M.Tech Programme in Nanoscience (NS) & Nanoelectronics (NE)

SI. No.	Name of Centre	Sub. Code & Sub. Code	Syllabus for Entrance Examination	Pattern of
		Number		Examination
1	Special Centre for	Nanoscience – NNST		
	Nano Sciences	(182)	Syllabus for JNU entrance exam to M. Tech in Nano-Science/Nano-Electronics	
			Part A: Research Methodology:	
			Numerical Ability: Numerical computation, numerical estimation, numerical reasoning and data interpretation and analysis.	
2		Nanoelectonics – NNET (190)	Precision and accuracy. Error analysis, propagation of errors. Least squares fitting. Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance;	
			Elementary physics, chemistry, biology, mathematics.	
			Opto-electronic devices (solar cells, photo-detectors, LEDs). A/D and D/A converters.	
			Microscopy techniques. Resolving powers of different microscopes.	
			Spectroscopy techniques. UV/visible, fluorescence, NMR spectroscopy, different types of mass spectrometry and surface plasma resonance methods	
			Part B-1: Subject specific	
			NNSP(182) Nanoscience	
			Chemical sciences :	
			 Inorganic Chemistry Chemical periodicity, Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory). Concepts of acids and bases, Hard-Soft acid base concept. Main group elements and their compounds: Allotropy, synthesis, structure and bonding. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties. Inner transition elements: spectral and magnetic properties. Organometallic compounds: synthesis, bonding and structure, and reactivity. Nuclear chemistry: nuclear reactions, fission and fusion. Physical Chemistry Basic principles of quantum mechanics: Postulates; operator algebra; exactly- solvable systems: particle-in-a-box and the hydrogen atom. Chemical bonding in diatomics; elementary concepts of MO and VB theories. Chemical thermodynamics: Laws, state and path functions and their relation to thermodynamic quantities – calculations for model systems. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; band structure of solids. Polymer chemistry: Different classification of polymers, Molar masses and their calculations. Organic Chemistry IUPAC nomenclature of organic molecules. Principles of stereochemistry: isomerism in acyclic and cyclic compounds. Aromaticity: Benzenoid and non-benzenoid compounds – (4n+2) Rule. 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 and rearrangements – applications in organic synthesis. 	Paper will be OBJECTIVE type
			Physical sciences:	
			Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors.	
			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. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction.	
			The first and second laws of thermodynamics, Thermodynamic functions, heat capacity, enthalpy, entropy.	
			Bravais lattices. Miller indices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. 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. Superconductivity: type-I and type-II superconductors.	
			Diamagnetism, Paramagnetism, Ferromagnetism, Ferrimagnetism, Anti-ferromagnetism.	
			Dielectric Materials; Types of Polarization; Piezoelectricity, Pyroelectricity and Ferroelectricity	
			Biosciences	

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Linklift Endamental Processes: DNA replication, repair and econtinuotion. RNA synthesis and processing and Posten synthesis Linklift Linematidate: Colls and modelus involved in initiate and adapted informative and improve synthesis induction by service information. Hypersensitive administration processes, component system, information. Hypersensitive administration processes and cause. Linklift Contents: Linklift Contents: Linklift Processes; DNA replication, repair and adapted informative complemental intesting, machine the system of processes and system informations. Linklift Contents: Linklift Processes; DNA replication, repair and adapted informative complemental intesting, machine adapted informative complemental interface. Linklift VI: Human Ebysiology; Photoproteche replantation adapted informative adapted informatintes adapted informative adapted informative adapted i		Unit-II:Cell Biology and cell communication: Membrane structure and function; Structural organization and function of intracellular organelles; Cell di signalling (hormones and their receptors, cell surface receptor, signal transduction pathways, bacteria and plant component systems)
United: Immediates: Colls and metabolis involved in invatis and adapted summulty, antigens, unigonality and immunos, programs, the complement system, immunos, programs and the complement system, immunos, programs and the complement system, immunos, programs and the complementation instruction. Unit.V.: Constraints: Advite Structures: Nuite Structures: Unit.V.: End of the structure, myogenic heart, specialized immune designed and suppression. Nuite Structures: Unit.V.: Hum Projections: Nuite Structure, myogenic heart, specialized issue, ECG – its principle and significance, cataliae cyste, heart as a pump, blood pathers Type of paper: Page: Structure, myogenic heart, specialized issue, ECG – its principle and significance, cataliae cyste, heart as a pump, blood pathers Unit.V.: Hum Projections: Numeroscience: Type of paper: Page: Structure, myogenic heart, specialized issue, ECG – its principle and significance, cataliae cyste, heart as a pump, blood pathers Type of paper: Page: Structure, myogenic heart, specialized issue, ECG – its principle and significance, cataliae cyste, heart as a pump, blood pathers Type of paper: Page: Structure, myogenic heart, specialized issue, ECG – its principle and significance, cataliae cyste, heart as a pump, blood pathers Type of paper: Page: Structure, myogenic heart, specialized issue, ECG – its principle and significance, cataliae cyste, heart as a pump, blood sits astructure, myoseen theart astructure, myose		Unit-III: Fundamental Processes: DNA replication, repair and recombination, RNA synthesis and processing and Protein synthesis
Unit V: Genetics: Mendelian principles, concept of gene: Alele, multiple saleles, pseudoallele, complementation tests, mutation types and cause. Unit VI: Funn Physiology: Blood corpuscles, blood coagulation, haemopolesis and formed elements, plasma function, blood volume,		<u>Unit-IV :Immunology:</u> Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes Monoclonal antibodies, antigen-antibody interactions, humoral and cell-mediated immune responses, the complement system, inflammation, hypersensitive bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immune deficiencies, vaccines.
Unit-VI - Bant Physiology: Photosynthesis (Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO ₂ fixetion (photossinitiate translocation). Unit-VII: Human Physiology: Block corputates, blood congulation, haemopolesis and formed elements, plasma function, blood volume, blood volume haemostasis. Comparative anatomy of heart structure, myogenic heart, specialized tissue. ECC – its principle and significance, cardiac cycle, heart as a pump, blood press Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, oxulation and neuroendocrine reg Type of paper: Paper vill be OBJECTIVE. Part 8-21 Engineering Sciences) NIEP/130) Nanoelisctronics United Endocitic Transport in somiconductor, PN Juncton. Diode equation and dools equivalent dirout. Breakdown in dooles, Zoner diodes, Som circuitos of DJT, JFTF, MOSPET, IC fobrication-craytal growth, callexy, obsing, eiching, solaton methods, mealization, bonding, Voltage regulated ICs and regulated power supptit, Basica (G Doord unroton intrasotrs and JFTF, single state amplifies, Feedt multivibrates, operational Amplifies (OP AMP) -characteristics and Applications. Computational Applications. Integrator, Differentiate. Unit.II Supprosition, Theorein, Nortion and Maximum Power Transfer Theorems, Network elements, Abard Meake analysis, Zoro and Poles Time and Pequency domain response. Image impedance and passes index and passes growthen index fragmed sparses theor potentials. Maximum equations. Theorems of AME downers Manufaltism Index, Frequency sportant, 1 modulator, Amplifice Duroculation (doord dococor		Unit V: Genetics: Mendelian principles, concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, mutation types and cause.
 Unit VIII. Luman Physiology, Biood corpuscles, blood coagulation, haemopolesis and formed elements, plasma function, blood volume, blood volume		<u>Unit-VI : Plant Physiology</u> : Photosynthesis (Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO ₂ fixation-C2 photoassimilate translocation.
Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pres Endocrine glands, basis mechanism of hormone action, hormones and diseases; reproductive processes; gametogenesis, ovulation and neuroendocrine reg Type of paper: Paper will be OBJECTIVE. Part B-2 (Engineering Sciences) NUEP1(30) Nancelectronics DILI Electronic Transport in semiconductor, PM Junction, Diode equation and diods equivalent circuit. Breakdown in diodes, Zener diodes, Turnel diode, Sen circuits of BJT, JFFT, MOSFET, IC fabrication-crystal growth, perspective discuss, decimal of the papers, doing, etching, isolation methods, metalizaten, bending, Voltage regulated ICs and regulated power supply. Biasing of Bipolar junction transistors and perspective discuss, metalizaten, bending, Voltage regulated ICs and regulated power supply. Biasing of Bipolar junction transistors and perspective, Differentiator, Unital Superposition, Thevenin, Notron and Maximum Power Transfer Theorems, Network graphs, Notal and Mesh analysis, Zero and Poles Time and frequency domain responses. Image impedance and passive filters. Two-port Network Parameters. Transfer functions, Signal representation, Signal representations, Signal representation, Markitaria markitaria, markitaria markitaria, Marketi didde deductor Coll forms of AM. Double side band suppresson terting, Maxwell equations, Reflection and refraction, polariza		Unit VII: Human Physiology: Blood corpuscles, blood coagulation, haemopoiesis and formed elements, plasma function, blood volume, blood volume re haemostasis.
Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation and neuroendocrine reg Type of paper: Paper will be OBJECTVE. Part 8-3 (Engineering Sciences) NEPF1901 Nanoelectronics Diffe Electronic Transport in semiconductor, PN Junction, Diode equivatent circuit, Breakdown in diodes, Zener diodes. Turnel diods. Ser ricuits of BLT, JEFT, MOSFFL, Co fabrication-crystal growth, epitaxy, oxidation, lithography, doping, etching, isolation methods, methioza, methioza, methioza, methioza, methioza, methioza, methioza, methioza, diversited (Ce and regulated for and regulated for and regulated power supply, Bissing of Bloer junction transistors and JEFT. Single stage amplifiers, Multistage amplifiers, Feedt multivitators, Operational Amplifiers (OP AMP) -characteristics and Applications, Integrators, Indeferration, Jong and Stage amplifiers, Feedt multivitators, Operational Amplifiers (OP AMP) -characteristics and Applications, Integrators, Indeferration, Jong and Stage amplifiers, Feedt multivitators, Operational Amplifiers (OP AMP) -characteristics and Applications, Integrators, Indeferration, Jong and Stage amplifiers, Feedt multivitators, Operational Amplifiers (OP AMP) -characteristics and paper and minimization techniques, Multivibrators and clock circuits, Curuters, Bi, analysis, Transient analysis, Logic tranilier, lip-logo, Gates, Boolean agbars and minimization techniques, Multivibrators and clock circuits, Curuters, Bi, analysis, Transient analysis, Logic tranilier, lip-logo, Gates, Boolean agbars and Divo Appreters, Booldaki circuits, Curuters, Bi analysis, Maxwell equations, modulation index Diricuit Electronation: Gaust's haw and its applications, Laplace and Poisson equations, bundray value problems, Magnetostatics: Biot-Savart law, Amper's theory potentials, Maxwell equations, Referction and refraction, polarization, Freinel's law, interference, otherence, and diffraction. Paramagnetism, Teromagnetism, Teromagnetism, Param		Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG - its principle and significance, cardiac cycle, heart as a pump, blood press
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For any other details please check website www.jnu.ac.in/SCNS/		Bravais lattices. Miller indices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. F Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic p and semiconductors. Superconductivity: type-I and type-II superconductors. Diamagnetism, Paramagnetism, Ferromagnetism, Ferrimagnetism, Anti- Polarization; Piezoelectricity, Pyroelectricity and Ferroelectricity.
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mins). Stabilizing interactions (Van der Waals, properties). Bioenergetics, glycolysis, oxidative d isozymes. Conformation and stability of nucleic	
vision and cell cycle. Microbial physiology. Cell	
, structure and function of antibody molecules. ity and autoimmunity, immune response during	
, C4 and CAM pathways). Solute transport and	
gulation, blood groups, haemoglobin, immunity,	
rre, neural and chemical regulation of all above. ation.	
conductor diodes, characteristics and equivalent hin film active and passive devices. Rectifiers, ck in amplifiers, oscillators, function generators,	
Bode Plots, Laplace, Fourier and Z-transforms. te variable method of circuit analysis, AC circuit g, Ripple. Synchronous, Asynchronous, Up and meration of AM (balanced modulator, collector b, Single side band suppressed carrier, SSBSC	
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Ph.D.

SI. No.	Name of Centre	Sub. Code & Sub. Code	Syllabus for Entrance Examination	Pattern of	
		Number		Examination	
1	Special Centre for Nano	Nano Sciences – NNSH	Syllabus for JNU entrance exam to Ph.D. in Nanoscience		
	Sciences	Sciences	(908)	Part A: Research Methodology:	
				Numerical Ability: Numerical computation, numerical estimation, numerical reasoning and data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting. Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; Elementary physics, chemistry, biology, mathematics.	
			Opto-electronic devices (solar cells, photo-detectors, LEDs). A/D and D/A converters.		
			Microscopy techniques. Resolving powers of different microscopes.		
			Spectroscopy techniques. UV/visible, fluorescence, NMR spectroscopy, different types of mass spectrometry and surface plasma resonance methods		
			Part B: Stream I: (Physical science)		
			Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigen value problems (particle in a box, harmonic oscillator). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors.		
			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. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction.		
			The first and second laws of thermodynamics, Thermodynamic functions, heat capacity, enthalpy, entropy.	be	
			Bravais lattices. Miller indices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. 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. Superconductivity: type-I and type-II superconductors.	ECTIVE ty	
			Diamagnetism, Paramagnetism, Ferromagnetism, Ferrimagnetism, Anti-ferromagnetism.	OBJ	
			Dielectric Materials; Types of Polarization; Piezoelectricity, Pyroelectricity and Ferroelectricity.	er will be	
			Stream II: (Biological science)	Pap	
			<u>Unit-I: Biomolecules and their interactions:</u> Composition, structure, function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins), Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.), Principles of biophysical chemistry (Michaelis Menten equation, 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, Conformation and stability of nucleic acids and proteins, Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins and diseases associated with metabolism defects.		
			<u>Unit-II: Cell Biology and cell communication</u> : Basic structure of cells in prokaryotes and eukaryotes, biological Membrane (structure and function); Structural organization and function of intracellular organelles; Cell growth and division, cell cycle, cytoskeleton,, intercellular communication and associated signalling pathways (hormones and their receptors, cell surface receptor, signal transduction pathways, bacteria and plant component systems)		
			Unit-III: Fundamental Processes: Lipid synthesis and degradation, DNA replication, repair and recombination, RNA synthesis and processing, and protein synthesis, protein sorting and diseases.		
			<u>Unit-IV :Immunology:</u> Innate and adaptive immunity (determinants, cellular and molecular mediators and signalling pathways), antigens, antigenicity and immunogenicity, B and T cell epitopes, structure and function of antibody molecules. Monoclonal antibodies, antigen-antibody interactions, humoral and cell-mediated immune responses, the complement system, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (e.g. tuberculosis), parasitic (e.g. malaria) and viral (e.g. HIV) infections, congenital and acquired immunodeficiencies, pathobiology of diseases and vaccines.		
			Unit V: Genetics: Mendelian principles, concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, mutation types and cause, basic structure of DNA and RNA, DNA as genetic material, chromosome (structure and functions), chromosomal basis of inheritance and chromosomal abnormalities, genetic testing and DNA fingerprinting.		
			Unit-VI:Plant Physiology: Photosynthesis(Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO ₂ fixation-C3, C4 and CAM pathways). Solute transport and photoassimilate translocation.		
				Unit VII: Human Physiology and Anatomy: General physiology and anatomy of human body, Blood and its constituents (Blood corpuscles, blood coagulation, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis).	
			Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all		

above.	
Endocrine system (endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation and neuroendocrine regulation).	
<u>Unit VIII</u> : General Microbiology: Microbes, classification, bacterial, fungal and viral structure, bacterial physiology, microbes in oral cavity and guts, pathogenic bacteria, commercially exploitable bacteria, phage, classification of microbial biochemical pathways, plasmids, bacteria for use in biosensors, bioremediation, antibiotic producing microbes, quorum sensing, biofilms, emerging infectious diseases, vaccines.	
Stream III: (Engineering science)	
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. Two-port Network Parameters. Transfer functions, Signal representation. State variable method of circuit analysis, AC circuit analysis, Transient analysis.	
<u>Unit-III</u>	
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.	
<u>Unit-IV</u>	
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. <u>Unit-V</u>	
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)	
Stream IV: (Chemical science)	
Inorganic Chemistry	
Chemical periodicity, Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory). Concepts of acids and bases, Hard-Soft acid base concept. Main group elements and their compounds: Allotropy, synthesis, structure and bonding. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties. Inner transition elements: spectral and magnetic properties. Organometallic compounds: synthesis, bonding and structure, and reactivity. Nuclear chemistry: nuclear reactions, fission and fusion.	
Physical Chemistry	
Basic principles of quantum mechanics: Postulates; operator algebra; exactly- solvable systems: particle-in-a-box and the hydrogen atom. Chemical bonding in diatomics; elementary concepts of MO and VB theories. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Le Chatelier principle. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications. Chemical kinetics: Empirical rate laws, order of reaction, zero order, first order, second order and pseudo order reactions, temperature dependence. Solid state: Crystal structures; Bragg's law and applications; band structure of solids. Polymer chemistry: Different classification of polymers, Molar masses and their calculations.	
Organic Chemistry	
IUPAC nomenclature of organic molecules. Principles of stereochemistry: isomerism in acyclic and cyclic compounds. Aromaticity: Benzenoid and non-benzenoid compounds – (4n+2) Rule. 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. Determination of reaction pathways. Common named reactions and rearrangements – applications in organic synthesis.	
For any other details please check website www.jnu.ac.in/SCNS/	