बिरसा मुंडा ट्रायबल युनिवर्सिटी
Birsa Munda Tribal University

राजपिपला, जि॰ नर्मदा Rajpipla, Dist. Narmda
Established by Tribal Development Department, Govt. of Gujarat

School of Science
B.Sc. (Chemistry) Programme
Subject Code & Name: - BS05MICHE3 Fundamentals of Thermodynamics and Quantum Mechanics

Teaching and Evaluation Scheme:

Teaching Scheme				Examination Scheme			
Credits				Component Weightage			
				CCE		SEE	
L	T	P	Total	TH	PWE	TH	PWE
2	-	2	4	25%	25%	25%	25%

Programme Name	B.Sc. (Chemistry)
Semester	V
Course Code	BS05MICHE3
Course Title	Fundamentals of Thermodynamics and Quantum Mechanics
Course Content Type(Th./Pr.)	Theory & Practical
Course Credit	4
Sessions+ Lab. Per Week	2+2
Total Teaching/Lab. Hours	60 Hours
* 2 Laboratory = 1 Session	

Learning Objectives

1. Understand the fundamental principle of thermodynamics, including concept such as energy, entropy and laws of thermodynamics.
2. Able to learn specific heat concepts, intensive and extensive variables
3. Applications of thermodynamics in various day to day life situations.
4. Understand the failure of classical mechanics through phenomena like black body radiation, Planck's Law, Photoelectric effect, Compton's effect, Specific heat of Solids at low temperatures, leading to the development to the phenomenon of wave particle duality and Heisenberg's uncertainty principle.

Prerequisites (if any):

12th Science passed with Physics as a subject.

Learning Outcomes :

On the Completion of this course, students will able to

1. Recall and explain the concepts of thermodynamic variables.
2. Explain the principles of thermodynamics including concepts such as energy, entropy of thermodynamics.

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3. Apply the laws of thermodynamics to anlyze and solve the problems related with energy transfer, heat engines, refrigeration system and other thermodynamic process.
4. Explain the basic posulates of quantum mechanics.
5. Explain the concept of wave packets.
6. Describe the principle off Heisenberg's uncertainty principle and its application.

Detailed Contents

UNIT	TOPIC/SUB-TOPIC	TEACHING HOURS
I	**Fundamentals of Thermodynamics:** Concept of thermodynamic state, Equation of state, Van der Waal's equation of state, Thermal equilibrium, Zeroth law of thermodynamics, Thermodynamic processes: Adiabatic, Isothermal, Isobaric and Isochoric changes, Work done during isothermal change, Adiabatic relations, Work done during adiabatic change, Internal energy, Internal energy as state function, First law of thermodynamics, Reversible and Irreversible changes, Problems. Thermodynamic variables, extensive & intensive variables, Maxwell's thermodynamic variables, applications of Maxwell's thermodynamic relations, thermodynamic potentials, Conversion of heat into work and it's converse, Second law of thermodynamics, Concept of entropy, Temperature - entropy diagram, T-dS equations, Clausius - Clapeyron latent heat equations, Problems.	15
II	Concept of the wave packet and its spread with time, Gaussian wave packet, Phase and Group velocity, de- Broglie wavelength using phase velocity and group velocity, Heisenberg uncertainty principle (uncertainty relations involving Canonical pair of variables), wave packet, Applications and consequences of the uncertainty principle, Representation of dynamical variables by operators (operators for the position, momentum, energy, angular momentum) Wave function, Physical Interpretation of wave function, Normalization of wave functions and box normalization, Probability current densities in one dimension, Normalization of wave function, Orthogonality Properties of wave function, Postulates of Quantum mechanics	15

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Text Book(s)	
Unit : I	i. Heat, thermodynamics and Statistical Mechanics by Brij Lal, Shubhrahmanium and P.S. Hemne, S. Chand Publication (2018 edition) ii. Thermal Physics -S.C. Gerg, R. M. Bansal & C.K. Ghosh, 2 nd Edition, Tata McGraw Hill Publication, (2017)
Unit: II	i. A Textbook of Quantum Mechanics by P.M. Mathews & K Venkatesan, 2 nd Edition, Tata McGraw Hill Publication. ii. Quantum Mechanics by G. Aruldhas, 2nd Edition, Prentice Hall of India. iii. Quantum Mechanics ;Concepts & Applications, 2nd Edition, Wiley Publication. iv. United Physics -III, R.P. Goyal Shivlal Publication. United Physics -III, Navbodh Publication.

Practical :
1. To determine Cauchy's Constant.
2. To determine resolving power of telescope.
3. To determine energy band gap of semiconductor.
4. To determine wavelength of light using plane diffraction grating. (Normal Incidence method)
5. To determine specific rotation of sugar solution using Laurent's half shade polarimeter.
6. To determine current and voltage sensitivity of Ballastic galvenometer.
7. To verify Newton's cooling Law.
8. To verify the Brester's law.
9. To measure the refractive index of given lens using optical lever.
10. To determine the C_1/C_2 using de sauty's method.

Reference Books
1. Heat and thermodynamics – M. W. Zemansky & R.H. Ditmann, 8th Edition, Tata McGraw Hill Publication (2017).
2. Thermodynamics, inetic theory and statistical thermodynamics – F.W. Sears & G. L. Salinger,3rd Edition, Narosa Publishing house (2013).
3. Quantum Mechanics: Theory and Problems , 4th Edition, S.L.Kakani & H.M. Chandalia, Sultan Chand &Sons
4. Introduction to Quantum Mechanics by David Griffiths, 2nd Edition, Pearson Publication
5. Quantum Physics (Berkley Series) by E.H.Wichman, 1st Edition, Tata McGraw Hill Publication (2017).
6. Concept of Modern Physics, A.Beiser, S. Mahajan & S.R.Choudhary, 7th Edition, Tata McGraw Hill Publication

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Web Resources
1. https://nptel.ac.in/courses/112108148
2. https://nptel.ac.in/courses/127106135
3. https://nptel.ac.in/courses/112105220
4. https://onlinecources.nptel.ac.in/noc20_cy27/preview
5. https://nptel.ac.in/cources/115/101/115101107/
6. https://nptel.ac.in/courses/115/102/115102023/
7. https://www.iiserpune.ac.in/~~sdude/phy202/threeD.pdf
8. https://www.azoquantum.com/video-details.aspx?VidID=9
Required Software(s) (if any)

L:: Lecture, **T::** Tutorial , **P::**Practical

CCE:: Continuous and Comprehensive Evaluation
(CCE Theory includes Mid Semester Examination, Assignment, MCQ quizzes, Seminar, Reflective notes, class participation, case analysis and presentation, slip tests (announced/ surprised), attendance etc. or any combination of these)
PWE:: Practical Work Examination
(PWE includes Laboratory practical work, project work, viva simulation exercise work etc.)
SEE:: Semester End Evaluation

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