Complete Course Grid and Syllabus

Diploma in Chemical Engineering

Assam Energy Institute, Sivasagar

Course: Diploma in Chemical Engineering

Total Number of Credits: 350

SEMESTER I					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
MA101	Mathematics-I	3	1	0	11
PY101	Physics-I	3	1	0	11
CY101	Chemistry-I	2	1	0	8
ME101	Engineering Mechanics	2	1	0	8
CS101	Fundamentals of Computer Engineering	2	0	2	8
ME103L	Engineering Workshop Practices Laboratory	0	0	3	3
CY101L	Chemistry Laboratory	0	0	2	2
Total					**51**
HU101	Universal Human Values	1	1	0	5
HU102	Communication Skills*	2	0	1	7

*****For selective students with less proficiency in English

SEMESTER II					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
MA102	Mathematics-II	3	1	0	11
PY102	Physics-II	3	1	0	11
CY102	Chemistry-II	3	0	0	9
EIE101	Fundamentals of Electrical and Electronics Engineering	3	1	0	11
CS102	Computer Programming	2	0	2	8
ME102L	Engineering Drawing	0	0	3	3
PY101L	Physics Laboratory	0	0	2	2
EIE101L	Fundamentals of Electrical and Electronics Engineering Laboratory	0	0	2	2
Total					**57**
HU103	Community Internship	1	1	0	5

SEMESTER III					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
ME202	Materials Science	3	0	0	9
CE201	Unit Operations -I	3	1	0	11
ME205	Engineering Thermodynamics	3	0	0	9
CE202	Materials and Energy Balance	3	1	0	11
CE203	Mechanical Operations	3	0	0	9
CE204	Chemical Technology - Inorganic	2	0	0	6
ME207L	Computer Aided Drafting Laboratory	0	0	2	2
CE201L	Unit Operations Laboratory-I	0	0	2	2
CE205	Group Discussion	0	0	2	2
Total					**61**

SEMESTER IV					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
CE206	Unit Operations - II	3	1	0	11
CE207	Unit Operations - III	3	1	0	11
CE208	Petroleum Refinery Operations	3	0	0	9
CE209	Chemical Engineering Thermodynamics	3	0	0	9
CE210	Chemical Technology- Organic	3	0	0	9
CE206L	Unit Operations Laboratory - II	0	0	2	2
CE211	Project	0	0	5	5
CE212	Seminar	0	0	2	2
Total					**58**

SEMESTER V					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
CE301	Unit Operations - IV	3	1	0	11
CE302	Chemical Reaction Engineering	3	0	0	9
CE303	Process Instrumentation and Control	3	0	0	9
CE304	Equipment Design	2	0	2	8
HU301	Humanities	2	0	0	6
HU302	Engineering Economics	2	1	0	8
CE302L	Chemical Reaction Engineering Laboratory	0	0	2/2	1
CE303L	Process Instrumentation and Control Laboratory	0	0	2/2	1
CE305	Project	0	0	5	5
CE306	Industrial Training	0	0	5	5
Total					**63**

SEMESTER VI					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
CE307	Corrosion Engineering and Materials Selection	3	0	0	9
CE308	Process Equipment and Plant Design	3	0	2	11
CE309	Process Plant Utilities	2	0	0	6
CE310	Industrial Pollution and Control	3	0	0	9
FSE314	Safety, Health and Environment Management	2	0	0	6
	Open Elective	3	0	0	9
	Departmental Elective	3	0	0	9
CE310L	Industrial Pollution and Control Laboratory	0	0	2/2	1
Total					**60**

Department Elective/Open Elective

S. No.	Code	Courses
1	CE311	Polymer Technology
2	CE312	Energy Resources and Utilization
3	CE313	Natural Gas Engineering

Category	Diploma in Chemical Engineering	Credits
HU	Humanities and Social Science	31
MA	Mathematics	22
PY	Physics	24
CY	Chemistry	19
	Institute Requirement Engineering	63
	Engineering Drawing (Manual and Computer Aided), Manufacturing Practices and Practice course of Department	6
CE	Departmental Core	165
	Departmental Elective	9
	Open Elective	9
	Project/ Industrial visit/ Training/Seminar/Group Discussion	19
Total		**367**

Institute Requirement Engineering				
Course Code	**Subjects**	**Semester**		**Credits**
		Odd	**Even**	
ME101	Engineering Mechanics	Odd		8
CS101	Fundamentals of Computer Engineering	Odd		8
EIE101	Fundamentals of Electrical and Electronics Engineering		Even	11
CS102	Computer Programming		Even	8
EIE101L	Fundamentals of Electrical and Electronics Engineering Laboratory		Even	2
ME201	Materials Science	Odd		9
ME205	Engineering Thermodynamics	Odd		9
ME207L	Computer Aided Drafting Laboratory	Odd		2
FSE315	Safety, Health and Environment Management		Even	6
Total				**63**

Engineering Drawing and Engineering Workshop Practices Course of Department				
Course Code	**Subjects**	**Semester**		**Credits**
		Odd	**Even**	
ME103L	Engineering Workshop Practices Laboratory	Odd		3
ME102L	Engineering Drawing		Even	3
Total				**6**

Syllabus

Semester I

Mathematics-I

1.1 Course Number: MA101
1.2 Contact Hours:3-1-0 Credits:11
1.3 Semester-offered: 1st Year –Odd
1.4 Prerequisite: Class 10th level Mathematics
1.5 Syllabus Committee Members: Dr. Rupjit Saikia & Dr. Satish Kumar Tiwari

2. Objective:

This course is designed to give a comprehensive coverage at an introductory level to the subject of Trigonometry, Co-ordinate Geometry, Complex Numbers, Differential Calculus and Vector Algebra.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Trigonometry**	Concept of angle; Measurement of angle in degree, grades and radians and their conversions; Trigonometric ratios; Sum, difference formulae and their applications (Without proof); Product formula (Transformation of Product to Sum and Differences and vice versa); Trigonometric Ratios of multiple angles, sub-multiple angles (2A,3A, A/2); Graph of sinx, cosx, tanx, cosecx, secx and cotx., Basic concept of inverse trigonometric functions.	8
2	**Co-ordinate Geometry**	Equation of straight line in various standard form (Without Proof); Intersection of two straight lines Angle between two straight lines; Parallel lines and perpendicular lines; Perpendicular distance formula Sections of a cone: Circle, Parabola, Ellipse and Hyperbola; General equation of a circle and its characteristics; Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations (without proof).	8
3	**Complex Numbers**	Definition of Complex numbers; Real and imaginary parts of a Complex number; Conjugate of a complex number; Modulus and amplitude of a complex number; Addition, Subtraction, Multiplication and Division of complex numbers, Polar and Cartesian form of a complex number and its conversion from one form to other, De-Movier's theorem and its application.	7
4	**Differential Calculus**	Definition of function; Concept of limits; Four standard limits $\lim_{x\to a}\frac{x^n-a^n}{x-a}, \lim_{x\to 0}\frac{\sin x}{x}, \lim_{x\to 0}\frac{a^x-1}{x}$ *and* $\lim_{x\to 0}(1+x)^{1/x}$, Differentiation of $x^n, \sin x, \cos x, e^x$ *and* $\log_a x$ by the first principle rule of derivative, Differentiation of sum, product and quotient of	12

		functions; Differentiation of function of a function; Differentiation of trigonometric and inverse trigonometric functions; Logarithmic differentiation; Exponential functions.Definition & meaning of partial derivative. Evaluation of partial derivatives. Definition & examples of homogeneous functions. Euler's theorem (1st order) on Homogeneous functions for 2 variables (without proof). Problems.	
5	**Vector Algebra**	Definition, notation and rectangular resolution of a vector; Addition and subtraction of vectors; Scalar and vector products of 2 vectors; Simple problems related to work; moment and angular velocity.	6
	Total		**41**

4. Reading

4.1 Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khana Publishers, New Delhi, 40th Edition, 2007.
2. Mathematics Textbook for Class XI and XII (NCERT).
3. S. L. Loney, The Elements of Coordinate Geometry Part-1 Cartesian Coordinate.

4.2 Reference Books:

1. R. D. Sharma, Mathematics for Class 11and 12.
2. E. Kreyszig, Advanced Engineering Mathematics, Khanna Publisher.
3. Murray R. Spiegel, Robert E. Moyer, College Algebra, Tata McGraw Hill, New Delhi, 2nd Edition, 2000.
4. Frank Ayers, Elliot Mendelson, Calculus, McGraw Hill, New York, 4th Edition.

5. Outcome of the Course:

After the completion of the course the students will be able to

1) Solve problems involving angles, triangles, and periodic phenomena using trigonometric functions. Apply trigonometry in real-world situations, such as navigation, physics, and engineering
2) Understand the cartesian coordinate system and the relationship between points, lines, and curves. Represent geometric figures using equations and inequalities.
3) Understand the concept of a derivative as the rate of change and slope of a function.
4) Apply complex numbers in solving equations and expressing solutions.
5) Understand the geometric and algebraic properties of vectors.

Physics-I

1.1 Course Number: PY101
1.2Contact Hours: 3-1-0 Credits:11
1.3 Semester-offered: 1st Year - Odd
1.4 Prerequisite: Class 10th level Physics and Mathematics
1.5 Syllabus Committee Members: Dr. Shikha Dwivedi & Dr. Nimisha Raghuvanshi

2. Objective:

i) Physics is the mother of all engineering disciplines hence students must have a fundamental understanding of the topic in order to grasp their core engineering diploma subjects more readily. As a result, while reviewing the curriculum, emphasis was placed on the concepts, laws, working equations, and basic notions of physics to assist students in studying the key courses. This will give a solid foundation for future self-development in order to cope with new advances.
ii) The course material places a strong emphasis on the practical application of physical concepts and analysis in a variety of engineering and technological sectors.
iii) The course will assist diploma engineers in using fundamental ideas and principles to tackle complex engineering issues and comprehend various technology-based applications.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Units and Measurements**	Physical quantities: Fundamental and derived, Units and systems of units (FPS, CGS and SI units), Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis. Measurements: Need, Measuring instruments, Least count, Types of measurement (direct and indirect), Errors in measurements (systematic and random), Absolute error, Relative error, Error propagation, Error estimation and significant figures.	8
2	**Scalars and Vectors**	Scalar and Vector quantities: Examples, Representation of vectors, Types of vectors, Addition and Subtraction of Vectors, Triangle and Parallelogram law, Scalar and Vector product,	7

		Resolution of a vector and its application to inclined plane. Kinematics equations in scalar and vector form with related numerical problems.	
3	**Force and Motion**	Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, Rockets, Impulse and its applications. Circular motion, Angular displacement, Angular velocity, Angular acceleration, Frequency, Time period, Relation between linear and angular velocity, Linear acceleration and angular acceleration (related numerical),Centripetal and centrifugal forces with live examples. Moment of inertia and its physical significance, Definition of torque and angular momentum and their examples.	8
4	**Work, Power and Energy**	Work: Concept and unit, Examples of zero work, Positive work and negative work. Friction: Concept, Types of friction, Laws of limiting friction, Coefficient of friction, Reducing friction and its engineering applications, Work done in moving an object on horizontal and inclined plane (for rough and smooth surfaces) and related applications. Energy and its unit, Kinetic energy, Gravitational potential energy with examples and derivations, Mechanical energy, Conservation of mechanical energy for freely falling bodies, Transformation of energy (examples). Power and its unit, Power and work relationship, Calculation of power (numerical problems).	7
5	**Properties of Matter**	Elasticity: Definition of stress and strain, Moduli of elasticity, Hooke's law, Significance of stress-strain curve. Pressure: Definition, Unit, Atmospheric pressure, Gauge pressure, Absolute pressure, Fortin'sBarometer and its applications. Surface tension: Concept, Unit, Cohesive and adhesive forces, Angle of contact, Ascent Formula, Applications of surface tension, Effect of temperature and impurity on surface tension. Viscosity and coefficient of viscosity, Terminal velocity, Stokes' law and effect of temperature on viscosity, Application in hydraulic systems. Hydrodynamics: Fluid motion, Streamline and turbulent flow, Reynold's number, Equation of continuity, Bernoulli's Theorem (formulae and numerical problems) and its applications.	12
Total			**42**

4. Readings

4.1 **Textbooks:**

1. Textbook of Physics for Class XI (Part-1, Part-2); N.C.E.R.T., Delhi.

4.2 **Reference Books:**

1. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
2. Concepts in Physics by H. C. Verma, Vol. I&II, Bharti Bhawan Ltd., New Delhi.
3. Engineering Physics by P. V. Naik, Pearson Education Pvt. Ltd, New Delhi.
4. Engineering Physics by D. K. Bhattacharya & Poonam Tandan; Oxford University Press, New Delhi.
5. Comprehensive Practical Physics, Vol, I & II, J. N. Jaiswal, Laxmi Publications (P) Ltd., New Delhi.
6. Practical Physics by C. L. Arora, S. Chand Publication.

5. Outcomes of the Course:

After undergoing this subject, the student will be able to:

1) Explain and identify physical quantities along with their units and make measurements with accuracy by minimizing different types of errors.
2) Understand the scalar and vector quantities and use this knowledge in solving relevant real-life problems.
3) Describe the types of friction, its coefficients and methods to reduce or increase friction between different surfaces.
4) Analyze different types of motion, acting forces along the motion and conservation of momentum principle to describe rocket propulsion, recoil of gun etc.
5) Compare and relate physical properties associated with linear motion and rotational motion along with the application of conservation of angular momentum.
6) Understanding of relationships for work, energy and power and solve related problems. Explain the principle of conservation of energy also identify various forms of energy, and energy transformations.
7) Describe the phenomenon related to properties of matter such as pressure, surface tension, stress, strain, elasticity, viscosity and their effect.

Chemistry-I

1.1 Course Number: CY101
1.2 Contact Hours: 2-1-0 Credits:8
1.3 Semester-offered: 1st Year –Odd
1.4 Prerequisite: Class 10th level Chemistry and Mathematics
1.5 Syllabus Committee Members: Dr. Sabyasachi Pramanik & Dr. Souvik De

2. Objective:

i) To impart the knowledge of fundamental principles of chemistry for future learning of engineering principles
ii) To make students realize the importance of fundamental chemistry in engineering disciplines.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Atomic Structure**	Atomic number, isotopes and isobars. Thompson's modeland its limitations, Rutherford's model and its limitations, Bohr's model and its limitations Quantum number, Aufbau principle, Hund's rule, Pauli's exclusion principle, electronic configuration.	5
2	**Periodic Properties of Elements**	Classification of Elements, Significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii Ionization enthalpy, electron gain enthalpy, electro negativity, valency. Nomenclature of elements with atomic number greater than 100. Basic Concepts of s, p, d and f-block Elements	6
3	**Chemical Bonding and Molecular Structure**	Orbit vs. Orbital, Valence electrons, ionic bond, covalent bond; Lewis structure, polar character of covalent bond, covalent character of ionic bond, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbitals and shapes of some simple molecules, Valence-Bond Theory.	6
4	**Concept of Moles and Chemical Equation**	Phases, Mole concept and problems, Standard solution, normal solution and molar solution, concentration terms-normality, molarity, gm/l, ppm, normality equation, acid-base titration. Chemical equation-definition, qualitative and quantitative significance, limitations, balancing by partial and ion-electron method, electronic concept of oxidation and reduction, Stoichiometric calculations.	5

5	**Acids-Bases and Salt**	Acids, bases and salts, Theories of acids and bases- Arrhenius, Bronsted-Lowry, Lewis theory, Strong acids and strong bases, Concept of pH and pKa, conjugate acid-base pair, classification of salts, hydrolysis of salts and its effect, Concept of Buffer, Indicator.	4
6	**Phase of Substances**	Kinetic Theory of gases, Boltzmann distribution, Ideal gas & Real gas, Types of solutions (solution, dispersion, colloids), expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties – relative lowering of vapour pressure, Raoult's law , elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, Vant Hoff factor. Micelle, lipid bilayer. Applications of Micelles	6
Total			**32**

4. Readings

4.1 Suggested Readings:

1. NCERT Textbook (Class XI and XII)
2. Engineering Chemistry, B. K. Sharma
3. A Textbook of Engineering Chemistry, Sashi Chawla
4. Engineering Chemistry, Jain and Jain
5. Applied Chemistry, Dr.Raman Rani Mittal

5. Outcomes of the Course:

After completion of this course students will be able to

1) Know about the structure of an atom and write the electronic configurationsof atoms.
2) Understand the variation of physical and chemical properties of elements such as ionization potential, electron affinity, electro negativity and learn about the periodic table.
3) Understand chemical bonding, concept of hybridization, as well as structure and shape of molecules.
4) Impart knowledge about various atomic and molecular quantities, strength and balancing chemical reaction.
5) Explore acid-base chemistry with a focus on the equilibrium aspects of these reactions.
6) Explain the existence of different states of matter in terms of balance between intermolecular forces and thermal energy of particles. explain the laws governing behaviour of ideal gases and apply gas laws in various real life situations. Understand the properties of liquids in terms of intermolecular attractions.

Engineering Mechanics

1.1 Course Number: ME101
1.2 Contact Hours: 2-1-0 Credits: 8
1.3 Semester-offered: 1st Year –Odd
1.4 Prerequisite: Class 10th level Physics & Mathematics
1.5 Syllabus Committee Members: Dr. Naveen Mani Tripathi, Dr. Sanat Kumar Singha, Dr. Abhimanyu Kar & Dr. Karthik Babu NB

2. Objective:

i) To develop the ability to model and analysis of mechanical engineering systems using vectorial representation of forces and moments.
ii) To be able to draw free-body diagrams of mechanical components and systems.
iii) To develop the capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
iv) To understand the phenomenon of friction and the ability to solve problems related to the same. Ability to apply the principles of virtual work.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Basics and statics of particles**	Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem,Parallelogram and triangular Law of forces – Vector representation of forces –Vector operations of forces – additions, subtraction, dot product, cross product –Coplanar Forces – rectangular components – Equilibrium of a particle – Forces inspace – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.	7
2	**Equilibrium of rigid bodies**	Free body diagram – Types of supports –Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions	7
3	**Properties of surfaces and**	Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by	7

	solids	integration – T section, I section, and Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section –Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.	
4	**Dynamics of particles**	Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Simple problems – Impact of elastic bodies.	7
5	**Friction and rigid body dynamics**	Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder and disc/wheel.	7
	Total		**35**

4. Readings

4.1 Textbooks:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

4.2 References Books:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

5. Outcome of the Course:

On successful completion of this course, the student will be able to

1) Illustrate the vectorial and scalar representation of forces and moments
2) Analyse the rigid body in equilibrium
3) Evaluate the properties of surfaces and solids
4) Calculate dynamic forces exerted in rigid body
5) Determine the friction and the effects by the laws of friction

Fundamentals of Computer Engineering

1.1 Course Number: CS101
1.2 Contact Hours: 2-0-2 Credits:8
1.3 Semester-offered: 1st Year –Odd
1.4 Prerequisite: Basic knowledge of computers
1.5 Syllabus Committee Members: Dr. Shikha Dwivedi

2. **Objective:**

The aim of the course is to help the students to attain the following basic competency through various teaching-learning experiences:

i) Identifying and learning about various computer hardware and their uses.
ii) Understanding of computer memory and its internal architecture.
iii) Basic knowledge of software including different operating systems and its working.
iv) Introduction to web designing using HTML coding.
v) Developing awareness regarding cyber security.
vi) Evolving logical thinking and problem-solving skills.
vii) The course will assist diploma engineers in using fundamental ideas and principles to tackle complex engineering issues and comprehend various technology-based applications.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Computer Organization**	Introduction to generations of computer and its classification, Logical organization of computer (functional block diagram), Input & Output devices (keyboard, mouse, joystick, scanner, OCR, OMR, MICR, barcode reader, web camera, monitor, printer, plotter), Central processing unit.	5
2	**Memory & Architecture**	Primary, secondary and auxiliary memory, Main memory unit, RAM, ROM, Cache memory, Registers, System bus, Hard disks & optical disks, CPU, SMPS, Motherboard, Ports and Interfaces, Expansion cards, Ribbon cables, Memory chips, Processors.	4

3	**Human Computer Interface**	Types of software (System and application), Operating system as user interface, Types of operating systems (Window, Linux, Mac), MS Office (Word, Excel, PowerPoint), Unix Shell and Commands, Programming languages, Compiler, Interpreter, VI editor, Computer viruses and its type, Detection and prevention of viruses.	5
4	**Computer Networks & Web Design**	Internet, TCP/IP, World Wide Web, Browser, Internet address (Domain name, URL), Search engine. Introduction to computer networks, Data communication and its components, Data transmission mode, LAN, MAN, WAN, Wireless LAN, Client/server network and peer-to-peer network, Intranet, Extranet. Hyper Text Mark-up Language (HTML), Cascading Style Sheet (CSS), Creating web pages, Lists, Hyperlinks, Tables, Web forms, Inserting images, Frames, Hosting options and domain name registration.	10
5	**Information Security**	Protection, Security, Risk, Threat, Vulnerability, Exploit, Attack, Confidentiality, Integrity, Availability, Non-repudiation, Authentication, Authorization, Codes, Plain text, Encryption, Decryption.	3
	Total		**27**

List of Experiments:

1. Introduction to various components of Computer system.
2. Study and Practice of handling Microsoft Windows – Folder related operations, My-Computer, Window explorer, Control Panel.
3. Introduction to Microsoft Office.
4. Creation and editing of Text files using MS Word.
5. Creation and operating of spreadsheet using MS Excel.
6. Creation and editing power-point slides using MS Power Point.
7. Introduction to Unix operating system (Ubuntu).
8. Study and practice of Open Office: OpenOffice Writer, OpenOffice Spreadsheet, OpenOffice Impress.
9. Study and practice of Basic Linux Commands.
10. Study and practice of Vim editor and its various commands in different modes.
11. Introduction to inter-networking protocols, world wide web, browsers and search engines.
12. Understanding of IP addresses, significance and uses of various domain names and URLs.

13. Create webpages and webforms including lists, hyperlinks, images, table etc. by using basic HTML program with HTML tag.
14. Modify the same webpages by using CSS codes.
15. Write the complete HTML coding using CSS for the following table:

Gradesheet of Diploma Students

	Maths	Physics	Chemistry	Human Values	Communication Skills	Engineering Themodynamics
Tom	47	39	25	33	43	36
Jimi	23	45	25	37	40	39
Tus	50	43	38	44	40	37
Ross	31	30	42	35	29	22
Max	34	35	38	44	49	43

16. Write the complete HTML coding using CSS for the following form :

Admission Form for Assam Energy Institute

First Name: enter your name Last Name: enter your title

Password: enter your password

Select Gender: Male Female

Answer the following questions:

Why do you want to join Assam Energy Institute?

Which branch have you selected and why?

Submit Form

4. Readings:

4.1 References Books:

1. A. Goel, Computer Fundamentals, Pearson Education.
2. P. Aksoy, L. De Nardis, Introduction to Information Technology, Cengage Learning.
3. P. K. Sinha, P. Sinha, Fundamentals of Computers, BPB Publishers.
4. R. S. Salaria, Computer Fundamentals, Khanna Publishing House.
5. Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House.
6. Andrew S. Tanenbaum, David J. Wetherall Computer Networks (5th Edition), PHI.

7. M. Merkow, J. Breithaupt, Information Security Principles and Practices, Pearson Education.
8. J. Minnick, Web Design with HTML5 and CSS3 (8th edition), Cengage Learning.

5. Outcomes of the Course:

After undergoing this subject, the student will be able to:

1) Describe functional units of a computer, its various peripherals and their applications.
2) Identify computer hardware as well as software (in the lab).
3) List the features of Word, Excel, PowerPoint and also able to perform calculations on excel sheet and demonstrate the use of PowerPoint for seminar presentations.
4) Identify various operating system file management commands (create, copy, move, delete and rename folders and files).
5) Demonstrate installation of application software in windows as well as in Linux operating system.
6) Acknowledge various computer languages and also able to differentiate between compiler and interpreters.
7) State computer networks such as LAN, MAN and WAN together with the internet, intranet and extranet.
8) Design basic web pages using the HTML along with the CSS.
9) Aware regarding the issues related to cyber security.

Engineering Workshop Practices Laboratory

1.1 Course Number: ME103L
1.2 Contact Hours: 0-0-3 Credits: 3
1.3 Semester-offered: 1st Year –Odd
1.4 Prerequisite: Class 10th level Mathematics
1.5 Syllabus Committee Members: Dr. Naveen Mani Tripathi, Dr. Sanat Kumar Singha, Dr. Abhimanyu Kar & Dr. Karthik Babu NB

2. Objective:

i) To get a hands-on basic training of various common manufacturing processes
ii) To understand the feasibility of different manufacturing processes depending on the raw materials and the product.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lab Sessions
1	**Carpentry**	Study of the joints in roofs, doors, windows and furniture, Hands-on-exercise: Woodwork, joints by sawing, planning and cutting	2
2	**Fitting Shop**	Introduction and practice of various fitting processes: Use of hand tools in fitting, preparing a male and female joint of M.S.	3
3	**Welding Shop**	Introduction and practice of various Welding processes: Electric Arc welding Practice and Gas welding, TIG, MIG, Gas Cutting and application. Joints such as a Lap joint, a T-joint or a Butt joint are to be prepared.	2
4	**Machine Shop**	Introduction and practice of various Machining processes: Plain and Stepped cylindrical turning, grooving, knurling and Thread-cutting of a job in lathe.	3
5	**Sheet Metal Work**	Basics of Sheet Metal Work, essential properties required for sheet metal (malleable and formable), Forming & Bending, Model making – Trays and funnels, Different type of joints.	2
	Total		**12**

4. Readings

4.1 Textbooks:

1. Elements of Workshop Technology, Vol. I and II by Hajra Choudhary, Khanna Publishers

4.2 Reference Books:

1. Workshop Technology by WAJ Chapman, Viva Books
2. Workshop Manual by Kannaiah / Narayana,Scitech

5. Outcome of the Course:

1) Practical knowledge of the several manufacturing processes
2) Skills developed in carpentry, fitting welding, machining and sheet metal work
3) Basic idea of how things are produced in the industry

Chemistry Laboratory

1.1 Course Number: CY101L
1.2 Contact Hours: 0-0-2 Credits: 2
1.3 Semester-offered: 1st Year –Odd
1.4 Prerequisite: Class 10th level Chemistry
1.5 Syllabus Committee Members: Dr. Sabyasachi Pramanik & Dr. Souvik De

2. Objective:

i) To incorporate the habit of working in laboratory while maintaining discipline, safety and integrity.
ii) To provide hands-on experience on the basic methods of quantitative analysis.

3. Course Content:

Sl. No.	List of Experiments
1	Introduction of a Chemistry Laboratory
2	Preparation of standard solution of oxalic acid or potassium permanganate.
3	Determination of strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator
4	Standardization of $KMnO_4$ solution using primary standard oxalic acid solution.
5	Determination of Fe content in Mohr Salt using $KMnO_4$ solution
6	Estimation of total hardness of given water sample using standard EDTA solution
7	Determination of Alkalinity of given water sample using known concentration of an acid
8	Determination of pH of given water sample
9	Determination of the total dissolved solid of a given water sample
10	Determination of viscosity of a solution using Ostwald viscometer

4. Outcome of the Course:

1) To prepare solution of a given strength
2) To use basic laboratory techniques and equipment such as titration, pH meter, viscometer etc.
3) To estimate of strength of acid /base and ions present in domestic/industry water
4) To estimate iron content in metal and alloys
5) To determine the quality of domestic/industry water

Universal Human Values

1.1 Course Number: HU101
1.2 Contact Hours: 1-1-0 Credits: 5
1.3 Semester-offered: 1st Year –Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee Members: All Faculties of AEI

2. Objective:

i) To help the student see the need for developing a holistic perspective of life.
ii) To sensitize the student about the scope of life – individual, family (inter-personal relationship), society and nature/existence
iii) To strengthen self-reflection
iv) To develop more confidence and commitment to understand, learn and act accordingly.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Motivation and Objectives of Human Values Course**	Introduction to the objectives of the course. Content and process of the course including mode of conduct. Daily life as lab for the course. Activities in the course.	2
2	**Purpose of Education**	How human being has a need for Knowledge, what should be the content of knowledge, how the content should be discussed in education. Complimentarily of skills and values, how the current education system falls short.	3
3	**Peers Pressure, Social Pressure**	In various dimensions of life, how do these things work. What is the way out? In the context of education, peer pressure etc.	2
4	**Concept of Competition and Excellence**	How competition leads to degradation of self and relationships. How excellence is the basic need of a human being. What is excellence?	2
5	**Time Management**	How does one deal with myriads of activities in college? Focus of the mind.	2
6	**Concept of**	How preconditioning affects our thinking, behavior,	3

	Preconditioning	work, relationships, society and nature. How do we develop pre-conditioning? What are the various sources of preconditioning? How do we evaluate our Preconditioning? How do we come out of it?	
7	**Concept of Natural Acceptance in Human Being**	What is natural acceptance? How can the concept of natural acceptance be used to evaluate our preconditioning? Universal nature of natural acceptance. Are anger, jealousy, hatred natural? How do we feel when we experience them? Which feelings are natural for a human being and which are not?	3
8	**Understanding Relationships**	Are relationships important? What is the role of relationships in our life? If relationships are important then why they are important? If they are important then why it is the case that we are not discussing them? What are the notions/conditions and factors which stop us to explore more into relationships? Relationships in family and extended family. Dealing with anger, Basic expectations in relationships. Seven types of relations, Gratitude as a universal value in relationships, Nine universal values in human relationships, Trust as the founding value, Concept of acceptance, Unconditional acceptance in relationships, Our preconditioning affecting our relationships, Our relationships with subordinate staff, with people of opposite gender, caste, class, race, How relationships have the power to force a person to change his preconditioning.	4
9	**Concept of prosperity Material goods**	What role others have played in making material goods available to me: Identifying from one's own life.	2
10	**Idea of Society**	What is a society? What constitutes a society? What systems are needed for a society to work? What is the purpose of society and various systems which are working in it? How understanding of Human Nature is important in order to understand the purpose of Society and various social systems? And what happens when this understanding is lacking?	2
11	**Balance in nature**	Balance which already exists in nature, How human beings are disturbing the balance. Resource depletion and pollution, our own role in wastage of electricity, water and in use of plastics, Waste management, Issues like global warming, animal extinction	2
	Total		**27**

4. Readings

4.1 Suggested Readings:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3. On Education - J Krishnamurthy
4. Siddhartha - Hermann Hesse
5. Old Path White Clouds -ThichNhatHanh
6. Diaries of Anne Frank - Anne Frank
7. Life and Philosophy of Swami Vivekananda
8. Swami Vivekananda on Himself
9. Small is Beautiful - E. F Schumacher
10. Slow is Beautiful - Cecile Andrews
11. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi
12. Rediscovering India - by Dharampal
13. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
14. India Wins Freedom -Maulana Abdul Kalam Azad
15. Autobiography of a Yogi – by ParamhansaYogananda
16. Gandhi and Question of Science – Sahasrabudhe

5. Outcome of the Course:

1. Analyze the significance of value inputs provided in formal education along with skills and develop a broader perspective about life and education.
2. Formulate their aspirations and concerns at different levels of living, and the way to fulfill them them in a sustainable manner.
3. Evaluate their current state of understanding and living and model a healthy lifestyle.
4. Examine the issues of home sickness, interactions with seniors on the campus, peer pressure with better understanding and feel grateful towards parents, teachers and others
5. Develop more confidence and commitment for value-based living in family, society and nature.

Communication Skills

1.1 Course Number: HU102
1.2 Contact Hours: 2-0-1 Credits:7
1.3 Semester-offered: 1st Year –Odd
1.4 Prerequisite: Class 10th level English
1.5 Syllabus Committee Members: DUGC

2. Objective:

i) To make the students confident of speaking in English impeccably and with utmost enthusiasm.
ii) To familiarize the students with different styles of communication.
iii) To enlighten the students with the seven concepts of communication.
iv) To make the students understand the nuances of communication.
v) To train the students and make them comprehend various aspects of Interview skills.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Parts of Speech**	Recognition and review of Nouns, Pronouns, Verbs, Adverbs, Adjectives, Prepositions, Conjunctions, Interjections, Knowledge of Courses/ Subjects, Object and Compliment of the Verb, Verbals –Infinitival, Gerund and Preposition Recognition and review	3
2	**Prepositions of time and place**	Contextual teaching of prepositions of time - on, in, at, since, for, ago, before, to, past, to, from, till/until, by Prepositions of place: in, at, on, by, next to, besides, near, between, behind, in front of, under, below, over, above, across, through, to, into, towards, onto, from	3
3	**Clause, phrases and Relative Clauses**	Basic definitions of clauses and phrases, Focus on Relative Pronouns and their use in sentences as relative clauses.	2
4	**Courses/Subjects Verb Agreement**	Rules that guide the agreement of the Courses/Subjects to its verb	2
5	**Sentence types and**	Assertive sentences, Exclamatory sentences, Interrogative sentences, Negative sentences, Compound sentences, complex	2

	Transformation of sentences	sentences, simple sentences, Degrees of Comparison	
6	**Voice**	Change from Active Voice to Passive Voice and vice versa	2
7	**Punctuation**	Use of the comma, semi-colon, colon, apostrophe, exclamation mark, question mark and quotation marks	2
8	**Word formation**	Change of one part of speech to the other: from Verbs to Nouns, Nouns to Verbs, Adjectives to Nouns, Nouns to Adjectives, Verbs to adverbs, and Adverbs to Verbs	2
9	**Affixation**	Prefixes and Suffixes and new word formations	2
10	**Nominal Compounds**	Common nominal compound	2
11	**Paragraph Writing**	Descriptive Paragraph on various related topics.	2
	Total		**24**

4. Readings

4.1 Suggested Readings**:**

1. Essential English Grammar with Answers by Raymond Murphy (Cambridge University Press)
2. English for Polytechnics by Dr Papori Rani Barooah (Eastern Book House Publishers)
3. English Grammar by Annie Brinda (Cambridge University Press)

5. Outcome of the Course:

1) Develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others.
2) Understand and practice different techniques of communication.
3) Practice and adhere to the 7Cs of Communication.
4) Familiarize with different types of Communication.
5) Understand and practice Interview Etiquettes.

Semester II

Mathematics-II

1.1 Course Number: MA102
1.2 Contact Hours: 3-1-0 Credits:11
1.3 Semester-offered: 1st Year –Even
1.4 Prerequisite: Class 10th level Mathematics
1.5 Syllabus Committee Members: Dr. Rupjit Saikia & Dr. Satish Kumar Tiwari

2. Objective:

This course is designed to give a comprehensive coverage at an introductory level to the subject of complex numbers, vector calculus, probability & statistics and differential equations (PDE and DE).

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Complex Numbers**	Definition of Complex numbers; Real and imaginary parts of a Complex number; Conjugate of a complex number; Modulus and amplitude of a complex number; Addition, Subtraction, Multiplication and Division of complex numbers, Polar and Cartesian form of a complex number and its conversion from one form to other, De-Movier's theorem and its application.	8
2	**Vector Calculus**	Definition, notation and rectangular resolution of a vector; Addition and subtraction of vectors; Scalar and vector products of 2 vectors; Simple problems related to work; moment and angular velocity. Gradient; Divergence and Curl.	8
3	**Ordinary Differential Equations**	Definition of differential equations; Order and degree of a differential equation; General and particular solution of a differential equation; Formation of differential equation whose general solution is given; Solution of first order and first-degree differential equation by variable separation method; Homogeneous differential equation of 1st order, Exact differential equation, First order linear differential equation.	9
4	**Partial Differential Equations**	Origin of PDE, Derivation of PDE, Lagrange's Method of Solving the Linear PDE of Order One, Charpit's Method of Solving equation of order one but of any degree.	9

5	**Probability and Statistics**	Definitions of probability and simple theorems, conditional probability, Bayes Theorem, random variables, discrete and continuous distributions, Correlation and regression.	8
	Total		**42**

4. Readings

4.1Textbook:

1. H. K. Das, Applied Mathematics for Polytechnics.
2. B.S. Grewal, Higher Engineering Mathematics, Khana Publishers, New Delhi, 40th Edition, 2007.
3. Mathematics Textbook for Class XI and XII (NCERT).
4. R. D. Sharma, Mathematics for Class 11and 12.
5. E. kreyszig, Advanced Engineering Mathematics, Khanna Publisher.
6. M. D. Raisinghania, Advanced Differential Equation.
7. R. K. Jain and S. R. K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House.

1.5 Reference Books:

1**.** J. W. Brown and R. V. Charchill**,** Complex variable & applications, McGraw Hills.
2. S. Narayan, A Text book of Vector algebra, S.Chand & CO.
3. J. J. Sciller, R. A. Srinivasan, M. R. Spiegel, Probability & Statistics, Schaum's outline series, McGraw Hill.
4. M. R. Spiegel, S. Lipschutz, D. Spellman, Vector Analysis, McGraw-Hill Book Company, New York.

5. Outcome of the Course:

1) The applications of complex numbers, vector calculus, probability & statistics in engineering and science related problems.
2) The technique of solving differential equations problems of engineering and science.

Physics-II

1.1 Course Number: PY102
1.2 Contact Hours: 3-1-0 Credits: 11
1.3 Semester-offered: 1st Year – Even
1.4 Prerequisite: Class 10th level Physics &Mathematics
1.5 Syllabus Committee Members: Dr. Shikha Dwivedi & Dr. Nimisha Raghuvanshi

2. Objective:

i) Physics is a core science subject from which all engineering technologies have evolved, a thorough understanding of the basic principles and applied aspects will assist students in understanding, applying, and evolving technologies more effectively, thereby improving the quality of life in society.
ii) This course will provide the knowledge of the physical environment through observations and predictions.
iii) The course attempts to enhance the student's factual knowledge along with the applications. This will foster a scientific mindset and aid in the application of fundamental concepts and principles to engineering and technology-based challenges.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Wave motion and its applications**	Wave motion, Transverse and longitudinal waves with examples, Definitions of wave velocity, Frequency and Wavelength and their relationship, Sound and light waves and their properties, Wave equation, Amplitude, Phase, Phase difference, Principle of superposition of waves and beat formation. Simple Harmonic Motion (SHM): Definition, Expression for displacement, Velocity, Acceleration, Time period, Frequency. Simple harmonic progressive wave and energy transfer, Free, Forced and resonant vibrations with examples. Ultrasonic waves: Introduction and properties, Applications of ultrasonics	7

		in engineering and medicals.	
2	**Optics**	Basic optical laws of reflection and refraction, Refractive index, Images and image formation by mirrors, Lens and thin lenses, Lens formula, Power of lens, Magnification of mirror & lens. Total internal reflection, Critical angle and conditions for total internal reflection, Applications of total internal reflection.	7
3	**Electrostatics**	Coulomb's law, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Gauss law: Application of Gauss law, Calculation of electrostatic potential at a point due to point charge, Relation between potential and electric field intensity. Capacitor and its working, Types of capacitors, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors (related numerical), Dielectric and its effect on capacitance, Dielectric breakdown.	8
4	**Current Electricity**	Electric Current, Resistance, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire, Ohm's law and its verification, Kirchhoff's laws. Cells, Internal resistance, Concept of terminal voltage and Electromotive force (EMF). Chemical effect of current, Electrolysis, Faraday's law of electrolysis, Heating effect of current, Joule's law, Electric power, Electrical energy and related numerical problems, Advantages of electrical energy over other forms of energy.	7
5	**Magnetism & Electromagnetism**	Biot-Savart law, Magnetic lines of force, Uniform & non-uniform field, Magnetic flux, Ampere's circuital law, Solenoid, Lorentz Force, Direction of magnetic force, Permanent magnets and electromagnets, Magnetic force on a current-carrying conductor, Magnetic moment, Magnetic dipole, Torque on a current loop, Moving coil galvanometer, Conversion of a galvanometer into ammeter and voltmeter. Magnetization, Types of magnetic materials: Dia, para and ferromagnetic with their properties. Electromagnetic induction, Faraday's Laws, Lenz law, Self and mutual	8

		induction, Motional electromotive force, Eddy currents, Alternating current, Transformers (step-up & step-down), Displacement current, Electromagnetic waves and its spectrum.	
6	**Modern Physics**	Particle Aspect of Radiation: Black body radiation, Photoelectric effect, Experimental study of Photoelectric effect and Einstein's explanation, Wave aspect of particles: De Broglie waves, Wave particle duality, Uncertainty Principle. Electron Orbits, Alpha particle scattering experiment; Rutherford's model of atom, Bohr model, energy levels, hydrogen spectrum	5
	Total		**42**

4. Readings

4.1 Textbooks:

1. Textbook of Physics for Class XII (Part-1, Part-2); N.C.E.R.T., Delhi

4.2 Reference Books:

1. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
2. Concepts in Physics by H. C. Verma, Vol. I & II, Bharti Bhawan Ltd., New Delhi.
3. Engineering Physics by P. V. Naik, Pearson Education Pvt. Ltd., New Delhi.
4. Engineering Physics by H. K. Malik and A. K. Singh, Mc Graw Hill.
5. Modern approach to Applied Physics- I and II, A. S. Vasudeva, Modern Publishers.
6. A Textbook of Optics, N. Subramanyam, Brij Lal, M. N. Avahanulu, S Chand and Company Ltd.
7. Introduction to Fiber Optics, Ajoy Ghatak and K. Thyagarajan, Cambridge University Press India Pvt. Ltd., New Delhi.

5. Outcomes of the Course:

After undergoing this subject, the student will be able to;

1) Explain wave motion, periodic motion as well as simple harmonic motion and their basic parameters such as amplitude, frequency, wavelength, velocity and related numerical problems. Also, able to describe ultrasonic waves and its applications in engineering, medical and industrial areas.
2) Understand the basic optical laws of refraction and reflection, establish the location and characteristics of the images formed by mirrors and lenses. Also, able to explain critical angle, total internal reflection and its applications.
3) Describe electric filed, electric flux, electric potential along with the examples, also able to explain the function of capacitors in simple circuits and solve simple problems.
4) Express electric current as flow of charge and concept of resistance. Also, able to list the effects of an electric current and its common applications, state Ohm's law, calculate the equivalent resistance of a variety of resistor combinations, determine the energy consumed by an appliance, Faraday's law, Joule's law and their numerical applications.
5) Understand magnetism, its intensity, flux and related laws, explain the operation of appliances like moving coil galvanometer. Also, able to differentiate among different types of magnetic materials for engineering applications, learn the eddy currents, alternating current, displacement current and applications of electromagnetic induction in transformers.
6) Have basic idea of atomic structure and modern Physics regarding wave-particle duality, uncertainty principle.

Chemistry-II

1.1 Course Number: CY102
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 1st Year –Even
1.4 Prerequisite: Class 10th level Chemistry & Mathematics
1.5 Syllabus Committee Members: Dr. Sabyasachi Pramanik & Dr. Souvik De

2. Objective:

i) To apply the fundamental concepts of chemistry for the understanding of process and technology relevant to industry.
ii) To become familiar with the scope, methodology, and application of modernchemistry and to learn to appreciate its ability to explain the physical world.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Organic Chemistry**	General introduction, IUPAC nomenclature of organic compounds. Electronic displacements in a covalent bond: inductive effect, electrometric effect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions. Classification of Hydrocarbons: Aliphatic Hydrocarbon- Alkane, Alkene, Alkyne. Aromatic Hydrocarbon- Benzene: resonance, aromaticity; chemical properties: mechanism of electrophilic substitution – nitration sulphonation, halogenation, Friedel Craft's alkylation and acylation.	6
2	**Alcohols, Phenols and Ethers**	Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses, with special reference to methanol and ethanol. Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols. Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.	6
3	**Energy &**	Sources of Energy, Fuels- classification, examples, relative	8

	Environment	merits, types of coal, Gaseous fuels: LPG, natural gas, CNG: Composition and applications. determination of calorific value of solid fuels, Bomb calorimeter, theoretical oxygen requirement for combustion, proximate & ultimate analysis of coal, manufacture of metallurgical coke, flue gas analysis, problems. Knocking and anti-knocking for petrol and diesel (octane number and cetane number) - diesel index Industrial revolutions and pollution. Air/water/ soil pollution, greenhouse gas & effect, chemical reactions involved, acid rain, effects of depletion of ozone layer, greenhouse effect and global warming – pollution due to industrial wastes; remedies of pollutions.	
4	**Chemical Kinetics**	Rate of a reaction (average and instantaneous), factors affecting rates of reaction: concentration, temperature, catalyst; order and molecularity of a reaction; rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order reactions); concept of collision theory (elementary idea, no mathematical treatment).Activation energy, Arrhenious equation.	6
5	**Electrochemistry**	Redox reactions; conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell – electrolytic cells and Galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells. Relation between Gibbs energy change and EMF of a cell, fuel cells; corrosion.	6
Total			**32**

4. Reading

4.1 Suggested Reading:

1. NCERT Textbook (Class XI and XII)
2. Engineering Chemistry, B. K. Sharma
3. A Textbook of Engineering Chemistry, Sashi Chawla
4. Engineering Chemistry, Jain and Jain
5. Applied Chemistry, Dr.Raman Rani Mittal

4. Outcome of the Course:

After completion of this course students will able to

1) Explain why the element carbon gives rise to a variety of compounds, and how those organic compounds are classified and will learn about the naming of organic compound and basic concept of mechanism of organic reactions.

2) Learn about the name of of alcohols, phenols and ethers according to the IUPAC system of nomenclature. Understand the reactions involved in the preparation of alcohols and their corresponding chemical reactions.

3) Understand the importance of chemistry related to the environment, energy and fuels and importance of fuels in our daily life. Knowledge of environmental pollutions, green chemistry and water related chemistry.

4) Understand the factors that influence chemical reaction rates, reaction mechanisms, and the quantitative techniques used to describe those rates.

5) Understand the fundamental aspects of redox chemistry and the technologies made possible from discoveries in the field of electrochemistry and to identify the appropriate materials, design and operation conditions to reduce the likelihood of corrosion in engineering systems and operations.

Fundamentals of Electrical and Electronics Engineering

1.1 Course Number: EIE101
1.2 Contact Hours: 3-1-0 Credits: 11
1.3 Semester-offered: 1st Year –Even
1.4 Prerequisite: Class 10th level Mathematics & Science
1.5 Syllabus Committee Members: Dr. Chinmayee Hazarika, Dr. M. Chakkarapani & Dr. Santosh Kumar Verma

2. Objective:

i) To impart basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
ii) To introduce the students about domestic wiring, the functioning of various electrical apparatus and the safety measures. Emphasize the effects of electric shock and precautionary measures.
iii) To establish the basic knowledge of DC and AC electric circuits and magnetic circuits and its application in generators, motors, transformers.
iv) To introduce the students about basic knowledge of electronic components like Diode, BJT, FETs, Op-Amp, Digital Circuits etc. and their application.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**DC Circuit Analysis**	Electrical circuit elements (R, L and C), voltage and current sources, Series and parallel resistive circuits, Ohm's Law, Kirchhoff's current and voltage laws, Nodal and Mesh analysis of simple circuits. Source Transformation, Superposition Theorem, Thevenin and Norton's Theorem.	9
2	**AC Circuit Analysis**	A.C. Circuits: Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor, Peak Factor, impedance, phase angle, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations. Three phase balanced circuits, voltage and current relations in star and delta connections.	10
3	**Magnetic Circuits and Electrical Machines**	Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law; Dynamically induced emf; Statically induced emf; Equations of self and mutual inductance; Ideal and Practical transformer, Principle of operation, EMF equation.	8

		Construction and Working principle of AC and DC machines; Basic equations and characteristic of motors.	
4	**Semiconductor Devices**	Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of diodes. Diode as rectifier –half wave and full wave rectifier, Working of BJT, BJT as amplifier.	10
5	**Introduction to Analog and Digital Circuits**	Introduction to Operational Amplifiers-Ideal, Practical Op-Amp, Inverting and Non-inverting amplifier. Introduction to Boolean Algebra, Logic Gates and their implementation as adder and subtractor, Flip-Flop and its application.	10
Total			**47**

4. Readings

4.1 Recommended Books:

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House
2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN :978-0-07-0088572-5
3. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition ISBN : 9781107464353
4. Theraja, B. L., Electrical Technology Vol – I, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924405
5. Theraja, B. L., Electrical Technology Vol – II, S. Chand Publications, New Delhi, 2015, ISBN:9788121924375
6. Jegathesan, V., Basic Electrical and Electronics Engineering, Wiley India, New Delhi, 2015, ISBN : 97881236529513
7. Sedha, R.S., A text book of Applied Electronics, S.Chand, New Delhi, 2008, ISBN-13: 978-8121927833
8. Malvino, Albert Paul, David, Electronics Principles, McGraw Hill Education, New Delhi,2015, ISBN-13: 0070634244-978
9. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014, ISBN-13-9788121924504

5. Outcome of the Course:

After the completion of this course the students will be able to:

1) Demonstrate an understanding of the basic knowledge of electrical quantities such as current,

voltage, power, energy and frequency to understand the impact of technology in a global and societal context.

2) Demonstrate an understanding of basic concepts of analysis of simple DC and AC circuits used in electrical devices like generators, motors and transformers etc.

3) Demonstrate an understanding of basic concepts of semiconductor material, electronics devices, and Digital electronics to perform the multidisciplinary tasks.

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Computer Programming

1.1 Course Number: CS102
1.2 Contact Hours: 2-0-2 Credits:8
1.3 Semester-offered: 1st Year –Even
1.4 Prerequisite: Class 10th level Computer knowledge
1.5 Syllabus Committee Members: Dr. Rupjit Saikia & Dr. Satish Kumar Tiwari

2. Objective:

To enable student, develop structured solutions to problems and implementing them using computers. This involves two parts: i) Formulating a solution for a given problem as a well-defined sequence of actions, and ii) Expressing solution in a machine-readable form or a programming language.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Basics of C Programming**	1.1 Introduction to number system 1.2 Introduction to flowchart and algorithm 1.3 History of C, where C stands 1.4 C character set, tokens, constants, variables, keywords 1.5 C operators (arithmetic, Logical, assignment, relational, increment and decrement, conditional, bit wise, special, operator precedence), C expressions data types. 1.6 Formatted input, formatted output.	7
2	**Decision Making**	2.1 Decision making and branching if statement (if, if-else, else-if ladder, nested if-else) Switch case statement, break statement. 2.2 Decision making and looping while, do, do-while statements for loop, continue statement.	7
3	**Arrays and Strings**	3.1 Arrays Declaration and initialization of one dimensional, two dimensional and character arrays, accessing array elements. 3.2 Declaration and initialization of string variables, string handling functions from standard library (strlen(), strcpy(), strcat(), strcmp()).	7
4	**Functions and Structures**	4.1 Functions: Need of functions, scope and life time of variables, defining functions, function call (call by value, call by reference), return values, storage classes. category of function	7

		(No argument No return value, No argument with return value, argument with return value), recursion. 4.2 Structures: Defining structure, declaring and accessing structure members, initialization of structure, arrays of structure.	
	Total		**28**

4. Readings

4.1 Recommended Books:

1. Programming in C by Sachaum Series, McGraw Hills
2. Programming in C by Kerning Lan and Riechle Prentice Hall of India, New Delhi
3. Programming in C by BalaguruSwamy, Tata McGraw Hill, New Delhi
4. Let us C by Yashwant Kanetkar, BPB Publications, New Delhi
5. Vijay Mukhi Series for C and C++
6. Programming in C by R Subburaj,Vikas Publishing House Pvt Ltd.,Jangpura, New Delhi
7. Programming in C by Kris A Jansa, Galgotia Publications Pvt. Ltd., Daryaganj, New Delhi
8. Programming in C by BP Mahapatra, Khanna Publishers, New Delhi
9. Elements of C by MH Lewin, Khanna Publishers, New Delhi

5. Outcome of the Course:

Student will be able to computationally formulate basic problems and write code snippets to execute them. Also, the students will be able to take decisions when to use an array, when to use loop and when to use conditional statements.

Engineering Drawing

1.1 Course Number: ME102L
1.2 Contact Hours: 0-0-3 Credits:3
1.3 Semester-offered: 1st Year –Even
1.4 Prerequisite: Class 10th level Mathematics
1.5 Syllabus Committee Members: Dr. Naveen Mani Tripathi, Dr. Sanat Kumar Singha, Abhimanyu Kar & Dr. Karthik Babu

2. Objective:

i) To understand the basic concepts of dimensioning and scales and their roles in engineering drawing.
ii) To draw orthographic projections of points, straight lines, laminae and solids when the mentioned objects are located with different configurations with respect to the plane of projections.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction to Engineering Drawing**	1.1 Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards. 1.2 Different types of lines in engineering drawing as per BIS specifications 1.3 Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments. 1.4 Free hand and instrumental lettering (alphabets and numerals) – upper case (capital letters), single stroke, vertical and inclined at 75degree, free hand and instrumental lettering in the ratio of 7:4	6
2	**Dimensioning Technique and Scales**	2.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions) 2.2 Dimensioning of overall sizes, circles, angles, tapered surfaces, holes, counter sunk holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches	6

		2.3 Scales – their needs and importance (theoretical instructions), type of scales, definition of representative fraction and length of scale	
3	**Orthographic Projections**	3.1 Theory of orthographic projections (elaborate theoretical instructions) 3.2 Projection of Points in different quadrants 3.3 Projection of straight lines (1st angle and 3rd angle) 3.4 Line parallel to both the planes 3.5 Line perpendicular to any one of the reference planes 3.6 Line inclined to any one of the references plane 3.7 Projection of planes – different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1st angle only. 3.8 Three views of orthographic projection of different objects	15
4	**Projection and Sections of Solids**	4.1. Definition and salient features of a solid 4.2. Types of Solid (polyhedral and solids of revolution) 4.3 To make projections, sources, top view, front view and side view of various types of solids. 4.4 Importance and salient features 4.5 Drawing of full section, half section, partial or broken out sections, offset sections, revolved sections and removed sections. 4.6 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections. 4.7 Orthographic sectional views of different objects	9
5	**Isometric Views**	5.1 Fundamentals of isometric projections and isometric scale 5.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.	3
Total			**39**

4. Readings

4.1 Textbooks:

1. A Textbook of Engineering Drawing by Surjit Singh; Dhanpat Rai& Co., Delhi
2. Engineering Drawing by PS Gill; SK Kataria& Sons, New Delhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt; Charotar Publishing House Pvt. Ltd., Anand
4. Engineering Drawing I by DK Goel, GBD Publication.

4.2 Reference Book:

1. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar

5. Outcome of the Course:

Knowledge of working with various drawing instruments.

1) Classify dimensioning methods and scales.
2) Understand the difference between first angle and third angle projection schemes.
3) Draw the orthographic and isometric views of simple objects.

Physics Laboratory

1.1 Course Number: PY101L
1.2 Contact Hours: 0-0-2 Credits:2
1.3 Semester-offered: 1st Year –Even
1.4 Prerequisite: Class 10th level Physics
1.5 Syllabus Committee Members: Dr. Shikha Dwivedi & Dr. Nimisha Raghuvanshi

2. Objective:

i) Experiments demonstrate the principle of physics covered in the theory and also provide the familiarities with various apparatus along with developing an attitude of perfection in practical tasks.
ii) The basic purpose of laboratory experiments in physics is to verify and validate the concepts, principles and hypotheses related to the physical phenomena.

3. List of Experiments:

1. To determine the volume of an unknown cylinder using Vernier Callipers.
2. To determine the cross-sectional area of a thin wire using Screw Gauge.
3. To determine the radius of curvature of a convex lens using Spherometer.
4. To verify and understand the law of conservation of energy using simple pendulum.
5. To determine the angle of minimum deviation for a glass prism by plotting a graph between the angle of incidence and angle of deviation.
6. To measure the angle of incidence, angle of refraction and the angle of emergence of a rectangular glass slab and interpret the results.
7. To verify the laws of reflection of light using plane mirror.
8. To study the magnetic field lines formed around a Bar magnet.
9. To verify the Ohm's Law using a single resistance, two resistances connected in series and two resistances connected in parallel by plotting a graph of potential difference versus current.
10. To measure the value of an unknown resistance using meter bridge.

4. Readings (Textbooks / Reference Books):

1. Textbook of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi.
2. Comprehensive Practical Physics, Vol, I & II, J.N. Jaiswal, Laxmi Publications (P)Ltd.
3. Practical Physics by C. L. Arora, S. Chand Publication.
4. E-books/e-tools/ learning physics software/YouTube videos/websites etc.

5. Outcomes of the Course:

After undergoing this subject, the student will be able to:

1) Use various measuring device such as Vernier Callipers, Screw Gauge and Spherometer.
2) Understand the law of conservation of energy using simple pendulum.
3) Learn about the angle of minimum deviation of a glass prism using laws of refraction.
4) Verify the laws of reflection using mirror and the laws of refraction using glass.
5) Study the magnetic field lines of a Bar magnet.
6) Verify the Ohm’s law and find an unknown resistance using meter bridge.

Fundamentals of Electrical and Electronics Engineering Laboratory

1.1 Course Number: EIE101L
1.2 Contact Hours: 0-0-2 Credits: 2
1.3 Semester-offered: 1st Year –Even
1.4 Prerequisite: Class 10th level Mathematics & Science
1.5 Syllabus Committee Members: Dr. Chinmayee Hazarika, Dr. M. Chakkarapani & Dr. Santosh Kumar Verma

1. Introduction to basic electrical circuit elements (R, L and C).
2. Study of CRO and Digital Multimeter
3. Measurement of Amplitude, Frequency and Time-period with the help of CRO.
4. Verification of the ohm's law.
5. Verification of KCL and KVL.
6. Verification of Mesh and Nodal Analysis for the given circuits.
7. Verification of Basic Theorems (The venin, Norton and Superposition).
8. Study of Step-up and Step-down Transformer.
9. Analysis of RLC circuit.
10. Study of speed control of DC motor.
11. Study of V-I Characteristics of PN-Junction Diode.
12. Study the operation of Half Wave and Full Wave rectifier.
13. Study of BJT and FET Characteristics.
14. Study the operation of Op-Amp in Inverting and non-inverting mode.
15. Verification of Basic Logic Gates.

Recommended Books:

1. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN :978-0-07-0088572-5
2. Theraja, B. L., Electrical Technology Vol – I, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924405
3. Sedha, R.S., A text book of Applied Electronics, S. Chand, New Delhi, 2008, ISBN-13: 978-8121927833
4. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014, ISBN-13-9788121924504.

Community Internship

1.1 Course Number: HU103
1.2 Contact Hours: 1-1-0 Credits: 5
1.3 Semester-offered: 1st Year –Even
1.4 Prerequisite: NA
1.5 Syllabus Committee Members: All Faculties of AEI

2. Objective:

i) Explore career alternatives prior to graduation.
ii) Integrate theory and practice.
iii) Assess interests and abilities in their field of study.
iv) Learn to appreciate work and its function in the economy.
v) Develop work habits and attitudes necessary for job success.
vi) Develop communication, interpersonal and other critical skills in the job interview process.
vii) Build a record of work experience.
viii) Acquire employment contacts leading directly to a full-time job following graduation from college.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Understanding Society**	Understanding Society Social structure and relationships, Social institutions and social groups, Socialization and social control: development of self	3
2	**Community Health**	Illness and Disease, Health and public health: Meaning, components, determinants of health, Wellbeing and Quality of life, Health as an aspect of social development, Nutrition and malnutrition, Community Health: relevance, needs assessment, developing mechanisms for people's participation, Community Mental Health	5
3	**Working with Groups**	Social Groups: Definitions, characteristics, functions and group structure, Principles of group work and Models of group work	5

		practice, Leadership - Theories of leadership, roles and responsibilities of group leader, Leadership Power, Leadership Styles, Leadership in Administration, Techniques and skills in group work, Group worker: roles and functions	
4	**Work with Communities**	Understanding Community: Definitions, types, approaches and framework, Community dynamics: Caste, class, religion and gender, Issues of identity, inclusion and exclusion, Community power structure, Community organization- principles, steps and process, Community work and community participation - Strategies and principles; Models and processes, Professionalism and inculcation of ethics in community practice	5
5	**Personality Development**	Definition of Personality, Determinants of Personality- biological, psychological and sociocultural factors, Communication, Flow and barriers of Communication, Listening, Spirituality and its role in personality development Stress: Causes, Management and Impact, Groups in organization, Interactions in group, Group Decision Taking, Team Building	5
6	**Development Communication**	Communication: concept, principles and its significance Process of Communication, Forms of communication: Verbal, non-verbal and written. Self-awareness in communication Barriers to communication	3
	Total		**26**

4. Readings

4.1 Suggested Readings:

1) Davis, K. 1969. Human Society, New York: The Macmillan.
2) Giddens, A.1999. Sociology, Cambridge: The Polity Press.

3) Dasgupta, M. & Lincoln, C.C. 1996, Health, Poverty and Development in India. New Delhi: Oxford University Press.
4) Trecker, H.B. 1972, Social Group Work: Principles and Practices. New York: Association Press.
5) Weil, M. (ed,) 1996, Community Practice: Conceptual Models. New York: The Haworth Press Inc.
6) Hergenhahn, B. R., &Olson., M. H. 2003, An Introduction to Theories of Personality, New Jersey: Prentice Hall.

5. Outcome of the Course:

As a result of participation in the course, students will be able to:

1) Assess and improve upon their own cultural competency skills.
2) Demonstrate understanding of theory and research guiding positive youth development programs.
3) Develop familiarity with positive youth development programs and approaches in building relationships with families and communities.
4) Understand how observation, documentation, and assessment are used to support children and families.
5) Develop applied professional skills to foster positive developmental outcomes for children and families.

Semester III

Materials Science

1.1 Course Number: ME202
1.2 Contact Hours: 3-0-0 Credits: 9
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Class 11 and 12th Physics& Chemistry
1.5 Syllabus Committee Members: Dr. Naveen Mani Tripathi, Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha & Dr. Karthik Babu

2. Objective:

i) Understand the classification of materials, bonding and the crystal structure.
ii) Identify and understand defects in crystals.
iii) Interpret and understand the phase diagrams of materials.
iv) Select suitable heat-treatment process to achieve desired properties of metals and alloys.
v) Understand the basic mechanisms of diffusion and the factors governing them. Develop an understanding on the properties and applications of different steels in engineering applications.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Atomic Bonding**	Structure of atoms and molecules, Bonding in solids: types of bonds and comparison of bonds, Classification of engineering materials based on bonds, Numerical problems on bond energy calculation	3
2	**Crystal Structure and Defects**	Crystal geometry, structure of solids (indexing of plane and direction & problems on planar and volume density), X-ray diffraction (principle and indexing examples (with extinction rules), real time problems on XRD indexing) (4) Imperfection in crystals - types of imperfection. Point imperfection, line, surface and volume defects [in context of definitions and real time applications], Numerical problems on point defects (2)	6
3	**Properties of Materials**	**Mechanical properties of materials:** Stress-Strain Curves for Brittle and Ductile Materials, Theoretical and Observed Shear Stress, Critical Resolved Shear Stress, (3) Deformation: Elastic, Anelastic, Plastic, Yield Criteria. (2)	12

		Fatigue: definition, types and method for improving fatigue resistance, application of SN curve for fatigue life measurement (numerical problems to solve) (2) Creep: Definition, types and methods for improving creep resistance, application of LM parameter for creep life measurement (numerical problems to solve) (2) Fracture: Definition, types, microstructural comparison and fracture toughness / stress intensity calculation (with preexisting crack in infinite and semi-infinite plate) (2) Impact toughness: Izod and Charpy test (2) Deformation of materials: Rolling, forging, extrusion, wire drawing [definition, types, products' properties, industrial application in context of chemical and steel industries] (4)	
4	**Engineering Materials**	**Ferrous metals & alloys:** Iron and their alloys, steel (types and brief application), Gibbs phase rule, lever rule, Iron carbon equilibrium diagram and microstructure evaluation by metallography. (5) ***Non-ferrous metals and alloys:*** Aluminium, copper, Zinc and Nickel alloys (with reference to the application in chemical and steel industries) (4)	9
5	**Non-metals and Advanced Engineering Materials** [with special reference to the applications in chemical Industries]	Ceramics and refractories: Their definition, Properties, examples and applications [with special reference to the applications in chemical Industries] [3] Organic materials: polymers and plastics: Definition, Properties, Examples and Applications [with special reference to the applications in chemical and steel Industries] [4] Advanced materials: Nanomaterials and composites [with special reference to the applications in chemical and steel Industries] [3]	10
Total			**40**

4. Readings

4.1 Textbooks:

1. Callister's Materials Science and Engineering, W.D.Callister, Jr, R. Balasubramaniam Wiley India, 2010
2. Materials Science, V. Raghavan, PHI Learning Private Ltd., 2010.

4.2 Reference Books:

1. Engineering Materials: Polymers, Ceramics and Composites, A.K. Bhargava, PHI Learning (P) Ltd.
2. Raj, Baldev, Tammana Jayakumar, and M. Thavasimuthu. Practical non-destructive testing. Wood head Publishing, 2002.

5. Outcome of the Course:

1) Describe the fundamentals of material science and concepts of unit cell & crystallography.
2) Illustrate different properties of materials and co-relate to the practical applications of different material.
3) Apply different heat treatment processes according to their corresponding needs.
4) Describe the basic properties of ceramics, composites and alloys with their applications.

Unit Operations-I

1.1 Course Number- CE201
1.2 Contact Hours- 3-1-0 Credits: 11
1.3 Semester Offered- 2nd Year Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee members- Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha, Dr Naveen Mani Tripathi, Dr. Karthik Babu NB

2. Objective:

i) To study statics, kinematics and dynamics of fluids.
ii) To understand the characteristics associated with the fluid flow though pipeline systems.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Fluid Statics**	Brief description of various fluid properties, Pressure at a point, Compressible and Incompressible fluid, Measurement of pressure, Manometry, Buoyancy, Archimedes' principle and stability	6
2	**Fluid Kinematics**	Classification of fluid flows – viscous vs inviscid flow, internal vs external flow, compressible vs incompressible flow, laminar vs turbulent flow, natural vs forced flow, steady vs unsteady flow, uniform vs non-uniform flow; Flow patterns – timeline, streamline, path line, streamline	9
3	**Fluid Dynamics**	Fluid flow rate, Conservation of mass, Continuity equation, The Bernoulli's equation and its application	9
4	**Pipe Flow**	Flow regimes in a pipe, Energy loss in pipes through Darcy-Weisbach equation and Hagen-Poiseuille equation, Friction factor, Turbulent flow in pipes, Moody's Diagram	9
5	**Pipeline Systems**	Basic of pipe network system, Minor losses in pipes, Energy and hydraulic grade line, Valves used in pipelines – Flow control valve, Check valve, Pressure relief valve/ Safety valves	6
Total			**39**

4. Readings

4.1 Textbooks/ Reference Books:

1) Elger, Donald F., Barbara A. LeBret, Clayton T. Crowe, and John A. Roberson. Engineering fluid mechanics. John Wiley & Sons, 2020.
2) Yunus, A. Cengel. Fluid Mechanics: Fundamentals and Applications (SI Units). Tata McGraw Hill Education Private Limited, 2010.
3) Fox, Robert W., Alan T. McDonald, and John W. Mitchell. Fox and McDonald's introduction to fluid mechanics. John Wiley & Sons, 2020.
4) R.K. Bansal, A textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.

5. Outcome of the Course:

1) Knowledge of fluid properties, stress, buoyancy and floatation.
2) Classify fluid flow and flow pattern.
3) Understand continuity and Bernoulli equations.
4) Derive Darcy-Weisbach equation and Hagen-Poiseuille equation associated with pipe flow.
5) Calculate friction factor from Moody diagram.
6) Knowledge of minor & major losses and energy & hydraulic grade lines corresponding to pipe flow.
7) Classify flow control valves and safety valves.

Engineering Thermodynamics

1.1 Course Number- ME205
1.2 Contact Hours- 3-0-0 Credits: 9
1.3 Semester Offered- 2nd Year Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee members- Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha, Dr Naveen Mani Tripathi, Dr. Karthik Babu NB

2. Objective:

i) To understand basic concept of thermodynamics and its properties.
ii) To generate the ability to differentiate different forms of energy i.e., heat and work.
iii) To apply first law of thermodynamics to closed and flow systems.
iv) To realize the need of second law of thermodynamics, spontaneity and irreversibility in nature.
v) To learn basic concepts of real gases and working of external and internal combustion engines.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Basic concepts and definition**	Scope and limitations of Thermodynamics, Macroscopic and Microscopic approaches; Definition of System, Surrounding, closed systems, and open system; Properties: (extensive and Intensive), Characteristics of properties (point and path function), and its representation on a property diagram; Units of measurements: Force, Pressure, and Energy.	6
2	**Equilibrium and Zeroth Law**	Equilibrium: Thermal, Mechanical, Chemical, Thermodynamic; Zeroth Law of Thermodynamics and temperature, Measurement of temperature and calibration of Thermometers, the ideal gas temperature scale.	5
3	**Processes and its representation**	Reversible and Irreversible processes; Different types of process and their representations.	2
4	**Work and Heat Transfer**	Definitions and calculations: Work Transfer, Different modes of work, Displacement Work for various processes, Heat Transfer, Specific heat, Latent heat.	4
5	**First Law of Thermodynamics**	Joule's experiment, Introduction of internal energy as a thermodynamics property, Introduction of enthalpy as a	5

		thermodynamic property; Definition of specific heats and their use in calculation of internal energy and enthalpy with emphasis on ideal gases.	
6	**Applications of First Law of Thermodynamics**	Application of First Law to control mass: Work done and heat transfer in various types of elementary processes; Application of First Law to control volumes; Nozzle, Diffuser, Compressor, Turbine, Throttling device, Heat Exchanger. (Only steady flow need be considered).	8
7	**Second Law of Thermodynamics**	Limitations of first law of thermodynamics; Cyclic heat engine; Energy reservoirs; Refrigerator and Heat Pump; Kelvin-Plank statement and Clausius statement of second law; Reversibility and Irreversibility; Carnot Cycle and Carnot Theorems;	5
8	**Entropy**	Clausius' Theorem and Clausius' inequality; Concept of entropy; Entropy and Disorder; Entropy changes in various processes, Entropy Principle and its application,	5
	Total		**40**

4. Readings

4.1 Textbooks:

1. Engineering Thermodynamics by P.K. Nag, Publisher: TMH
2. Basic Engineering Thermodynamics by Rayner Joel, Pearson Education

4.2 Reference Books:

1. Engineering Thermodynamics by Van Wylen and Sontang, John Wiley
2. Engineering Thermodynamics by M. Achuthan, Publisher: PHI
3. Applied Thermodynamics by Eastop and McConkey, Publisher: Pearson
4. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher. PHI
5. Engineering Thermodynamics by Russel and Adebiyi, publisher, Oxford
6. Steam Tables in SI Units by Ramalingam, Scitech.

5. Outcome of the Course:

1) Basic understanding thermodynamics and its applications
2) Understand the basics of Engineering Materials (its applications) and Stress-Strain
3) Basic understanding of boilers, engines and latest automobile technologies.

4) Understand the basics Applied Mechanics, Simple lifting Machines & Power Transmission
5) Understand the basics of Engineering surveying and Smart Infrastructure Development.

Materials and Energy Balance

1.1 Course Number: CE202

1.2 Contact Hours: 3-1-0 Credits: 11

1.3 Semester-offered: 2nd Year –Odd

1.4 Prerequisite: Diploma level Physics, Chemistry & Mathematics

1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

i) To understand the concept of stoichiometry.

ii) To understand the streams involved in different unit operations and also the reactions in different unit processes.

iii) To learn the basic calculations related to material and energy flow in the processes.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Fundamental Concepts of Stoichiometry**	Mole concept, Composition of solids, Composition of liquids, Composition of gas and gas mixtures.	4
2	**Material Balance without Chemical Reaction**	Basic Material balance principles, Total and component balance, Steady state and Unsteady state process, Batch and continuous process, Tie element, Basis for calculation, Steps for solving Material Balance problems, Material Balance in Unit Operations.	10
3	**Material Balance with Chemical Reaction**	Classification of chemical reactions, Rate of chemical reaction, Rate expression, rate constant, Elementary and non-elementary reaction, Stoichiometry, Molecularity, Limiting Reactant and Excess Reactant, Conversion, Yield and Selectivity, Reaction coordinate, Equilibrium constant, Bypass Operations, Recycle Operations: Introduction, Application, Recycle Ratio, Purging Operation: Purge ratio, Combined feed ratio.	14
4	**Fuel and Combustion**	Combustion of Solid, Liquid and Gaseous fuel: Orsat Analysis, Proximate and Ultimate analysis of coal, GCV, NCV.	6

5	**Energy Balance**	Energy and its classification, Heat Capacity, Heat of Reaction, Heat of Formation, Heat of Combustion, Hess Law, Phase Change Operation.	6
TOTAL			**40**

4. Readings:

4.1. Textbooks:

1. D.M.Himmelblau and J. B.Riggs, Basic Principles and Calculations in Chemical Engineering, Pearson.
2. A.Olaf, K.M. Watson and R.A. R. Hougen, Chemical Process Principles, Part 1: Material and Energy Balances, John Wiley & Sons.

4.2 Reference Books:

1. K. A. Gavhane, Introduction to Process Calculation, Nirali Prakashan.
2. K. Narayanan and B Lakshmikutty, Stoichiometry and Process Calculation, Eastern Economy Edition.
3. B. I. Bhatt and S M Vora, Stoichiometry, Tata McGraw Hill Edition.

5. Outcome of the Course:

The students completing the course will be able to formulate and solve mass and energy balance problems concerning different unit operation and processes in industries.

Mechanical Operations

1.1 Course Number: CE203
1.2 Contact Hours: 3-0-0 Credits: 9
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Diploma level Mathematics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To learn about operations related to size reduction, size separation, filtration, mixing, transportation and storage which are important in many chemical and metallurgical industrial practices from the point of view of consequence and process economy. It is therefore, important to study the principles of operation of different equipment and selection of equipment for specific purpose from host of different alternatives.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Properties and Storage of Solids**	Characteristics of Solid Particles, Particle Shape, Particle Size, Average Particle sizes. Solids in Bulk, Angle of Repose, Angle of Internal Friction, Storage of Bulk Solids, Flow of Bulk Solids.	6
2	**Size Reduction of Solids**	Objectives and Methods of size reduction, Impact, Attrition, Compression, Shear Properties of Solids, Energy and Power consumption, Crushing Efficiency, Laws of Communition, Rittinger's Law, Kick's law, Bond's Law. Size Reduction Equipments and their Classification.	8
3	**Separation and Transportation of Solids**	Introduction, Purpose of separation, Different methods of separation, Screening and types of screens, Description Screening Equipments, Different methods of transportation of solids- pneumatic conveying, vertical and horizontal, Hydraulic conveying. Description of different conveying equipment's -Belt Conveyors, Screw Conveyors, Bucket Elevators.	6
4	**Filtration**	The theory of filtration, relation between thickness of cake and volume of filtrate, flow of liquid through the cloth, flow of filtrate through the cloth and cake combined, compressible filter cakes, Filtration	8

		practice, washing of filter cake, Different Filtration equipment	
5	**Mixing and Agitation**	Agitation of liquids, Purpose of agitation equipment, Impellers, Flow patterns in agitation vessels, effect of system geometry.	5
6	**Motion of particles in a fluid**	Free settling and Hinderd settling, Stock's law & Newton's law regimes of settling, Gravity settling processes, gravity classifiers, sorting classifiers: sink-and-float methods, differential settling methods. Clarifiers and thickeners, Cyclones, hydro cyclones.	7
TOTAL			**40**

4. Readings:

4.1 Textbooks:

1. W.L. McCabe, J.Smith and P.Harriot,Unit Operations of Chemical Engineering, McGraw-Hill, International Edition.

Reference Books:

1. W.L. Badger and J.T. Banchero, Introduction to Chemical Engineering, Tata McGraw-Hill, International Edition.
2. C.J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall, India.
3. B.K. Dutta. Principles of Mass Transfer and Separation Processes Phi Learning Private Ltd.

5. Outcome of the Course:

On completion of this course, the student will be able to understand and operate the various equipment used for different operations like size reduction, size separation, filtration, mixing, transportation and storage and solve simple problems.

Chemical Technology – Inorganic

1.1 Course Number: CE204
1.2 Contact Hours: 2-0-0 Credits:6
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Diploma level Chemistry
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To study the concept of unit processes and unit operations, process technologies of various inorganic process industries.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	Typical chemical processes: Unit operations and unit processes, Importance and overview of chemical process industries, Classification of Indian chemical process industries, Inorganic chemical industries, Study aspects of a CPI- raw materials, process, chemical reactions, process flow diagram, major engineering issues and uses.	6
2	**Sulfur and Sulfuric Acid**	Sulfur Industry: Classification of production process, Sulphur- its forms, Properties and Sources, Manufacturing of Sulphur, Manufacturing of Sulphuric acid by Contact Process, Uses of sulfur and sulfuric acid.	6
3	**Fertilizer Industry**	Chemical fertilizers: Definition, Types, Nitrogeneous fertilizers, Phosphoric fertilizers, Potassium fertilizers, mixed fertilizers, Manufacture of Ammonia by Habers process, Manufacture of urea, and its major industrial problems.	8
4	**Chlor-Alkali Industries**	Soda Ash, Properties, uses, classification of processes, manufacturing process of Soda ash by Solvay process, Caustic soda and Chlorine: Properties, uses, classification of processes, manufacturing process of Caustic soda and Chlorine.	8
5	**Cement Industry**	Cement: Definition, properties, methods of production, types of Portland cement, manufacturing of Portland cement and its major industrial problems.	6
TOTAL			**34**

4. Readings:

4.1 Textbooks:

1. C. L. Dryden, Outlines of Chemical Technology, Edited and Revised by M. Gopala Rao and S. Marshall, Affiliated East West, New Delhi.
2. T. G. Austin and S. Shreve, Chemical Process Industries. McGraw Hill, New Delhi.

4.2 Reference Book:

1. R. E. Kirk, and D. F. Othmer, Encyclopaedia of Chemical Technology, Interscience, New York.

5. Outcome of the Course:

After completion of this course, students will be able to

1) Identify different unit operations and unit processes in a given process flow diagram.

2) Understand the role of chemical process engineer in chemical industry.

3) Demonstrate thorough the understanding of some important process industries (sulfur and sulfuric acid, fertilizers, chloro-alkali, cement).

4) Identify and solve engineering problems during manufacturing of the above-mentioned products.

Computer Aided Drafting Laboratory

1.1 Course Number- ME207L
1.2 Contact Hours- 0-0-2 Credits: 2
1.3 Semester Offered- 2nd Year Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee members- Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha, Dr Naveen Mani Tripathi, Dr. Karthik Babu NB

2. Objective:

i) To acquire practical skills in drawing 2D and 3D objects in CAD software
ii) To be able to make detail, assembly and 3D drawing of machines parts using software

3. Course Content:

Unit	Topics	Sub-Topic	Lab Sessions
1	**2D Drawing**	2D Drawing commands – line, polyline, circle, polygon. Editing commands, Array and grouping	4
2	**Annotation**	Dimensioning in different ways – aligned, horizontal, baseline and continued dimensions, leader, single and multiline text	1
3	**3D Drawing**	Basic ways to generate 3D solids: Region, Extrude, Press pull, revolve etc., 3D editing commands, viewports, UCS and projections.	4
4	**Blocks and Layers**	Blocks, layers, line type and their uses	1
5	**Auto LISP**	Creating customized drawings as per user input, customized curves and shapes which are not available in AutoCAD commands	2
		Total	**12**

4. Readings

1. AutoCAD Tutorial

5. Outcome of the Course:

1) To be able to draw a 3D drawing from a model and dimensional information
2) To be able to produce complete drawing sheets from a rough sketch or design information of any machine part or assembly

Unit Operations Laboratory – I

1.1 Course Number: CE201L
1.2 Contact Hours: 0-0-2 Credits: 2
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Diploma level Mathematics and Physics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

i) The lab is to provide practical and theoretical experience in a number of important chemical engineering unit operations ensuring a thorough understanding of the principles of unit operation. The course includes experimental execution, data analysis and error analysis, skills development in oral presentation, technical report writing, and team-building.

ii) The experiments are designed to illustrate the principles of fluid and particle mechanics, separation processes.

3. Course Content:

Sl. No.	List of Experiments
1	To verify the Bernoulli's equation
2	To study the head losses due to various fittings in pipeline
3	To study different types of flow
4	To measure the viscosity of oil using Redwood Viscometer
5	To measure the discharge through Venturi meter, Orifice meter and Rotameter
6	To study the Reciprocating pump characteristics
7	To study the Centrifugal pump characteristics
8	To study the operation of ball mill
9	To study the operation of gyratory sieve shaker
10	To study the working principle of froth flotation cell
11	To study the operation of plate and frame filter press

4. Outcome of the Laboratory:

This lab will give the student a thorough knowledge of fluid and particle mechanics, separation processes. Understand to analyze experimental data and observed phenomena to write good technical report.

Semester IV

Unit Operations - II

1.1 Course Number: CE206
1.2 Contact Hours: 3-1-0 Credits:11
1.3 Semester- offered: 2nd Year –Even
1.4 Prerequisite: Diploma level Mathematics and Physics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	Heat and Modes of heat transfer: Conduction, Convection, Radiation, Concept of steady state and unsteady state heat transfer, Analogy between flow of heat and electricity.	4
2	**Conduction**	Thermal conductivity, Fourier's law of heat conduction, Steady state equation, Heat flow equation for composite walls, Composite cylinders, Spheres, Insulation and insulating materials, Critical insulation thickness.	8
3	**Convection**	Nature of heat convection, Dimensional analysis and significance of various dimensional groups, Forced convection (No derivation), Free convection (No derivation)	8
4	**Thermal Radiation**	Nature of thermal radiation, Absorption, Transmission, Reflection and Emission of radiation, Emissive power of black body, Plank's distribution, Total emissive power, Stefan-Boltzman law, Emissivity, Kirchoff's law, Black body, Wien's displacement law.	6
5	**Heat Exchangers**	Introduction, Types of Heat Exchangers, Overall Heat Transfer Coefficient, Construction and Description of Various Types of Heat Exchangers, Logarithmic Mean Temperature Difference, LMTD for Parallel and Counter Current Heat Exchangers.	8
6	**Boiling, Condensation and**	Interface, Bubble and Film boiling, Boiling regime, Concept of condensation, Types of condensation: Drop wise and Film wise condensation, Evaporation:	6

	Evaporation	Introduction, Liquid characteristics, types of evaporator, economy & capacity, method of feeding, examples based on single effect evaporator.	
TOTAL			**40**

4. Readings:

4.1 Textbooks:

1. J. P. Holman, Heat Transfer, McGraw - Hill.
2. B. K. Dutta, Heat Transfer, Prentice Hall of India.

4.2 Reference Books:

1. D.Q. Kern, Process Heat Transfer, Tata McGraw - Hill.
2. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill.

5. Outcome of the Course:

Students completing the course will be able to:

1) Understand basic laws associated with conduction, convection and radiation and its applications.
2) Analyze problems involving steady heat conduction in simple geometries.
3) Understand the concept of convective heat transfer and to analyze the problems involving heat transfer coefficients for natural and forced convection
4) Analyze heat exchanger performance using LMTD and use it for parallel or counter flow
5) Recognizer various type of heat exchanger working principle, and basic geometries of heat exchanger.
6) Determine the overall heat transfer coefficient for a heat exchanger.
7) Understand the concept of boiling and condenser.
8) Analyze the performance of evaporator.

Unit Operations - III

1.1 Course Number: CE207
1.2 Contact Hours: 3-1-0 Credits: 11
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Diploma level Physics & Mathematics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

The purpose of this course is to introduce the students with the laws of diffusion; convective mass transfer, inter phase mass transfer and mass transfer coefficients, mass transfer theories. This course will also provide proper understanding and application of mass transfer such as absorption, humidification, drying and crystallization.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction to Mass Transfer: Diffusion**	Introduction to Mass Transfer Operations and Classifications, Diffusion: Types of diffusion, Fick's Law of diffusion, Measurement and estimation of diffusivity, Molecular diffusion in solids: Molecular, Knudsen & Surface diffusion. Inter-phase mass transfer, Mass transfer coefficients, Convective mass transfer, Dimensionless groups in mass transfer and their significance, Analogy between Momentum, Heat and Mass transfer, Diffusion between phases, Theories of Mass Transfer: Film Theory, Penetration theory, Surface renewal theory.	12
2	**Absorption**	Absorption: Application, Types; Choice of solvent, Equipments, Different materials used in absorption column.	6
3	**Humidification**	Humidity: Absolute, Relative, Percentage; Dew point, Dry bulb and Wet bulb temperature, Adiabatic saturation temperature, Cooling towers: Principle, Classification.	6
4	**Drying**	Principle, Equilibrium in drying, Definitions of moisture content, Mechanism of batch and continuous drying, Rate of batch drying: drying curve, Time required for drying, Classification and selection of industrial dryers.	8

5	**Crystallization**	Principle, Classification, Solid-liquid phase equilibrium, Nucleation and crystal growth, Melt crystallization, Batch crystallization, Crystallization equipments.	8
TOTAL			**40**

4. Readings:

4.1 Textbooks:

1. R. E. Treybal, Mass Transfer Operations, McGraw – Hill, International Edition.
2. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill, International Edition.

4.2 Reference Books:

1. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall, India.
2. B.K. Dutta, Principles of Mass Transfer and Separation Processes, Prentice Hall of India.

1. Outcome of the Course:

Students completing this course will be able to explain the

1) Principles of molecular diffusion, determine mass transfer rates using Fick's Law and estimate diffusion coefficients for liquids and gases, analogy and theories of mass transfer, concept of inter phase mass transfer.
2) Basic principles and application of gas absorption, understanding of various Equipments to carryout absorption.
3) Different terms and definition of humidification process, different type of cooling tower.
4) Different terms and definition of drying, calculate the drying time and equipments to carryout drying (batch and continuous).
5) Theories of crystallization yield of crystals and different types of crystallizers.

Petroleum Refinery Operations

1.1 Course Number: CE208
1.2 Contact Hours: 3-0-0 Credits: 9
1.3 Semester- offered: 2nd Year –Even
1.4 Prerequisite: Diploma level Chemistry and Unit Operations III & IV
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

Petroleum sector plays the most vital role for keeping the wheels of economic development rolling and chemical engineers mainly run the petroleum industry. Knowing the sources of crude petroleum, extraction of the crude petroleum, its refining to the useful petro-products and efficient transport to the end users through network are important tasks to the petroleum or chemical engineers. This course intends to form the foundation of the chemical engineers on all the above-mentioned basic fields of petroleum from extraction to the safe end use where refining is the most challenging. The course puts major thrust on all the techniques/processes of petroleum refining encompassing selection of the mass/heat transfer devices, their operation and basic design. The course also covers the feed stocks of petrochemical industries and manufacture important petrochemicals.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction to Petroleum Industry**	Overview of Indian petroleum industry, Crude oil: Origin, Composition, Characteristics; Exploration Methods, Search for crude oil, Scientific methods for petroleum survey, Introduction to rigs.	6
2	**Quality Control of Petroleum Products**	Classification of laboratory tests: Distillation, Vapour pressure, Flash and Fire points, Octane number, Performance number, Cetane number, Aniline point, Viscosity index, Calorific value, Smoke point, Char value, Viscosity, Viscosity index, Penetration test, Cloud and Pour points, Drop point of grease, Melting and Settling points of wax, Softening point of Bitumen, Induction period of gasoline, Thermal stability of jet fuels, gum content, Total Sulphur, Acidity and Alkalinity, Copper Strip Corrosion Test, Silver-Strip Corrosion Test for ATF, Ash, Carbon Residue (Conradson method, Ramsbottom method), Colour, Density and Specific gravity.	10

3	**Petroleum Products**	Composition, Properties & Specification of LPG, Naphthas, Motor spirit, Kerosine, Aviation Turbine Fuels, Diesel Fuels, Fuel Oils.	6
4	**Crude Oil Distillation, Thermal and Catalytic Conversion Process**	Desalting of crude oils, Atmospheric distillation of crude oil, Vacuum distillation of atmospheric residue. Products of fractional distillation of crude oil and their boiling ranges. Thermal Cracking Reactions, Thermal Cracking, Visbreaking (Conventional Visbreaking and Soaker Visbreaking), Coking (Delayed Coking, Fluid Coking, Flexicoking), Fluid catalytic cracking; Comparison between thermal and Catalytic cracking, Hydrocracking, Hydrotreating, Reforming, Isomerization, Alkylation: Hydrofluoric acid process, Sulphuric acid process; Polymerization.	12
5	**Introduction of Petrochemical Industry**	Definition, History, Raw materials for petrochemicals, Characteristics of petrochemical Industry, Major petrochemical producers in India, different petrochemical products and their uses.	6
TOTAL			**40**

4. Readings:

4.1 Textbooks:

1. W.L. Nelson, Petroleum Refinery Engineering, McGraw Hill, New York.
2. B.K. B Rao, Modern Petroleum Refining Processes, Oxford & IBH *Publishing.*

4.2 Reference Books:

1. B.K. B Rao, A Text on Petrochemicals, Khanna Publishers.
2. S. Maity, Introduction to Petrochemicals, Oxford and IBH Publishing.

5. Outcome of the Course:

On completion of this course, students will be able to

1) Understand the worldwide scenario of petroleum refinery, growth prospects, origin of crude oil, their characteristics and future trends.
2) Demonstrate the comprehensive understanding of classification, properties and uses of various refinery products.
3) Develop the knowledge of different refining operations like pretreatment of crude oil, atmospheric and vacuum distillation, cracking operations.
4) Study of different advance processing techniques like hydro cracking, visbreaking, isomerization, polymerization along with process flow sheet and descriptions.

5) Identify and suggest safe practices in operations of refineries and petrochemical complexes.

Chemical Engineering Thermodynamics

1.1 Course Number: CE209
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Diploma level Mathematics & Physics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To introduce the basic concepts of thermodynamics; apply the laws of thermodynamics; thermodynamic properties of fluid and performance of thermal systems used in industry, vapour-liquid equilibrium, reaction equilibrium.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**PVT behaviour of pure fluids**	Equation of states and concept of ideal gas, Equations of states for real gases, Critical properties, corresponding state, Real gas and compressibility factor, Virial equations, Cubic equations, Generalized correlations and Eccentric factor,	10
2	**Applications of laws of thermodynamics**	Flow processes, Refrigeration, Liquefaction processes	6
3	**Homogenous Mixtures**	Thermodynamics properties of homogenous mixtures, Property relationships for systems of variable compositions, Partial molal properties. Fugacity and fugacity coefficient, Clapeyron's equations, Residual properties. Excess properties, Activity and activity coefficients.	8
4	**Phase Equilibria**	Concept of chemical potential, Gibb's Duhen Equation, Ideal and non-ideal solutions, Vapor liquid equilibrium, dew point and bubble point, Criteria for equilibrium between different phases in multi component non-reacting systems, Vapour-liquid equilibrium, non-ideal solutions: Azeotropes.	8
5	**Chemical Reaction Equilibrium**	Reaction coordinate, Criteria of chemical reaction equilibrium, Standard free energy change and reaction	8

		equilibrium constant, Evaluation of reaction equilibrium constant, Effect of temperature on equilibrium constant, Phase rule for reacting and non-reacting system,	
TOTAL			**40**

4. Readings:

4.1 Textbooks:

1. J. M. Smith, H C Van Ness, Introduction to Chemical Engineering Thermodynamics, McGraw Hill Edition.
2. K. V. Narayanan, Chemical engineering Thermodynamics, Eastern Economy Edition.

4.3 Reference Books:

1. Y. V. C. Rao, Engineering Thermodynamics, University Press.
2. P. K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill Edition.

5. Outcome of the Course:

Students completing this course will be able to

1) Understands the laws of thermodynamics and their applications.
2) Calculate the thermodynamic properties using residual properties.
3) Estimate the thermodynamic properties of substances for ideal and real mixture.
4) Evaluate the equilibrium constant and Gibb's free energy change of a chemical reaction by applying criterion of equilibrium. Analyze the effect of change in temperature, pressure and composition on equilibrium conversions for chemical reactions, Phase rule for reacting and non-reacting system.

Chemical Technology- Organic

1.1 Course Number: CE210
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Diploma level Chemistry & Chemical Technology Inorganic
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To study the process technologies of various organic process industries. Study of organic process industries involving process technology, flow sheets of process, raw material availability, production pattern, engineering problems.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Sugar Industry**	Manufacturer of cane sugar, Various engineering problems encountered in sugar industry, Pollution abatement in sugar industry.	6
2	**Fermentation Industry**	Introduction of fermentation industry, Fermentation processes for the production of ethyl alcohol, Various engineering problems encountered in fermentation industry, Pollution abatement in fermentation industry**.**	6
3	**Pulp and Paper Industries**	Methods of pulp production, manufacture of pulp by Kraft process, recovery of chemicals from black liquor, various engineering problems encountered in paper industry & Pollution abatement in pulp and paper industry.	8
4	**Oil & Soaps Industry**	Refining of edible oils and fats, fatty acids, Manufacturing of soap, glycerin as by products from soap, Various engineering problems encountered in oil & soaps Industry.	6
5	**Polymer Industry**	Types of polymer, polymerization process, manufacture of polyethylene, styrene, nylon 6, nylon 66, rayon, Types of rubber and their production process, properties and uses.	8
TOTAL			**34**

4. Readings:

4.1 Textbooks:

1. C. L. Dryden, Outlines of Chemical Technology, Edited and Revised by M. Gopala Rao and S. Marshall, Affiliated East West, New Delhi.
2. T. G. Austin and S. Shreve, Chemical Process Industries. McGraw Hill, New Delhi.

4.2 Reference Book:

1. R. E. Kirk, and D. F. Othmer, Encyclopaedia of Chemical Technology, Interscience, New York.

5. Outcome of the Course:

After completion of this course, students will be able to

1) Understand the manufacturing of various organic chemicals.

2) Understand the role of chemical process engineer in chemical industry.

3) Ability to understand the process flow diagram and various process parameters.

4) Identify and solve engineering problems during manufacturing of organic chemicals.

Unit Operations Laboratory – II

1.1 Course Number: CE206L
1.2 Contact Hours: 0-0-2 Credits:2
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Diploma level Mathematics and Physics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

This course is designed to introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes.

3. Course Content:

Sl. No.	Name of the Experiments
1	Study of conduction heat transfer in composite wall
2	Study of conduction heat transfer in metal rod
3	To Find the Logarithmic Mean Temperature Difference (LMTD) effectiveness of Shell and Tube type heat exchanger
4	To study the boiling heat transfer phenomenon
5	To study the evaluation of mass transfer coefficient in wetted wall column
6	Study of the effect of temperature on the diffusion coefficient
7	To study about the mass transfer in case of absorption Packed Column Apparatus
8	To study the drying characteristics of a solid under forced draft condition using Tray Drier
9	To study the characteristics of Batch Distillation

4. Course Outcomes:

After completion of course student will be able to

1) Account for the consequence of heat and mass transfer in analyses of engineering systems
2) Analyze problem and develop confidence in handling the heat and mass transfer equipments used in chemical process industries.
3) Estimation of performance analysis of heat and mass transfer equipments.
4) Develop experimental and technical writing skills.

5) Work in team and develop interpersonal skills.

Semester V

Unit Operations - IV

1.1 Course Number: CE301
1.2 Contact Hours: 3-1-0 Credits:11
1.3 Semester-offered: 3rd Year –Odd
1.4 Prerequisite: Diploma level Mathematics, Physics, Chemistry & Mass Transfer Operations- I
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To teach the different mass transfer operations and separation processes such as distillation, liquid-liquid extraction, solid-liquid extraction, adsorption Chromatography and Ion-exchange, membrane separation, supercritical fluid extraction.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Distillation**	Vapour-liquid equilibrium: Constant pressure equilibria, Constant temperature equilibria, Relative Volatility, Methods of distillation: Flash distillation, Differential distillation. Continuous distillation of binary mixtures, multistage contact operations, McCabe-Thiele methods, Total, Minimum and Optimum reflux ratios, Tray efficiency, Introduction to Azeotropic and Extractive distillation.	12
2	**Extraction & Leaching**	Liquid-liquid extraction, Choice of solvent, Extraction equipments and their application. Solid-Liquid Extraction (Leaching), Industrial application of leaching, Factor affecting the rate of leaching, Leaching equipments and their application.	6
3	**Adsorption, Chromatography and Ion-exchange**	Adsorption: Types; Parameters affecting the adsorption rate, Types of adsorbents and their industrial application. Chromatography: Types of equipment and commercial processes, Chromatographic separation processes. Ion-exchange: Mechanism, Industrial application.	8
4	**Membrane Separation**	Basic principle of membrane separation, Classification of membrane processes: Osmosis, Reverse Osmosis,	8

		Nanofiltration, Ultrafiltration, Microfiltration, Dialysis, Electrodialysis, Pervaporation, Advantages and disadvantages of membrane separation processes, Industrial applications, Types and selection of membranes.	
5	**Supercritical Fluid Extraction**	Supercritical Fluid Extraction: Supercritical fluids, Industrial applications; Important supercritical processes: Decaffination of coffee, Extraction of oil from seeds, Residuum oil supercritical extraction (ROSE), Supercritical fluid chromatography, Supercritical fluid reactions etc.	6
TOTAL			**40**

4. Readings:

4.1 Textbooks:

1. R. E. Treybal, Mass Transfer Operations, McGraw -Hill International Edition.
2. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill, International Edition.
3. H. M. Schoew, New Chemical Engineering Separation Techniques, Interscience Publishers
4. C.J. King, Separation Processes, Tata McGraw - Hill Publishing Co. Ltd

4.2 Reference Books:

1. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall, India.
2. B.K. Dutta, Principles of Mass Transfer and Separation Processes, Prentice Hall of India.

5. Outcome of the Course:

After the completion of the course, students will be able to

1) Learn the basic concepts, principles and classification of distillation operation, learn graphical solutions and able to formulate, solve and analyze continuous distillation problems, concept of azeotropic and extractive distillation, Basic understanding of various equipments to carryout distillation.
2) Understand the basic concept, principles and applications of liquid-liquid extraction and solid-liquid extraction, basic understanding of various equipments to carryout liquid-liquid extraction and solid-liquid extraction.
3) Understand the fundamental concepts, equilibrium, operation and analysis of adsorption operation, chromatography and ion-exchange separation processes,
4) Understand the concept of membrane separation processes and their industrial applications.
5) Understand the fundamentals of supercritical fluid extraction and their industrial applications.

Chemical Reaction Engineering

1.1 Course Number: CE302
1.2 Contact Hours: 3-0-0 Credits: 9
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Diploma level Mathematics & Chemistry
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

i) To understand and analyze reaction rate data to determine rate laws, and to use them to design chemical reactors.

ii) To learn about different ideal reactors and their reacting schemes in order to choose the most appropriate reactor for a given need.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Basics of Chemical Reactions & Kinetics of Homogeneous Reactions**	Scope and importance of Chemical Reaction Engineering, Chemical Kinetics, Classifications of Chemical Reaction, Rate of Chemical reaction: Reaction rate on various basis, Factors affecting the rate equation, Rate Expression, Concentration Dependent term, Rate constant, Reaction Mechanism, Elementary and Non-Elementary Reaction, Molecularity and Order of reaction, Temperature Dependent term of rate equation: Arrhenius law, Activation Energy.	10
2	**Batch Reactor Data**	Constant volume batch reactor, Integrated rate equation for different order reaction, Half-life Method.	8
3	**Ideal Reactors and Their Design Equations**	Features of Ideal reactor, Different types of reactors and their design equations: CSTR, PFR; Space Time, Space velocity.	8
4	**Design for Single Reactors**	Size comparison of single reactors, Comparison of CSTR with PFR for first order reaction, CSTR in series: Unequal size, Equal size, PFR in series, PFR in parallel; Reactors of different types in series.	6

5	**Heterogeneous Processes**	Heterogeneous processes: Classification of catalysts, Preparation of catalysts, Promoters and Inhibitors, General mechanism of catalytic reactions surface area and pore size distribution Rate equation of fluid solid catalytic reactions	8
TOTAL			**40**

4. Readings:

4.1 Textbooks:

1. Y.O. Levenspiel, Chemical reaction engineering, John Wiley and Sons.
2. H. S. Fogler, Essentials of Chemical reaction engineering, Prentice Hall International series.

4.2 Reference Books:

1. L. D. Schmidt, The Engineering of Chemical reactions, Oxford University Press.
2. K. A. Gavhane, Chemical Reaction Engineering-I, Nirali Prakashan.

5. Outcome of the Course:

Students completing the course will be able to:

1) Demonstrate the understanding of basic concepts involved in using reaction rate equations and rate constants.
2) Develop rate laws for homogenous reactions.
3) Design ideal reactors for single reactions.
4) Basic concepts of heterogeneous process, catalyst, inhibitors, promoters etc.

Process Instrumentation and Control

1.1 Course Number: CE303
1.2 Contact Hours: 3-0-0 Credits: 9
1.3 Semester-offered: 3rd Year –Odd
1.4 Prerequisite: Diploma level Physics & Mathematics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

i) To learn about different process instruments widely used in chemical industries.
ii) To introduce the fundamentals of process control using mathematical models based on transfer function approach and the different components in a control system loop.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction to Process Instrumentation**	Instruments: Static and dynamic characteristics of instruments. Temperature Measuring Instruments: Expansion Thermometers, Electrical Temperature Measurements- RTD, Thermocouple, Thermistor, Pyrometers. Pressure Measuring Instruments: Barometer, Manometers, Bourdon tube, Pirani Gauge.	10
2	**Introduction to Process Control**	Process Control with examples; Control system classification; Modeling tools for process dynamics: Laplace Transform: Transforms of simple function, Transforms of Derivative, Initial value theorem and Final value theorem, Transform of Integral.	8
3	**Process Dynamics**	Response of First Order process, Second order process, Interacting and non-interacting system.	8

4	**Closed Loop Systems**	Components of control system; Block diagram and its development; Piping and instrumentation design; Instrumentation symbols; Closed loop transfer function.	6
5	**Controllers and Final Control Elements**	Proportional, Proportional Integral, Proportional Integral Derivative controllers; Responses to Set point and Load change; Control valve; valve sizing and its characteristics; Types of valve.	8
TOTAL			**40**

4. Readings:

4.1 Textbook:

1. D. R. Coughanowr and L. B. Koppel, Process systems Analysis and Control, Mc-Graw-Hill.

4.2 Reference Books:

1. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill, Publishing Ltd, New Delhi.
2. G. Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall, New Jersey.

5. Outcome of the Course:

Students completing the course will be able to:

1) Identify and understand the principles involved in measurements and application of different pressure and temperature measurement devices used in chemical industries.
2) Understand different control system loops having different components and its function.

Equipment Design

1.1 Course Number: CE304
1.2 Contact Hours: 2-0-2 Credits: 8
1.3 Semester-offered: 3rd Year – Odd
1.4 Prerequisite: Diploma level Mathematics, Physics & Material Science
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

i) To learn about the basic of design process in chemical industries.
ii) To learn the mechanical design of different commonly used process equipment and its parts.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Basic Consideration in Process Equipment Design**	General Design Procedure, Requirement of Chemical Engineering design, Equipment Classification, Equipment Symbols, Essentials of Drawing, Computer Aided Drafting, Mechanical Properties, Engineering Materials, Choice of Material.	6
2	**Design Considerations**	Stresses Created due to Static and Dynamic loads, Design Stress, Joint efficiency, Elastic Instability, Fatigue, Brittle, Fracture, Creep, Temperature effects, Fabrication: Types, Effects; Economic Considerations.	4
3	**Design of Machine Elements**	Shafts, Keys, Bolts, Couplings, Bearings, Joints: Riveted, Welded, Flanged, Packing and Gaskets, Mechanical design of piping systems: Schedule Number.	6
4	**Pressure Vessels**	Pressure Vessel Codes, Selection of material, Design condition and stresses, Design of shell and its components: Types of head, Nozzles, Flanged joints.	10
5	**Storage Vessels and Supports**	Storage of Fluids: Volatile and Non-volatile, Fixed Roof storage, Variable roof storage, Types of roof, Storage of gases: Horton spheres. Supports: Bracket or Lug supports, Leg supports, Skirt support, Saddle support.	8
TOTAL			**34**

4. Readings:

4.1 Textbooks:

1. S.D Dawande, Process Equipment Design, Dennet& Co.

4.2 Reference Books:

1. V. V. Mahajani and S. B. Umarji, Process Equipment Design, Macmillan Publishers.
2. B. Young, Process Equipment Design, Wiley India Pvt. Ltd.

5. Outcome of the Course:

The students completing the course will be able to analyze, synthesize and design pressure vessels, storage vessels and supports used in industries.

Humanities

1.1 Course Number: HU301
1.2 Contact Hours: 2-0-0 Credits: 6
1.3 Semester-offered: 3rd Year –Odd
1.4 Prerequisite: Diploma level English
1.5 Syllabus Committee Members: DUGC

2. Objective:

i) Foster intellectual curiosity, global knowledge, critical thinking, personal responsibility, and ethical and cultural awareness.
ii) Prepare students to use language effectively.
iii) Establish a framework for students to develop an aesthetic appreciation for fine arts.
iv) Prepare students to be responsible citizens, lifelong learners, and world-ready leaders in their chosen fields.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction to Sociology**	Definition of sociology, some sociological concepts: social structure, status, role, norms, values etc. Socialization, and culture and change. Social stratification - various approaches and concept of social mobility. Population and society - Trends of demographic change in India and the world, Human Ecology, Trends of Urbanization in the developing countries and the world. Major social institutions - Family and marriage, caste and tribe and organizations: (i) formal organization (bureaucracy) (ii) informal organization. Processes of social change - Modernization (including Sanskritization), industrialization, environmental/ecological changes and development. Social movements - protest movements, reformist movement and radical movements in India.	9
2	**Introduction to Literature**	Nature of Literature: Literature as a Humanistic Experience. Definitions: (i) Humanities: concern with culture, values, ideologies; (ii) Literature: concepts of imitation, expression,	7

		intuition & imagination. Major Themes of Literature: Nature, Science, Selfhood, Love, Rebellion. The Language of Literature: Modes of literary and non-literary expression. The concepts of Figurative language, imagery, symbolism, style. The Forms of Literature: Prose Narratives (short stories & novels) Poetry, Drama and Essays (Suitable texts are to be chosen by the instructors), Use of a Learner Dictionary.	
3	**Introduction to Philosophy**	Philosophy and History of Science: Growth of scientific knowledge: factors leading to the emergence of modern science. Conceptual evolution: internal and external history. Methodology of science: induction, falsifications, confirmation and probability. Nature of scientific laws and theories: realism, instrumentalism, and under-determination. Relationship between scientific observation, experiment and scientific theory. Nature of scientific explanation: teleological explanations and the covering law model. Selected case studies on scientific theories. Logic and the nature of mathematical reasoning: Inductive and deductive forms of reasoning. Nature of axioms: formal axiomatic systems. Concept of consistency, independence, and completeness. Nature of rules of inference and proof. Selected examples of axiomatic systems and proof procedures. Cognition: Current approaches to the understanding of mind and mental processes: empiricist, rationalist, behaviorist and cognitivist. Ethics: Impact of science and technology on man and society: elements of environmental and professional ethics	7
Total			**23**

4. Readings:

4.1 Textbook/Reference Books:

(A) Introduction to Sociology:

(a) L. Broom, P. Selznick and D. Dorrock, Sociology, 11th Edn. 1990 (Harper International).
(b) M. Haralambos, Sociology: Themes and Perspectives, Oxford University Press, 980.
(c) M.S.A. Rao (ed) Social movements in India, vols. 1-2, 1984, Manohar.
(d) David Mandelbaum, Society in India, 1990, Popular.
(e) M.N. Srinivas, Social change in modern India, 1991, Orient Longman.
(f) Guy Rocher, A. General Introduction to Sociology, MacMillan, 1982.

(B) Introduction to Literature:

(a) David Murdoch (ed.). The Siren's Song: An Anthology of British and American Verse, Orient Longman, 1988.
(b) S. Alter & W. Dissanayake (eds.) The Penguin Book of Modern Indian Short Stories. Penguin Books (India), 1989.
(c) Bertrand Russell, Impact of Science on Society. Allen &Unwin, 1952.

(d) Henrik Ibsen, A Doll's House, Macmillan India, 1982.
(e) George Orwell, Animal Farm, Penguin, 1951.
(f) J. Bronowski. The Ascent of Man, BBC, 1973.

(C) Introduction to Philosophy:

(a) A.C. Grayling (ed.) Philosophy: A Guide through the Courses/Subjects, Oxford Univ. Press, London, 1995.
(b) Marx W. Wartofsky, Conceptual Foundations of Scientific Thought: An Introduction to the Philosophy of Science, Macmillan, London, 1968.
(c) I.B. Cohen, The Birth of a New Physics, Vakils, Feffer and Simons Pvt. Ltd., Bombay, 1968.
(d) H. Eves and C.V. Newsom, Foundations and Fundamental Concepts of Mathematics, Boston, PWS-Kart Pub. Co., 1990.
(e) K.E. Goodpaster and K.M. Sayre (eds.) Ethics and Problems of 21st Century, Univ. of Notre Dame Press, London, 1979.
(f) S.D. Agashe, A. Gupta & K. Valicha (eds.) Scientific Method, Science, Technology and Society: A Book of Readings, Univ. of Bombay Press, 1963.

5. Outcome of the Course:

Students will demonstrate:

Knowledge of the conventions and methods of at least one of the humanities in addition to those encompassed by other knowledge areas required by the General Education program.

Engineering Economics

1.1 Course Number: HU302
1.2 Contact Hours: 2-1-0 Credits: 8
1.3 Semester-offered: 3rd Year –Odd
1.4 Prerequisite: Diploma level Mathematics
1.5 Syllabus Committee Members: DUGC

2. Objective:

i) To make fundamentally strong base for decision making skills by applying the concepts of economics.
ii) Educate the students on how to systematically evaluate the various cost elements of a typical manufactured product, an engineering project or service, with a view to determining the price offer.
iii) Prepare engineering students to analyze profit/revenue data and carry out make economic analysis in the decision-making process to justify or reject alternatives/projects.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction to Economics**	Introduction to economics – Flow in an economy – Law of supply and demand – Concept of engineering economics – Engineering efficiency – Economic efficiency – Scope of engineering economics – Element of costs – Marginal cost – Marginal revenue – Sunk cost – Opportunity cost – Break-even analysis – V ratio – Elementary economic analysis – Material selection for product design selection for a product – Process planning.	14
2	**Value Engineering**	Make or buy decision – Value engineering – Function – Aims – Value engineering procedure – Interest formulae and their applications –Time value of money – Single payment compound amount factor – Single payment present worth factor – Equal payment series sinking fund factor – Equal payment series payment Present worth factor – Equal payment series capital recovery factor – Uniform gradient series annual equivalent factor – Effective interest rate – Examples all methods.	12
3	**Cash Flow**	Methods of comparison of alternatives – Present worth method (Revenue dominated cash flow diagram) – Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram) – Annual equivalent method	12

		(Revenue dominated cash flow diagram, cost dominated cash flow diagram) – Rate of return method – Examples all methods.	
	Total		**38**

4. Readings:

4.1 Textbooks:

1. Panneer Selvam, R., "Engineering Economics", Prentice Hall of India Ltd, 2001.
2. Smith, G.W., "Engineering Economy", Lowa State Press, 1973.

4.2 Reference books:

1. Park, C.S., "Contemporary Engineering Economics", Prentice Hall of India, 2002.
2. Newman, D.G. and Lavelle, J.P., "Engineering Economics and Analysis", Engineering Press, 2002.
3. Degarmo, E.P., Sullivan, W.G. and Canada, J.R, "Engineering Economy", Macmillan, 1984.
4. Grant, E.L., Ireson, W.G. and Leavenworth, R.S., "Principles of Engineering Economy", Ronald Press, 1976.

5. Outcome of the Course:

Upon completing the course, students will be able to:

1) Understand major principles of economic analysis for decision making among alternative courses of action in engineering.
2) Apply economic principles to prices and quantities in competitive supply and demand for goods and for money.
3) Solve economic problems involving comparison and selection of alternatives by using analytical techniques including benefit-cost ratio and breakeven analysis.

Chemical Reaction Engineering Laboratory

1.1 Course Number: CE302L
1.2 Contact Hours: 0-0-2/2 Credits: 1
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Diploma level Mathematics and Physics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To apply the basics of reaction engineering using different reactors. The course includes experimental execution, data analysis and error analysis, skills development in oral presentation, technical report writing, and team-building.

3. Course Content:

Sl. No.	List of Experiments
1	To study of a Non-Catalytic Homogeneous reaction in an isothermal batch reactor
2	Study of the effect of non-catalytic homogeneous reaction in a series arrangement of PFTR and CSTR
3	To study of a non-catalytic homogeneous reaction in a CSTR
4	Study of the effect of non-catalytic homogeneous reaction in a PFTR
5	To study of a non-catalytic homogeneous reaction in a packed bed reactor

4. Outcome of the Course:

The student will be able to verify the various theoretical principles of reaction engineering using different reactors.

Process Instrumentation and Control Laboratory

1.1 Course Number: CE303L
1.2 Contact Hours: 0-0-2/2 Credits: 1
1.3 Semester-offered: 3rd Year –Odd
1.4 Prerequisite: Diploma level Mathematics and Physics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To understand the fundamentals of process control with applications using P, PI, and PID controllers in different control trainers, control valve and first order processes. The course includes experimental execution, data analysis and error analysis, skills development in oral presentation, technical report writing, and team-building.

3. Course Content:

Sl. No.	List of Experiments
1	To study the Control Valve Characteristics
2	To study the basic principles of level control using Level Control Trainer
3	To study the basic principles of flow control using Flow Control Trainer
4	To study the basic principles of Temperature control using Temperature Control Trainer
5	To study the characteristics of thermometer & thermocouple
6	To study the step response of the first order system using Thermometer and U-Tube Manometer

4. Outcome of the Course:

Students completing the course will be able to:

1) Identify and operate the commonly used pressure and temperature measuring instruments in chemical plant.
2) Identify the dynamics and further use different controllers to control the different process responses.

Semester VI

Corrosion Engineering and Materials Selection

1.1 Course Number: CE307
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 3rd Year – Even
1.4 Prerequisite: Diploma level Chemistry and Material Science
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

The objective of this course is to enable the students to understand the industrial corrosion scenarios and to develop understanding on microscopic and electrochemical origins of the corrosion phenomena. This course will also help students to understand the factors responsible for industrial corrosion and to design corrosion mitigation strategies by using appropriate engineering methods.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	Introduction and Corrosion Principles	General Introduction, corrosion rate expression, electrochemical reactions, polarization, passivity	4
2	Types of Corrosion	Galvanic (two-metal corrosion), Pitting, selective leaching, crevice corrosion, stress corrosion, hydrogen damage, erosion corrosion, intergranular corrosion, microbial corrosion, high temperature corrosion	4
3	Corrosion in Petroleum Industries (upstream and downstream)	Corrosion problems in (a) production, (b) transportation and storage and (c) refinery operations	5
4	Important Engineering Alloys for Industrial Application	Carbon steels, stainless steels, Al and its alloys, Cu and its alloys, Ni and its alloys), Non metallics	5
5	Materials Selection (Corrosion Resistant Materials) for Chemical Industries	Materials (metallic/nonmetallic) for sulfuric acid, nitric acid & hydrochloric acid	4
6	Corrosion Prevention in Petroleum Industries	Alteration of environment (changing medium, inhibitors) Cathodic and Anodic Protection	4

		Coatings (metallic and inorganic)	
7	High Temperature Corrosion and Materials Selection	Mechanism and Kinetics, High Temperature Materials (Hot corrosion of alloys)	2
Total			**28**

4. Readings:

4.1 Text books:

1. Corrosion Engineering (third edition) by Mars G. Fontana, Tata McGraw-Hill.

4.2 Reference books:

1. J.F. Shackelford and W. Alexander, Material Science and Engineering Handbook, CRC
2. V. Saini, Corrosion and Corrosion Control, Scitus Publisher.

5. Outcome of the course:

Upon completion of this course, students will be able to rationally arrive at the solutions for corrosion mitigation. They will also be able to select the materials for corrosion control and to analyze the failures caused by corrosion.

Process Equipment and Plant Design

1.1 Course Number: CE308
1.2 Contact Hours: 3-0-2 Credits:11
1.3 Semester-offered: 3rd Year –Even
1.4 Prerequisite: knowledge of Unit Operation II, III, IV
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

The objective of this course is to acquire basic understanding of design parameters, complete knowledge of configuration and design procedures for commonly used process equipment in Heat transfer and Mass transfer operations.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	Introduction to Design	Importance of plant design for process industries, The design objective (the need), Basic design procedure and theory, Codes and standards, Factors of safety (design factors), Systems of units, Information flow and design variables, Selection of design variables	6
2	Design of Heat Exchanger	Basic design procedure and theory, Heat exchanger analysis: the effectiveness NTU method, Overall heat-transfer coefficient, Fouling factors (dirt factors). Shell and tube exchangers: Construction details, Tube-sheet layout (tube count), Shell types (passes), Shell and tube designation, Baffles. General design considerations, Shell and tube fluid velocities, Stream temperatures, Pressure drop, Tube-side heat-transfer coefficient and pressure drop (single phase), Flow pattern, Design methods, Kern's method, Bell's method.	10
3	Design of Condenser	Condensers, Heat-transfer fundamentals, Condensation outside horizontal tubes, Condensation inside and outside vertical tubes, Condensation inside horizontal tubes, Condensation of steam, Mean temperature difference, De superheating and sub-cooling Condensation of mixtures Pressure drop in condensers.	8
4	Design of Reboilers	Boiling heat-transfer fundamentals: Pool boiling, Convective boiling, Design of forced-circulation reboilers, Design of thermosyphon reboilers, Design of kettle reboilers.	6

5	Design of Distillation Column	Introduction, Continuous distillation: Basic principles, process description. Design variables in distillation, Design methods for binary systems, Basic equations, Plate efficiency, Approximate column sizing, Plate contactors, Selection of plate type, Plate construction, Plate-design procedure: Plate areas, Diameter, Liquid-flow arrangement, Entrainment, Weep point, Design of packed columns for absorption/stripping, Types of packing, Packed-bed height- Prediction of the height of a transfer unit (HTU), Prediction of the number of transfer units (NTU), Column diameter (capacity), Column internals, Wetting rates, Column auxiliaries.	10
TOTAL			**40**

4. Readings:

4.1 Textbooks:

1. J. M. Coulson and J. F. Richardson, Chemical Engineering Vol 6: Design, Butterworth-Heinemann Ltd; 2nd edition.
2. D. Kern, Process Heat Transfer, McGraw Hill Education.

4.2 Reference Book:

1. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill, International Edition.
2. Towler G. and Sinnott R. K., "Chemical Engineering Design", Butterworth-Heinemann.2008

3. I.S.: 4503-1967, "Indian Standard Specification for Shell and Tube Type Heat Exchangers", Bureau of Indian Standards.2007

5. Outcome of the Course:

Students completing the course will be able to

1) Analyze and design processes for process heat exchangers, reboiler and condenser.
2) Integrate and apply techniques and knowledge acquired to design distillation and packed column.

Process Plant Utilities

1.1 Course Number: CE309
1.2 Contact Hours: 2-0-0 Credits:6
1.3 Semester-offered: 3rd Year – Even
1.4 Prerequisite: Diploma level Chemistry, Heat transfer and Material Science
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

i) The objective of this subject is to study the requirement of different utilities and their generation process and utilization for the process plant.
ii) It will also provide platform to study the various properties of insulation materials, inert gases and their specific uses in industries.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	Introduction	Importance of process utilities in chemical industries, Introduction to the use of various utilities.	3
2	Water and Steam	Sources of water, their characteristics, storage and distribution of water, water for boiler use, cooling purposes, drinking and process water treatment reuse and conservation of water, water resources management**.** Steam generation and its application in chemical process plants, distribution and utilization, design of efficient steam heating systems, steam economy, condensate utilization, steam traps, their characteristics, selection and application, waste heat utilization.	8
3	Compressors and vacuum pumps	Types of compressors and vacuum pumps and their performance characteristics. Methods of vacuum development and their limitations, materials handling under vacuum, piping systems, lubrication and oil removal in compressors in pumps.	6
4	Refrigeration systems	Refrigeration system and their characteristics, load calculation and load calculation and humidification and de-humidification equipments, drying and cooling tower, air blending, exhaust, ventilation, cryogenics, their	5

		characteristics and production of liquid N_2 and O_2.	
5	Insulation	Importance of insulation for meeting for the process equipment, insulation material and their effect on various materials of equipment piping, fitting and valves, insulation for high, intermediate, low and sub-zero temperatures including cryogenic insulation, determination of optimum insulation thickness.	6
6	Inert gases	Introduction, properties of inert gases & their use, sources and methods of generation, comparison of nitro generation routes, general arrangement for inerting system, operational, maintenance and safety aspects.	4
Total			**32**

4. Readings:

4.1 Text books:

1. J. Broughton, Process utility systems, Institution of Chem. Engineers U.K.
2. *D. B. Dhone, Plant Utilities,* Nirali Prakashan.

4.2 Reference books:

1. Reid, Prausnitz poling, The properties of gases & liquids, IVth ed. McGraw Hill international.
2. S. C.Arora and, S. Domkumdwar, A course in refrigeration and air conditioning, Dhanpat Rai & Co.(P) ltd.

5. Outcome of the course:

This subject will give the student a thorough knowledge of process utilities such as uses of water, steam generation, working of Compressors and vacuum pumps, uses of refrigeration systems, insulation and inert gases, which is essentially required for working in any chemical or related industry.

Industrial Pollution and Control

1.1 Course Number: CE310
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 3rd Year –Even
1.4 Prerequisite: Diploma level Chemistry and Chemical Technology
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To learn the essential principles used in industrial pollution control and also understand the important issues in industrial pollution control and importance of different environmental acts and legislations.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Types of environments and their pollutants**	Classification of pollutants, Legislative aspects including water act. 1974, Air Act 1981 and effluent standards, EPA Air pollution: Sources and effects of different air pollutants, Sampling and analysis of air pollutants, Air pollution control methods and equipment, Cyclone separator, Baghouse, ESP, Venturi scrubber.	10
2	**Water pollution**	Sources, sampling and classification of water pollutants, determination of basic parameters and computations associated with: BOD, COD, TS, TDS, SS; Waste water treatment: primary, secondary, tertiary and advanced; aerobic treatment with special reference to activated sludge, trickling filter, RBDC and RBRC, EA, Non-conventional: WSP, anaerobic treatment with special reference to AFFR, UASB.	10
3	**Solid waste management**	Sources and classification, Public health aspects, Methods of collection and disposal methods: Open dumping, Landfill, Incineration, Composting, Vermiculture; Solid waste management using bioremediation for specific pollutants like chromium. Mercury, Ammonia/ urea, Phenolic sludges. Management and handling of Bio-medical waste; E-waste-classification and re-use and disposal, Hazardous waste management- Electro-chemical and photo-chemical oxidation - dye waste, chrome slag – case studies.	10
4	**Pollution**	Fertilizer industries, Petroleum refineries and petrochemical	10

	control in selected process industries	units, Pulp and paper industries, Tanning industries, Sugar industries, Dairy, Alcohol industries, Electroplating and metal finishing industries, Radioactive wastes, Ranking of wastewater treatment alternatives. Case Studies.	
TOTAL			40

4. Readings:

4.1 Textbooks:

1. C. S. Rao Environmental Pollution Control Engineering, New age Publishing.
2. Connwell and Devis, Introduction to Environmental Engineering, Tata McGraw - Hill Publishing Co. Ltd.

4.3 Reference Books:

1. Metcalf and Eddy, Wastewater Engg, Tata McGraw - Hill Publishing Co Ltd.
2. S.P. Mahajon Pollution Control in process industries, Tata McGraw - Hill Publishing Co Ltd.
3. S.J. Arceivala, Wastewater treatment for pollution control, Tata McGraw - Hill Publishing Co Ltd.

5. Outcome of the Course:

Students completing the course will be able to:

1) Demonstrate comprehensive understanding of various types of pollution from chemical industries and various regulations pertinent to air, solid and water pollutions.
2) Suggest process modifications in order to reduce pollution and waste from a chemical industry.
3) Design gravity settling chamber, cyclones, electrostatic precipitator, fabric filters and absorbers for air pollution control.

Safety, Health and Environment Management

1.1 Course Number: FSE315
1.2 Contact Hours: 2-0-0 Credits: 6
1.3 Semester-offered: 3rd Year – Even
1.4 Prerequisite: NA
1.5 Syllabus Committee Members: Ms. Ananya Borah & Dr. Nilambar Bariha

1. Objective:

i) To create the awareness among students regarding importance of safety in industries.
ii) To introduce the definitions, concepts, methodologies used in management of occupational safety in industries.
iii) Students will be able to recognize and evaluate occupational safety and health hazards in the workplace, and to determine appropriate hazard controls following the hierarchy of controls.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Safety - Need for safety- HSE policy Definitions**	Health, Safety, Accident, Near Miss, Lost Time Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. History of safety movement- Causes of Accident- Safety education & training – Importance, Various training methods, Effectiveness of training.	4
2	**FIRE**	Definition of Fire, Fire Triangle, Tetrahedron of Fire, Classification of fires, Types of Extinguishing Media, Principles of Fire Extinguishing Methods Cooling, Starvation, Smothering, Retarding Chain Reaction, Stages of Fire, various Products of combustion, ignition sources.	4

3	**Active & passive fire protection system**	Overview of suppression and extinguishment, Suppression agents, Portable Fire Extinguishers-Classifications of portable fire extinguishers. Water based suppression system, Foam based Suppression system, Carbon Dioxide based Suppression system, Dry & Wet Chemical based Suppression system. Overview of Fire Fighting Equipments.	7
4	**Hazard**	Classification of Hazards-Risk Control Hierarchy- Risk Assessment- HIRA- Process Safety Management-Elements of PSM. Job Safety Analysis- Plant Inspection- Safety Audit- Near Miss Reporting – Accident investigation.	7
5	**Work permit system**	Objectives, hot work and cold work permits. Entry to Confined space- Confined Space permits. Working at height & Scaffolding hazards. Electrical hazards- Electrical Permit- LOTO. Personal Protective equipments.	5
6	**Occupational Health monitoring system. Environmental impacts of various industrial operations**	EIA. Case studies of various major Industrial accidents. OISD 105, OISD 115, 116, OISD 117, OISD-166.	5
Total			**32**

4. Readings

4.1 Textbooks:

1. Sesha, P., Manual of Fire Safety
2. A. *Maurice* Jones, Fire Protection System- Third Edition,2021
3. RK Jain and Sunil S Rao- Industrial Safety, Health and environment Management system.

4.2 Reference Books:

1. Petroleum act,1934 & Petroleum Rules, 2002, PESO
2. OISD-115 (Oil Industry Safety Directorate), (2002). Guidelines on Fire Fighting Equipment and

Appliances in Petroleum Industry. <http://www.oisd.nic.in/oisd-std-115>.
3. OISD-116 (Oil Industry Safety Directorate), (2017). Fire Protection Facilities for Petroleum Refineries and Oil/Gas Processing Plants. <http://www.oisd.nic.in/oisd-std-116>.
4. OISD-117 (Oil Industry Safety Directorate), (2017). Fire Protection Facilities for Petroleum Depots, Terminals, Pipeline Installations & Lube oil installations. <http://www.oisd.nic.in/oisd-std-117>.
5. OISD-105 (Oil Industry Safety Directorate), Work Permit System.

5. Outcome of the Course:

On completion of this course, students will be able to-

1) Demonstrate the knowledge and understanding of basic terms in safety management.
2) Understand safety organizational requirements for effective safety management.
3) Evaluate the workplace hazards and apply controls measures using hierarchy of control.

Department Elective/ Open Elective

Polymer Technology

1.1 Course Number: CE311
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 3rd Year –Even
1.4 Prerequisite: Diploma level Chemistry and Chemical Technology
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To provide a broad and fundamental knowledge of the polymers and their chemical, physical and mechanical behavior. Emphasis is on the processing techniques, along with the production of polymers and their uses.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Polymerization Chemistry**	Introduction to polymers, Classification of polymers - Plastics, elastomers, fibres & resins, Polymerization: Chain, step and miscellaneous polymerization reactions and polymerization technique, Polymerization kinetics: Free radical, cationic and anionic polymerization, Polycondensation and polymerization. Degree of polymerization, Glass Transition temperature,	8
2	**Mechanism of Polymerization**	Addition polymerization, Free radical polymerization (Initiation, propagation, termination), Ionic polymerization, Co-ordination polymerization such as polymerization with	8

		Ziegler-Natta catalyst, chain transfer Reaction, condensation polymerization- polycondensation, ring opening polymerization, co poly condensation.	
3	**Polymerization Techniques**	Bulk polymerization, Solution polymerization, Suspension polymerization, Emulsion polymerization, Melt polycondensation, Solution Polycondensation, Interfacial polymerization	6
4	**Polymer processing**	Extrusion, injection molding, compression molding, blow molding, film extrusion, spinning, extrusion film blowing, etc.	6
5	**Manufacture of Polymers & their uses**	Manufacturing processes and uses of important polymers: Plastics - Polyethylene, Polystyrene, PVC, PP, Teflon, Polyacrylonitrile, Polyamide, Natural rubber, Resins, Fibers.	12
Total			**40**

4. Readings:

4.1 Textbooks:

1.1 V. R. Gowariker, N. V. Viswanathan and J. Sreedhar, Polymer science, New Age.

4.2 Reference Books:

1. J. R. Fried, Polymer Science & Technology, Prentice Hall of India.
2. P. Bahadur and N. V. Sastry, Principles of Polymer Science, Narosa Publishing House.

5. Outcome of the Course:

Students completing the course will be able to:

1) Demonstrate the understanding of different polymers and its uses.
2) Analyze the different polymer processing techniques and along with its kinetics.

Energy Resources and Utilization

1.1 Course Number: CE312
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 3rd Year –Even
1.4 Prerequisite: Diploma level Chemistry
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

Main purpose of this course is to introduce various conventional (coal and petroleum) and non-conventional energy resources (solar, nuclear, wind, tidal, geothermal), ways of harnessing energy from these sources, its distribution and utilization.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Energy Scenario**	Energy Scenario: Indian and global, Energy crisis, Classification of various energy sources, Renewable and non-renewable energy sources, Remedial measures to some energy crisis, Biomass and its conversion routes to solid, gaseous and liquid fuels.	8
2	**Solid Fuel**	Coal its origin and formation, Coal analysis, Coal classification, Coal preparation, Coal washing and coal blending, Coal carbonization, Treatment of coal gas and recovery of chemical from coal tar, Coal gasification, Liquid fuel synthesis from coal, CBM.	8
3	**Liquid and Gaseous Fuels**	Petroleum crude, Types of crude, Emergence of petroleum products as energy source, Gaseous Fuels: Natural gas, Water gas, Producer gas, LPG, Bio-gas, Coke oven gas, Blast furnace gas, LNG, CNG, Gas hydrates, GTL Technology (gas to liquid), Biodiesel.	8
4	**Non-**	Solar energy:Photo thermal and photovoltaic conversion, Solar	10

	conventional Energy Sources	water heating, cooking, drying and its use for other industrial processes, Solar cells their material and mode of operation, direct and indirect methods, Solar energy storage, Sensible heat and latent heat storage materials, Solar ponds, Bio energy, Biogas plants and their operation, Wind energy - its potential and generation by wind mills. Hydroelectric potential, its utilization & production, Geothermal energy its potential status and production, Energy from Tidal and Ocean thermal sources, MHD systems.	
5	**Nuclear Energy**	Status, Raw materials, Nuclear reactors and their classification, Generation of nuclear power, Nuclear installations in India and their capacity, Limitations of nuclear energy, Cogeneration of fuel and power.	6
Total			**40**

4. Readings:

4.1 Textbooks:

1. Brame J.S.S. and King J.G., Edward Arnold “Fuel Solid, Liquid and Gases” Edward Arnold (1967).
2. Rao S. & Parulckar B.B. ”Energy technology” Khanna Publisher

4.2 Reference Book:

1. Sukhatme S.P, "Solar Energy - Principles of Thermal Collection and Storage", 3rd Edition, Tata McGraw- Hill., (2008).

5. Outcome of the Course:

Students completing the course will be able to

1) Understand the energy scenario, energy crisis, classification of various energy sources.
2) Understand the origin, properties and applications of solid, liquid and gaseous fuels.
3) Demonstrate understanding of the different types of renewable and non-renewable energy sources that are currently available and how they are used to provide energy.
4) Realize the sustainability of natural resources, primary global energy resource profile.
5) Identify the strengths and limitations associated with different energy sources.

Natural Gas Engineering

1.1 Course Number: CE313
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 3rd Year –Even
1.4 Prerequisite: Diploma level Petroleum Refinery Operations, Chemistry, Unit operation-I & Thermodynamic
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

Main purpose of this course is to introduce the basic knowledge of natural gas processing, their properties, storage, transportation and utilization.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Gas from condensate and oilfields**	Scope of Natural gas industry. Basic thermodynamic and system energy concepts in Natural Gas Engineering. Review of physical and chemical properties of natural gas and associate hydrocarbons.	8
2	**Flow of fluids**	Compression calculations. Heat Transfer and Mass Transfer principles and applications in Natural Gas Engineering. Gas flow measurement. Process control and instrumentation in natural gas processing plants.	8
3	**Natural Gas Processing**	Field separation and oil absorption process. Refrigeration and low temperature processing. Liquification process. Dehydration of Natural Gas sweetening of Natural gas and sulphur recovery,	8

		Processing for LPG, LNG, CNG system.	
4	**Transmission of Natural Gas**	Specifications. Utilization of Natural Gas. Underground storage and conservation of Natural Gas	8
5	**Unconventional Gases**	Coal Bed Methane, Natural Gas Hydrate. Conversion of gas to liquid. Economic consideration for development of gas fields.	8
Total			**40**

4. Readings:

4.1 Textbooks:

1. Kumar S., "Gas Production Engineering", Gulf Publishing Co., (1987).
2. Beggs H. D., "Gas Production Operations", OGCI Publication, (1984).
3. Ikoku C. K., "Natural Gas Engineering", John Wiley, (1984).

Reference Books:

1. Alexandre R., "Natural Gas: Production, Processing and Transport", Hyperion Books, (1995).
2. Katz D. L., "Hand Book of Natural Gas Engineering", McGraw Hill.

5. Outcome of the Course:

Students completing the course will be able to

1) Understand the sources of natural gas, their processing, properties, transportation and uses.

2) Understand the importance of unconventional gases such as coal bed methane, Natural Gas Hydrate and their economy aspects in present energy scenario.

Industrial Pollution and Control Laboratory

1.1 Course Number: CE310L
1.2 Contact Hours: 0-0-2/2 Credits:1
1.3 Semester-offered: 3r^{d} Year –Even
1.4 Prerequisite: Diploma level Mathematics and Chemistry
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar & Mrs. Sukanya Hazarika

2. Objective:

To study the physical, chemical and biological water quality parameters. The course includes experimental execution, data analysis and error analysis, skills development in oral presentation, technical report writing, and team-building.

3. Course Content:

Sl. No.	List of Experiments
1	To determine the Total Solids of a given sample
2	To find out Total Dissolved Solids of a given sample
3	To find out Fixed and Volatile solids of the given sample
4	To determine the Acidity of the given sample
5	To determine the Alkalinity of the given sample
6	To determine the Total Hardness of the given sample
7	To find out amount of Sulphates in a given sample
8	To estimate the content of Chlorides in the given water sample
9	To find the quantity of the Dissolved Oxygen present in the given sample
10	To determine the BOD of a given wastewater sample
11	To determine the COD of a given wastewater sample

4. Outcome of the Course:

The lab will give the student a thorough understanding to analyze different waste water samples.