

**DEPARTMENT OF CHEMISTRY**  
**NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

COURSE PLAN – PART I			
Name of the programme and specialization	M. Sc. Chemistry (I-Semester)		
Course Title	Nuclear Chemistry		
Course Code	CH 635	No. of Credits	3 (Theory)
Course Code of Pre-requisite subject(s)			
Session	July 2018	Section (if, applicable)	A / B
Name of Faculty	Dr. Seenuvasan Vedachalam	Department	Chemistry
Email	<a href="mailto:vseenu@nitt.edu">vseenu@nitt.edu</a>	Telephone No.	8220462456
Name of Course Coordinator(s) (if, applicable)	Dr. Seenuvasan Vedachalam		
E-mail	<a href="mailto:vseenu@nitt.edu">vseenu@nitt.edu</a>	Telephone No.	8220462456
Course Type	<input type="checkbox"/> Core course <input checked="" type="checkbox"/> Elective course		
<b>Syllabus (approved in BoS)</b>			
<p><b>Discovery:</b> Types of decay - decay kinetics: decay constant, half-life period, mean life parent - daughter decay - growth relationships - secular and transient equilibrium - units of radioactivity - alpha, beta and gamma decay: Theory of decay, energies and properties -artificial radioactivity - detectors: Ionization chamber, electron pulse counters, scintillation detectors, semiconductor, detectors, thermo luminescence detectors and neutron detectors.</p> <p><b>Types of nuclear reactions:</b> Bethe notation, the compound nucleus theory - reaction cross – section - transmutation reactions, elastic and inelastic scattering, spallation, fragmentation, stripping and pick-up, fission, fusion, photonuclear reactions, thermonuclear reactions. The fission energy - reproduction factor - classification of reactors - based on moderators, coolant, phase of fuel and generation - principle of thermal nuclear reactors. The four-factor formula - reactor power - critical size of a thermal reactor - excess reactivity and control - breeder reactor - reprocessing of spent fuels - nuclear waste management - safety culture - active and passive safety, containment building, nuclear criticality safety, ionizing radiation protection - enforcement agencies.</p> <p><b>Radiation chemistry:</b> Passage of radiation through matter - units for measuring radiation absorption - radiation dosimetry - radiolysis of water - free radicals in water radiolysis - chemical dosimetry: Radiolysis of Fricke dosimeter solution - radiation - induced color centers in crystals - Effects of radiation with matter: Radiolysis of inorganic gases, organic gases, organic compounds, solids, and polymers - Annealing of radiation damage.</p> <p><b>Application of radioisotopes:</b> Probing by isotopes, reactions involved in the preparation of radioisotopes, the Szilard-Chalmer's reaction - radiochemical principles in the use of tracers - applications of radioisotopes as tracers - chemical investigations, analytical applications, agricultural and industrial applications - neutron activation analysis - carbon and rock dating - use of nuclear reactions - radioisotopes as source of electricity - nuclear medicines.</p>			

**References:**

1. W. Loveland, D. Morrissey, G. Seaborg. Modern Nuclear Chemistry, Wiley- Interscience, Hoboken, NJ, 2006.
2. Arnikaar, H. J., Essentials of Nuclear Chemistry, 4th Ed., New Age International Publishers Ltd., New Delhi, 1995.
3. K. H. Lieser, Nuclear and Radiochemistry, 2nd revised ed., Wiley-VCH, Berlin, 2001.
4. G. Choppin, J. O Liljenzin and J. Rydberg. Radiochemistry and Nuclear Chemistry. 3rd ed. Butterworth-Heinemann, Oxford, 2002.
5. G Friedlander, GW Kennedy, ES Macias and JM Miller. Nuclear and Radiochemistry. 3rd ed., John Wiley & Sons, New York, 1981.
6. S. Glasstone, Source Book on Atomic Energy, Krieger Pub Co, 3rd Ed, 1979.

**COURSE OBJECTIVES**

To know the concept of Nuclear chemistry in modern approach. Also students will be studying the various nuclear reaction, kinetics and application towards various industries such as agricultural, medicine and nuclear reactor for energy application.

**COURSE OUTCOMES (CO)**

Course Outcomes	Aligned Programme Outcomes (PO)
1. Students will become familiar with the basics of Nuclear chemistry	
2. In addition, they will be learning the Types of decay, Theory of decay and know the knowledge of various radiation detector.	
3. Students gain knowledge on various types of Nuclear reaction and how to handle safely from radiation hazard with the help of various physical parameters.	
4. Students will become familiar with how the nuclear radiation is useful to the human societies	
5. This course is highly useful because students can get better knowledge in applied sciences.	

**COURSE PLAN – PART II****COURSE OVERVIEW**

This is an elective course offered for the M. Sc. Students. Three credits are awarded for the course. Three lectures will be conducted every week by a faculty member in Chemistry dept.

**COURSE TEACHING AND LEARNING ACTIVITIES**

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	I-Week Aug/2018	<b>Discovery:</b> Types of decay -decay kinetics:	Chalk and Talk
2	II-Week Aug/2018	decay constant, half-life period, mean life parent - daughter decay - growth relationships - secular and transient equilibrium	Chalk and Talk

3	<b>III-Week Aug/2018</b>	units of radioactivity - alpha, beta and gamma decay: Theory of decay, energies and properties -artificial radioactivity -	Chalk and Talk
4	<b>IV-Week Aug/2018</b>	detectors: Ionization chamber, electron pulse counters, scintillation detectors, semiconductor, detectors, thermo luminescence detectors and neutron detectors	Chalk and Talk
5	<b>I-Week Sep/2018</b>	Types of nuclear reactions: Bethe notation, the compound nucleus theory - reaction cross –section - transmutation reactions	Chalk and Talk
6	<b>II-Week Sep/2018</b>	elastic and inelastic scattering, spallation, fragmentation, stripping and pick-up	Chalk and Talk & PPT
7	<b>III-Week Sep/2018</b>	fission, fusion, photonuclear reactions, thermonuclear reactions the fission energy - reproduction factor - classification of reactors - based on moderators, coolant, phase of fuel and generation	Chalk and Talk & PPT
8	<b>IV-Week Sep/2018</b>	- principle of thermal nuclear reactors. The four-factor formula - reactor power - critical size of a thermal reactor - excess reactivity and control - breeder reactor - reprocessing of spent fuels -.	Chalk and Talk & PPT
9	<b>I-Week Oct/2018</b>	nuclear waste management - safety culture - active and passive safety, containment building, nuclear criticality safety, ionizing radiation protection - enforcement agencies	Chalk and Talk & PPT
10	<b>II-Week Oct/2018</b>	Radiation chemistry: Passage of radiation through matter - units for measuring radiation absorption - radiation dosimetry - radiolysis of water - free radicals in water radiolysis - chemical dosimetry:	Chalk and Talk & PPT
11	<b>III-Week Oct/2018</b>	Radiolysis of Fricke dosimeter solution – radiation – induced color centers in crystals – Effects of radiation with matter: Radiolysis of inorganic gases, organic gases, organic compounds, solids, and polymers – Annealing of radiation damage	Chalk and Talk & PPT
12	<b>IV-Week Oct/2018</b>	Application of radioisotopes: Probing by isotopes, reactions involved in the preparation of radioisotopes,	Chalk and Talk & PPT

13	<b>I-Week Nov/2018</b>	Szillard-Chalmer's reaction - radiochemical principles in the use of tracers - applications of radioisotopes as tracers - chemical investigations,	Chalk and Talk & PPT
14	<b>III-Week Nov/2018</b>	analytical applications, agricultural and industrial applications - neutron activation analysis - carbon and rock dating - use of nuclear reactions - radioisotopes as source of electricity - nuclear medicine	Chalk and Talk & PPT

**COURSE ASSESSMENT METHODS (shall range from 4 to 6)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assignment I	<b>II-Week Sep/2018</b>	One week	5
2	Test I	<b>II-Week Oct/2018</b>	1hour	20
3	Assignment II	<b>IV-Week Oct/2018</b>	One week	5
4	Test II	<b>II-Week Nov/2018</b>	1hour	20
CPA	Compensation Assessment* Re-Test	<b>IV Nov Dec/2018</b>	1 hour	20
5	Final Assessment *	<b>I-Week Dec/2018</b>	3 hours	50

**COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)**

1. Feedback from students during class committee meetings.
2. Anonymous feedback through questionnaire at the end of semester.

**COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)**

**MODE OF CORRESPONDENCE (email/ phone etc)**

Phone:8220462456

**ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)**

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

**THEORY:**

Each student should score minimum of **40% is higher** to pass in this course

**COMPENSATION ASSESSMENT POLICY**

Those who are absent for the assessment test on genuine grounds shall be given an opportunity only once for the retest with prior permission of the concern faculty member and head of department. The retest will be conducted before the end semester exam and portion will be all the five units.

**ACADEMIC DISHONESTY & PLAGIARISM**

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying

from others during an assessment will be treated as punishable dishonesty.

- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
- The above policy against academic dishonesty shall be applicable for all the programmes.

**ADDITIONAL INFORMATION**

The respective faculty will be available for consultation at times as per the intimation by the faculty.

**FOR APPROVAL**

Course Faculty N. Saravanan CC-Chairperson G. Venkataran HOD [Signature]

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