 early mRNAs by RNase III. Control at

the processing level. Regulation of transcription in bacteria : Introduction and repression. Represser as a regulatory molecule. Coordinated control of gene clusters. Positive and negative regulation : Regulation of transcription of lac, trp, ara, his, and gal operons. Regulation through catabolite repression. CAP protein as a positive control factor.

Transcriptional regulation in bacteriopohage Lambda: Lytic and Lysogenic switch. role of various regulatory proteins.

Translation
Genetic code. Origin of genetic code. Essential components of translation. Ribosome : the site for translation, subunit composition and assembly. Role of ribosomal RNA in translation. tRNA : Salient features of tRNA. Aminoacyl tRNA   synthetases. Difference between initiator fmet-tRNA and met-tRNA, Suppressor tRNAs, frameshift suppression. Codon-Anticodon recognition : Wobble hypothesis.Process of translation: Activation, Initiation, elongation translocation and termination. Factors involved in various steps.Peptidyltransferases. Co-translational and Post - translational mechanisms. Control of gene expression at translational level.

Eukoryotic Molecular biology & Molecular Genetics
Introduction to Eukoryotic 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.
Dynamic genome – 3 D cell, dynamic genome architecture in nuclear space, chromatin movement, microscopes , mictrorrays 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
Nuclear Matrix and gene regulation: Nuclear matrix, nuclear matrix proteins, nuclear-matrims, structure and function, DNA Binding Properties of the Nuclear Matrix and Individual Matrix Prose.
Ins, 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 and nuclear lamina nuclear matrix and expression of globin gene
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
Programmed cell death- Apoptotic and necrotic cell death, apoptotic and anti-apoptotic genes, tumore suppressor genes, cell fate through decision between cell cycle arrest and apoptosis
Gene regulation and disease: order vs disorder in transcriptional regulation, network disfunction and disease, transcriptional therapeutics in diseases control.

Cell Biology

Composition and organization of biological membranes:

Membrane lipids: Properties and how they affect the curvature and fluidity of the membrane lipid rafts: composition, a platform for organization of signaling complexes

Membrane proteins: Properties and orientation in biological membranes
Membrane asymmetry
Practice questions and discussion

Cellular transport mechanisms

Principles of transport of small molecules across membrane: organization and functioning of carriers and channels, membrane excitability
Practice questions and discussion

Protein transport across membranes:
Transport across 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
Practice questions and discussion

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
Practice questions and discussion

Cell Signalling
Molecular Cell Biology of Cell Surface Receptors: molecular pharmacology, regulation and signaling of G-protein-coupled receptors and tyrosine kinase-linked receptors.

Proteolysis based signaling (Wnt, Notch, Hedgehog): Structural and functional basis for normal and abnormal signaling

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.

Molecular biology of ionic signaling: Calcium signaling in excitation-contraction coupling in cardiomyocytes; Neutrophils and inflammation

Cytoskeleton:
Cytoskeleton networks: actin, Microtubules and intermediate filaments.
Physical and biochemical properties of extracellular matrices: Collagen, Fibronectin (Tensional homeostasis and fibrosis)
Role of cytoskeleton network and extracellular matrix in cell migration, cell polarity, and cancer

Cell junctions:
Type of junctions: tight junction, anchoring junction, and
Communicating junction
Composition and function of junctions
Cell junctions: tissue development, and disease

Analytical Techniques
Concept of pH buffer and solutions
Electrophoresis techniques
Chromatography techniques
Protein and DNA estimation
Sequencing of proteins and DNA
Spectroscopic techniques (UV – Visible, IR fluorescence, CD, NMR and Mass Spectrometry)

GENETIC ENGINEERING AND ITS APPLICATIONS

Introduction to genetic engineering, general work flow, 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: Defection 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.
Inclusion bodies formation and strategies for the production of soluble proteins.
Cell synchronization and its importance in the genetic engineering.
Methods of introduction of DNA into mammalian cells.
Transient and stable integration of foreign DNA into mammalian cells.
The viral vectors and their use in gene delivery
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
The packaging of retroviral vectors and helper cells for 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
Role of integrated OMICS in the genetic engineering
Importance of computational tools and system biology for genetic engineering
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.
Plant Genetic Engineering: Introduction to plant tissues culture; Agrobacterium infection biology; Explant selection and regeneration; Plant transformation (Agrobacterium-mediated, Microprojectile bombardment-mediated and Floral-dip method of plant transformation); Transgenic Selection and Regeneration; Discussion.

Applications of plant genetic engineering: Understanding issues encountered in plant biotechnology Germplasm Improvement; Plant and human health; Plant Molecular farming (Bioreactors); Bio-fortification; Discussion. Precise genome engineering.

Immunology

Introduction to the Immune System
Historical background, cellular and molecular components of immune system

Innate Immunity
Innate immune cells, Pathogen associated molecular pattern (PAMP), Pathogen recognition receptors (PRR), Type 1 IFN, Interferon Stimulated Genes (ISGs), Complement system.

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.

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

The Adaptive Immune Response
T cell mediated immunity, Entry of naïve T cells and APCs into peripheral lymphoid organs, Naïve T cells priming by pathogen-activated dendritic cells,T cell-mediated toxicity, Macrophage activation by TH1 cells, humoral immune response, Immunological memory, Cytokines

Immune system in Disease
Self tolerance, autoimmune diseases, transplant rejection, allergy and anaphylactic shock, AIDS immunology

Immune aging
Immunosenescence, Immune-exhaustion during aging and chronic infection, Gut Immunology

NK cells and Diseases
Inhibitory receptors, KIR receptors, CTL responses in cancer, Immunotherapy

Characterization of lymphocytes specificity, frequency and function
Lymphocyte isolation, ELISPOT assay, Multicolor flow cytometry, HLA-tetramer assay

Plant Biotechnology

Prologue to Plant's World
Plant and human society; Growth and development; Plant hormones; Photosynthesis

An Introduction to Plant Genetics
Plant genome organisation; Polyploidy; Genetic diversity; Molecular markers and mapping; Phylogenetics and genomics; Breeding and methods; Discussion; Forward vs. reverse genetics;

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

Transgenic Crops
Global status of transgenic crops; Traits under development; Case Studies; Challenges; Discussion

Applications
Plant Molecular farming (Bioreactors);Renewable energy crops and biofuels; Bio-fortification for Human Health; Discussion

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

Bioinformatics
Biological Databases
Overview of biological databases, types, nucleic acid databases, NCBI: PubMed, Entrez, Blast, OMIM, Taxonomy, Structure, Locuslink. Protein databases - primary, functional, composite, secondary, structural classification database, Sequence formats & storage, Errors in databases, Submissions to databases.
Pairwise and Multiple sequence alignments
Local alignment, Global alignment, Scoring matrices - PAM, BLOSUM, Gaps and penalties, Dot plots. Dynamic programming approach: Needleman and Wunch Algorithm, Smith and waterman Algorithm, Hidden Markov Model: Viterbi Algorithm. Heuristic approach: BLAST, FASTA.
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, Human genome project

Bioprocess Technology
Introduction: A systems approach to Biology
Introduction to material and energy balances
Elemental balances in biological systems: Degrees of reductance
Energy balance in biological systems: Enthalpy efficiencies
Growth kinetics in batch systems
Growth and substrate utilization in continuous systems
Concept of maintenance
Product formation in anaerobic systems

| | | | *Product formation kinetics*
Continuous reactor systems with recycle
Fed batch reactors
Feed design in fed batch reactors and its analysis
Heat transfer in bioreactors
Mass transfer in bioreactors: Concept $K_L a$
$K_L a$ estimation methods
Scale up principles

Downstream Processing

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.
Cell harvesting – Cell disruption – ball mill, chemical lysis, homogenization, selection of unit operation for insoluble removal . Centrifugation – general theory of centrifugation – final settling velocity, critical particle diameter, sigma factor. Types of centrifuges: tubular bowl, disc stack, basket, Sharples super-centrifuge. Theory of disc-stack centrifuges. Filtration . Types of filtration –rotary vacuum drum, plate and frame , leaf filters. Compressible cakes and filter aids. Theory of filtration .
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.
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.
Membrane filtration: tangential flow filtration , micro-filtration , ultra-filtration , reverse osmosis. Transport equations, gel layer formation, osmotic pressure. Time required for filtration in T.F.F.
Polishing - Crystallization – separation, purity, nucleation, crystal growth, characteristic length, crystal size distribution, dominant crystal length.
Lyophilisation and drying.
Scale –up: Basic ideas of scale –up , Geometric , Kinematic, Dynamic similarity. Why scale up of bioprocesses is difficult? Typical time constants for mixing, kinetic, heat transfer, mass transfer phenomena in bioreactor. Criteria for scale-up P/V, kla , N, rules of thumb . |

11. SCHOOL OF SANSKRIT AND INDIC STUDIES

The pattern of JNUEE 2020-21 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

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Sanskrit and Indic Studies (SSIS)	Ayurveda Biology - AYBU (411)	**Syllabus:** The syllabus is 10+2 level CBSE for Sanskrit, Science and General Aptitude questions.

M.A.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Sanskrit and Indic Studies (SSIS)	Sanskrit – SANM (228)	**Syllabus:** Test may cover the following areas: Vedic & 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.

M.Phil & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Sanskrit and Indic Studies (SSIS)	Sanskrit Studies – SANP (170) & SANH (906)	**Syllabus:** The test will cover the following areas: Indian Philosophical Systems; Traditions of Yoga & 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 & Research Aptitude.

II. Part-time Courses

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	School of Sanskrit and Indic Studies (SSIS)	Pali – PALC (705)	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.
2		Sanskrit Computational Linguistics – SCLC (706)	
3		COP in Yoga Philosophy – YOPC (707)	
4		COP in Vedic Culture – VECC (708)	
5		COP in Sanskrit – SANC (709)	

12. SPECIAL CENTRE FOR STUDY OF NORTH EAST INDIA

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.Phil. & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Special Centre for the Study of North East India (SCSNEI)	North East India Studies- NESP (175) & 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.

13. SPECIAL CENTRE FOR MOLECULAR MEDICINE

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.Sc. Programme

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Molecular Medicine (SCMM)	Molecular Medicine- CMMM (233)	**Part A** 1. Basic Maths; 10th level geometry, PC, statistics, Arithmetic, Log, Basic knowledge of Computer science. 2. Chemistry: Concept of Molarity, Normality, Periodic Table, Organic Chemistry, Synthesis, Thermodynamics, Entropy, Enthalpy, Free energy, Law of Mass action, Reaction kinetics 3. Physics: Newton's law, radioactivity, Electricity, capacitance, optics, sound, gravity, spectroscopy. 4. Basic Biology: Zoology/Botany - classification/Evolution Biology/Population Biology. 5. General Aptitude and reasoning. 6. General awareness. **Part B** **Section 1 ;** Biochemistry: Metabolism, Nutrition, Biomolecules, Hormones, Enzymes, Omics. **Section 2 ;** Microbiology: Bacterial genetics, Antibiotics mode of action, Infectious disease, Industrial Biotechnology . **Section 3**; Physiology, Diseases, Pharmacology, Genetics, Molecular Biology, Developmental biology, Zoology, Population genetics. **Section 4 ;** Botany: Molecular Biology. **Section 5** ; Advanced Chemistry, Spectroscopy, Molarity/Normality, Radioactivity, Atomic Structure, Acid base, pH.

Section 6 ; Medicinal Chemistry: Drug-receptor interaction, DNA, Protein, Hormones as receptor, Pharmacokinetics, G-protein coupled receptor, Pharmacodynamics.
Section 7 ; Cell biology: Organelles, Cell-Cell interaction, Cell signalling/ trafficking, Cell cycle.
Section 8; Drug/ Drug resistance.
Section 9;Immunology: Basic immunology .
Section 10; Aptitude, Bioinformatics ,Others .

Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	Centre for Molecular Medicine (SCMM)	Molecular Medicine-CMMH (905)	**Section A; General Aptitude/Research Methodology** **Section B; Different Subject Areas of Molecular Medicine** **Section A** **Aptitude / Research Methodology** **Basic Maths** ; geometry, statistics, Arithmetics, Log, Basic knowledge of Computer science. **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. **Section B** **Biochemistry:** Metabolism, Nutrition, Biomolecules, Hormones, Enzymes, Omics. **Microbiology:** Bacterial genetics, Antibiotics mode of action, Infectious disease, **Industrial Biotechnology. Physiology, Diseases, Pharmacology, Genetics, Molecular Biology, Developmental Biology, Zoology, Population genetics. Botany**, **Molecular Biology**, **Advanced Chemistry;** Spectroscopy, Molarity/Normality, Radioactivity, Atomic Structure, Acid base, pH**. Medicinal Chemistry:** Drug-receptor interaction, DNA, Protein, Hormones as receptor, Pharmacokinetics, G-protein coupled receptor, Pharmacodynamics. **Cell biology: Organelles, Cell-Cell interaction, Cell signalling/ trafficking, Cell cycle. Drug resistance. Immunology**

14. CENTRE FOR THE LAW & GOVERNANCE

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.Phil & Ph.D.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination
1	**Centre for the Law & Governance (CSL&G)**	**Law & Governance – CLGP (171) & 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.

15. SPECIAL CENTRE FOR NANO SCIENCES

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

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

| 1 | Special Centre for Nano Sciences | Nanoscience – NNST (182) | **Chemical Sciences:**

Periodic Table and periodicity in properties. Chemical bonding and shapes of compounds, VSEPR theory, lattice energy. Main group elements (s and p blocks). Transition metals and inner transition metals (d and f block). Allotropes. Coordination compounds. Organometallic compounds. Stoichiometry. Acids and bases. Oxidation reduction and precipitation reactions. Radioactivity. Nuclear reactions: fission and fusion.

Quantum mechanics. Chemical bonding. Chemical thermodynamics. Kinetic theory of gases. Electrochemistry & Chemical kinetics: Conductance, EMF, Free energy, Nernst equation, redox systems, electrochemical cells, Reactions of various order, Arrhenius equation, Enzyme kinetics, Catalysis. Solutions. Ionic equilibria in solutions, pH and buffer solutions, Hydrolysis, Solubility product, Phase equilibria–Phase rule. Vapour pressure and Osmotic pressure. Molecular weight determination.

IUPAC nomenclature. Stereochemistry. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Common named reactions and rearrangements – applications in organic synthesis. Polymers.

Physical Sciences:

Interference. Diffraction. Polarization. Quantum mechanics: Postulates; Wave-particle duality. Commutators and Heisenberg uncertainty principle. Schrödinger equation (time-dependent and time-independent). Exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom. Tunneling through a barrier. Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Scalar and Vector potentials, Maxwell equations. First and second laws of thermodynamics, Thermodynamic functions, Heat capacity, enthalpy, entropy. Bonding in solids, Crystal structures. Bravais lattices. Miller indices. Reciprocal lattice. Bragg's law and applications; Diffraction and the structure factor. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity. Hall Effect and thermoelectric power. Electron motion in a periodic potential, Band theory of solids: metals, insulators and semiconductors. Dielectrics. Ferroelectrics. Magnetic materials. Superconductivity: type-I and type-II superconductors.

Biological Sciences:

Biomolecules: 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. Catalysis, |

			enzymes and enzyme kinetics.
			Cell Biology: Membrane structure and function; Cell organelles; Cell division and cell cycle. Microbes, infectious disease biology and microbial diseases.
			Fundamental Processes: DNA replication, repair and recombination, RNA synthesis and processing and Protein synthesis
			Immunology: Innate and adaptive immunity, antigens, antibody, antigen-antibody interactions, immune responses, congenital and acquired immune deficiencies, vaccines.
			Genetics: Mendelian principles, Gene: Allele, multiple alleles, mutation types and cause.
			Human Physiology: Blood, coagulation, blood groups, Heart, Endocrine glands, Hormones and diseases.
2		Nanoelectonics – NNET (190)	**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, doping, bonding, Thin film active and passive devices. 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. **Unit-II** Network theorems, Network graphs, Nodal and Mesh analysis. Time and frequency domain responses. Image impedance and passive filters. Two-port Network Parameters. Transfer functions, Signal representation. State variable method of circuit analysis, AC circuit analysis, Transient analysis. 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. Modulation index, frequency spectrum, generation of AM (balanced modulator, collector modulator), Amplitude Demodulation (diode detector Other forms of AM: Double side band suppressed carrier, DSBSC generation (balanced modulator), Single side band suppressed carrier, SSBSC generation and Phase modulation, modulation index . **Unit-III** Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell equations. Reflection and refraction, polarization. **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.

Sl. No.	Name of Centre	Sub. Code & Sub. Code Number	Syllabus for Entrance Examination [Type of Questions for Entrance Examination: Multiple choice questions]
1	Special Centre for Nano Sciences	Nano Sciences – NNSH (908)	**Part-A: Research Methodology (Common for all)**

Under the Syllabus column for Sl. No. 1:

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, ICPR, 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

Interference. Diffraction. Polarization. Basic principles of quantum mechanics: Postulates; Wave-particle duality. Commutators and Heisenberg uncertainty principle. Schrödinger equation (time-dependent and time-independent). Exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom. Tunneling through a barrier. Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Scalar and Vector potentials, Maxwell equations. The first and second laws of thermodynamics, Thermodynamic functions, Heat capacity, enthalpy, entropy. Bonding in solids, Crystal structures. Bravais lattices. Miller indices. Reciprocal lattice. Bragg's law and applications; Diffraction and the structure factor. Defects in Solids, Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Dielectrics. Ferroelectrics. Magnetic materials. Superconductivity: type-I and type-II superconductors.

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.

Cell Biology: Membrane structure and function. Cellular organization and function of organelles. Cell division and cell cycle. Cell communication and cell signalling. Microbes and infectious disease biology.

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.

<u>**Chemical Sciences**</u>

Stereochemistry: 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 alkynes, 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.

<u>**Engineering Sciences**</u>

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, metalization, bonding, Thin film active and passive devices.

Unit-II: Superposition, Thevenin, Norton and Maximum Power Transfer Theorems, Network elements, Network graphs, Nodal and Mesh analysis, Zero and Poles, Bode Plots, Laplace, Fourier and Z-transforms. Time and frequency domain responses. Image impedance and passive filters. Twoport Network Parameters. Transfer functions, Signal representation. State variable method of circuit analysis, AC circuit analysis, Transient analysis.

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, DSBSC 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)

16. SPECIAL CENTRE FOR DISASTER RESEARCH

The pattern of JNUEE 2020-21 will be based on Multiple Choice Questions (MCQs) through Computer Based Test (CBT)

M.A. Programme

Sl. No.	Name of Centre	Sub. Code & Sub. Code (Number)	Syllabus for Entrance Examination
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.

Sl. No.	Name of Centre	Sub. Code & Sub. Code (Number)	Syllabus for Entrance Examination
1	Special Centre For Disaster Research (SCDR)	Disaster Studies - DSSH (911)	**Syllabus for Entrance Exam:** *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*: 1. Constitutional Law, Laws related to Disasters, Governance and Implementation of Disaster Risk Reduction Policies. 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. **5.** Public Health, Emergency Preparedness and Disasters.