Complete Course Grid and Syllabus

Diploma in Mechanical Engineering

Rajiv Gandhi Institute of Petroleum Technology

RGIPT Sivasagar Campus

Course: Diploma in Mechanical Engineering

Total Number of Credits: 340

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	3	0	0	9
ME101	Engineering Mechanics	2	1	0	8
CS101	Fundamentals of Computer Engineering	2	0	2	8
ME102L	Engineering Drawing	0	0	3	3
PY101L	Physics Laboratory	0	0	2	2
TOTAL					**52**
HU101	Universal Human Values	1	1	0	5
L101	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
EE101	Fundamentals of Electrical and Electronics Engineering	3	1	0	11
CS102	Computer Programming	2	0	2	8
ME103L	Engineering Workshop Practices Laboratory	0	0	3	3
CY101L	Chemistry Laboratory	0	0	2	2
EE101L	Fundamentals of Electrical and Electronics Engineering Laboratory	0	0	2	2
TOTAL					**57**
HU102	Community Internship	1	1	0	5

SEMESTER III					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
ME201	Materials Science	3	0	0	9
ME204	Fluid Mechanics	3	1	0	11
ME205	Manufacturing Technology-I	3	1	0	11
ME206	Engineering Thermodynamics	3	0	0	9
ME208	Strength of Materials	3	1	0	11
ME209	Renewable and Alternative Energy Sources	3	1	0	11
ME207L	Computer Aided Drafting Laboratory	0	0	2	2
CE201L	Unit Operations Laboratory-I	0	0	2	2
ME210	Group Discussion	0	0	2	2
TOTAL					**68**

SEMESTER IV					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
ME211	Theory of Machines	3	1	0	11
ME212	Heat and Mass Transfer	3	1	0	11
ME213	Applied Thermodynamics	3	1	0	11
ME215	Design of Machine Elements	3	1	0	11
ME214	Manufacturing Technology – II	3	1	0	11
ME216	Mechatronics and Industrial Automation	3	0	0	9
ME218L	Workshop Technology Laboratory	0	0	3	3
ME217	Seminar	0	0	2	2
TOTAL					**69**

SEMESTER V					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
ME301	Pipe Hydraulics and Hydraulic Machinery	3	0	0	9
HU301	Humanities	2	0	0	6
MT301	Engineering Economics	2	1	0	8
	Departmental Elective	3	0	0	9
	Open Elective	3	0	0	9
ME306L	Applied Mechanics Laboratory	0	0	3	3
ME307L	Advanced Workshop Technology Laboratory	0	0	3	3
TOTAL					**47**

SEMESTER VI					
Course Code	**Subjects**	**L**	**T**	**P**	**Credits**
ME308	Skill Development Certificate Course			x*	x*
ME309	Project			30-x	30-x
TOTAL					**30**

Subject Code	Departmental Elective/Open Elective
ME302	Power Plant Engineering
ME303	Quality Control and Metrology
ME304	Offshore and Cross-Country Pipeline
ME305	Industrial Engineering and Management

Component distribution for diploma in Mechanical Engineering					
Category	**Program Components**	**Approved Range**		**Mechanical**	
		Min	**Max**	**Existing**	**Recommended (Revised)**
HU	Humanities and Social Science	12	24	16	16
IS	Institute Science Courses	50	80	66	66
IE	Institute Engineering Courses	40	70	67	50
EP	Engineering Drawing, Manufacturing Practices, and Practice course of Department	8	24	16	16
LM	Language and Management	8	20	15	15
DC	Departmental Core	125	160	136	129
DE	Departmental Elective	8	20	9	9
OE	Open Elective	8	20	9	9
DP	Project/ Industrial visit	20	50	20	30
	Total	**340**	**360**	**354**	**340**

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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: Dept. of Mathematical Sciences, RGIPT

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 functions; Differentiation of function of a function; Differentiation of trigonometric and inverse trigonometric functions; Logarithmic differentiation; Exponential functions.Definition & meaning of partial derivative. Evaluation	12

		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 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.
ii) This will give a solid foundation for future self-development in order to cope with new advances. The study of physics encompasses a wide range of fascinating subjects, many of which have something to do with the materials and objects that surround us. It tries to provide a knowledge of this environment via both observation and behavior prediction of such items.
iii) The course material places a strong emphasis on the practical application of physical concepts and analysis in a variety of engineering and technological sectors.
iv) 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 (Statement only), Scalar and Vector product, Resolution of a vector and its application to inclined plane. Kinematics equations in scalar and vector form with related	7

		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's Barometer and its applications. Surface tension: Concept, Unit, Cohesive and adhesive forces, Angle of contact, Ascent Formula (No derivation), 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, Stream line and turbulent flow, Reynold's number, Equation of continuity, Bernoulli's Theorem (only formula and numerical) 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: 3-0-0 Credits:9
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 model and 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.	8
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, electronegativity, valency. Nomenclature of elements with atomic number greater than 100. Basic Concepts of s, p, d and f-block Elements	8
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.	8
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.	7
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.	7
Total			**38**

4. Readings

4.1 Textbooks:

1. NCERT Textbook (Class XI and XII)
2. Engineering Chemistry, B. K. Sharma

4.2 References Books:

1. A Textbook of Engineering Chemistry, Sashi Chawla
2. Engineering Chemistry, Jain and Jain
3. 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 configurations of atoms.

2) Understand the variation of physical and chemical properties of elements such as ionization potential, electron affinity, electronegativity 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.

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 in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.	6
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	6
3	**Properties of surfaces and solids**	Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, and Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular,	6

		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.	5
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.	5
	Total		**28**

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 &**	Internet, TCP/IP, World Wide Web, Browser, Internet address (Domain name, URL), Search engine.	10

	Web Design	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.	
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**

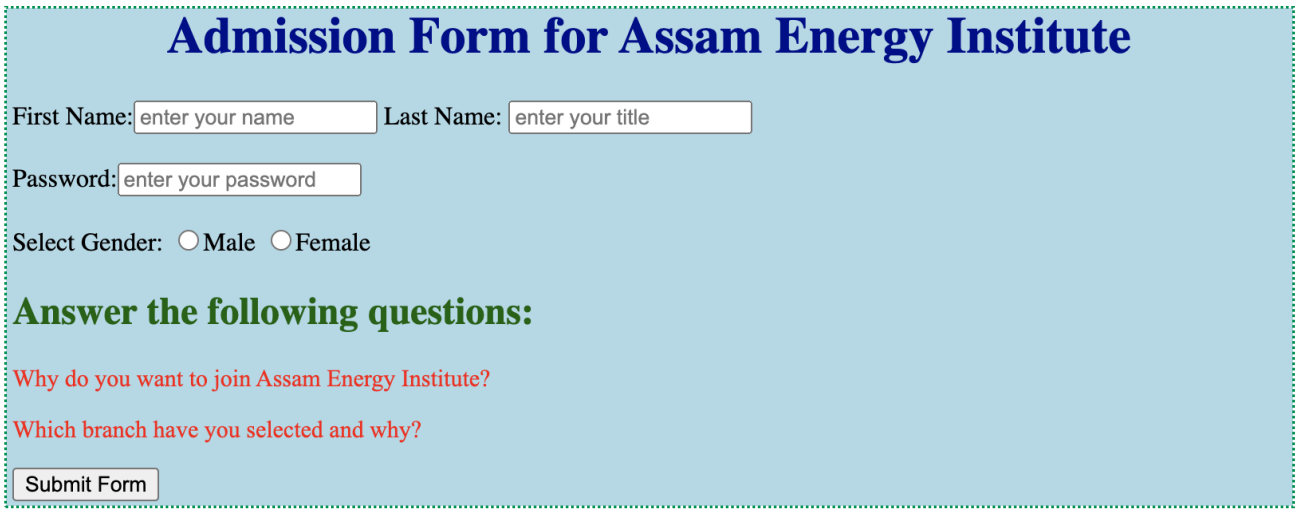
List of Experiments:

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 :



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 Drawing

1.1 Course Number: ME102L
1.2 Contact Hours: 0-0-3 Credits:3
1.3 Semester-offered: 1st Year –Odd/Even
1.4 Prerequisite: Class 10^{th} 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	Lab Sessions
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 75 degree, free hand and instrumental lettering in the ratio of 7:4	2
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 2.3 Scales – their needs and importance (theoretical instructions), type of scales, definition of representative fraction and length of scale	2

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	5
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	3
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	1
Total			**13**

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 –Odd/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 measure length, radius of a given metallic cylinder and a metallic spherical ball using a Vernier caliper and find volume of each object.
2. To determine the diameter of a wire, a metallic spherical ball and thickness of cardboard using a screw gauge.
3. To verify the laws of reflection using a plane mirror and to study the characteristics of the image formed.
4. To determine the refractive index of the material of the glass slab by pin method.
5. To locate the poles of a bar magnet and measure the magnetic length. To plot the magnetic field lines of the bar magnet.
6. a). To verify Ohm's law by Ammeter-Voltmeter method. b). Find equivalent resistance using voltmeter with three resistors connected in series and then in parallel.
7. To plot $L-T$ and $L-T^2$ graph using a simple pendulum. To find effective length of a second's pendulum using appropriate graph.
8. To study the relation between the length of a given wire and tension for constant frequency using sonometer.
9. To study the co-efficient of viscosity of a given viscous liquid by measuring the terminal velocity of a given spherical body.
10. To study the variation in volume with pressure for a sample of air at constant temperature by plotting graphs between pressure and volume.

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 and Screw Gauge.
2) Verify the laws of reflection using mirror and the laws of refraction using glass.
3) Study the magnetic field lines of a Bar magnet.
4) Verify the Ohm's law and find an unknown resistance using meter bridge.
5) Understand the relation between length and time period of simple pendulum.
6) Learn the effect & use of resonance in sonometer.
7) Determine the coefficient of viscosity of any spherical metallic body.
8) Understand the relation between volume and pressure of air using Boyle's Law.

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.	1
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.	2
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.	1
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?	1
5	**Time Management**	How does one deal with myriads of activities in college? Focus of the mind.	1
6	**Concept of Preconditioning**	How preconditioning affects our thinking, behavior, 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?	1

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?	2
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.	2
9	**Concept of prosperity Material goods**	What role others have played in making material goods available to me: Identifying from one's own life.	1
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?	1
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	1
	Total		**14**

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: L101
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 Transformation of sentences**	Assertive sentences, Exclamatory sentences, Interrogative sentences, Negative sentences, Compound sentences, complex sentences, simple sentences, Degrees of Comparison	2

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: Dept. of Mathematical Sciences, RGIPT

2. Objective:

This course is designed to give a comprehensive coverage at an introductory level to the subject of Determinants and Matrices, Integral Calculus, Differential Equations, Permutations & Combinations, Probability & Statistics.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Determinants and Matrices**	Elementary properties of determinants up to 3rd order, Algebra of matrices, Inverse of a matrix, Consistency of equations; Crammer's rule, Matrix inverse method to solve a system of linear equations in 3 variables.	8
2	**Integral Calculus**	Integration as inverse operation of differentiation; Simple integration by substitution, by parts and by partial fractions (for linear factors only); Definite Integral, Use of formula $\int_0^{\pi/2} \sin^n x dx, \int_0^{\pi/2} \cos^n x dx$ & $\int_0^{\pi/2} \sin^m x \cos^n x dx$ for solving problems where m and n are positive integers.	9
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	**Permutations & Combinations**	Definition of factorial of a number, permutation (${}^nP_r$) & combination (${}^nC_r$) with formula only. Binomial Theorem (without proof) for any index, simple problems on positive index only. Expansion of $(1 + x)^{-1}$, $(1 - x)^{-1}$, where $\|x\| < 1$, exponential & logarithmic series only (no problem).	5
5	**Probability and Statistics**	Definition & examples of frequency distribution. Measure of Central Tendency (mean, median, mode) for ungrouped frequency distribution. Measures of dispersion-Standard deviation, Simple problems. Definition of random experiment, sample space, event, occurrence of events & types of events (eg. Impossible, Mutually exclusive, Exhaustive, Equally likely). Classical definition of probability, simple problems.	9
	Total		**40**

4. Readings

4.1 Textbook:

- H. K. Das, Applied Mathematics for Polytechnics.
- B.S. Grewal, Higher Engineering Mathematics, Khana Publishers, New Delhi, 40th Edition, 2007.
- Mathematics Textbook for Class XI and XII (NCERT).

4.2 Reference Books:

1. R. D. Sharma, Mathematics for Class 11and 12.
2. R. K. Jain and S. R. K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House.
3. M. D. Raisinghania, Advanced Differential Equation.
4. E. Kreyszig, Advanced Engineering Mathematics, Khanna Publisher.
5. J. J. Sciller, R. A. Srinivasan, M. R. Spiegel, Probability & Statistics, Schaum's outline series, McGraw Hill.

5. Outcome of the Course:

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

1) Understand the concept of matrices and their properties. Apply matrix operations to real-world problems, such as transformations and Markov chains.

2) Apply integration to solve problems in physics, engineering, and economics.

3) Solve first-order ODEs using various methods, such as separation of variables, integrating factors, and exact equations.

4) Understand the fundamental principles of permutations-combinations & probability-statistics.

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, Acoustics of buildings. Ultrasonic waves: Introduction and properties, Applications of ultrasonics in engineering and medicals.	9
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 and defects. Total internal reflection, Critical angle and conditions for total internal reflection, Applications of total internal reflection.	6
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,	9

		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.	
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.	8
5	**Magnetism & Electromagnetism**	Inverse square law of magnetism, Magnetic field and intensity, Magnetic lines of force, Magnetic flux, Ampere's circuital law, Solenoid, Torque on a current loop, Magnetic moment, Magnetic dipole, Moving coil galvanometer, Conversion of a galvanometer into ammeter and voltmeter. Uniform & non-uniform field, Magnetization, Earth's magnetism, Permanent magnets and electromagnets, Types of magnetic materials: Dia, para and ferromagnetic with their properties. Electromagnetic induction, Faraday's Laws, Lenz law, Self and mutual induction, Motional electromotive force, Eddy currents, Alternating current, Transformers (step-up & step-down), Displacement current, EM waves and its spectrum.	10
	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 modern chemistry 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.	9
2	**Fuels & Combustion**	Sources of Energy, Fuels- classification, examples, relative merits, types of coal, Gaseous fuels: LPG, natural gas, CNG: Composition and applications. determination of calorific value of solid fuels, Bomb calorimeter, Knocking and anti-knocking for petrol and diesel (octane number and cetane number) - diesel index.	8
3	**Environmental Chemistry**	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; pollution due to industrial wastes; strategy for control of environmental pollution.	6
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	8

		theory (elementary idea, no mathematical treatment). Activation energy, Arrhenius equation.	
5	**Electrochemistry**	Redox reactions; conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration, Electrochemical cells: Galvanic cell (daniel cell); Electrode potential; electrochemical series and its applications; Nernst equation and it's application. Fundamental concept of corrosion.	8
	Total		**39**

4. Reading

4.1 Textbooks:

1. NCERT Textbook (Class XI and XII)
2. Engineering Chemistry, B. K. Sharma

4.2 References Books:

1. A Textbook of Engineering Chemistry, Sashi Chawla
2. Engineering Chemistry, Jain and Jain
3. Applied Chemistry, Dr.Raman Rani Mittal

5. 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) 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.

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

4) 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: EE101
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.	8
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. Construction and Working principle of AC and DC machines; Basic equations and characteristic of motors.	7
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	9

		characteristics, types of diodes. Diode as rectifier –half wave and full wave rectifier, Working of BJT, BJT as amplifier.	
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.	8
Total			**41**

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.	6
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.	9
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()).	6
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 (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.	7
	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 Workshop Practices Laboratory

1.1 Course Number: ME103L
1.2 Contact Hours: 0-0-3 Credits:3
1.3 Semester-offered: 1st Year –Odd/Even
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: ɔodwork, 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/Even
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

Fundamentals of Electrical and Electronics Engineering Laboratory

1.1 Course Number: EE101L
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.
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 Mess and Nodal Analysis for the given circuits.
7. Verification of Basic Theorems (Thevenin, 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 textbook 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	2
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	3
3	**Working with Groups**	Social Groups: Definitions, characteristics, functions and group structure, Principles of group work and Models of group work practice, Leadership - Theories of leadership, roles and responsibilities of group leader, Leadership Power,	2

		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	3
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	2
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	2
	Total		**14**

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: ME201
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Diploma level Physics & Chemistry
1.5 Syllabus Committee Members: Dr. Naveen Mani Tripathi, Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha & Dr. Karthik Babu NB

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, transformation across various regions, pearlite transformation, TTT Diagram.
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) 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	12

		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	**Heat Treatment and NDT**	Description of processes: Annealing, hardening, normalizing and tempering Hardening processes: surface hardening, Flame hardening case hardening, methods, their scope, limitation and advantages TTT curves: interpretation and use Non-Destructive Testing: Introduction and classification of NDT techniques; (a) Magnetic particle testing: Operating principle and magnetising technique. (b) Liquid Penetrating technique: Principle, process description. (c) Ultrasonic Testing: Definition, advantages and applications, inspection methods. (d) Radiography: Electromagnetic radiation sources, process description. (e) Eddy current testing; Leak testing: Bubble emission testing, Air leak testing.	10
Total			**40**

4. Readings

4.1 Textbooks:

1. Materials Science, V. Raghavan, PHI Learning Private Ltd., 2010.
2. Materials Science, G.K. Narula, K.S. Narula, V.K. Gupta, Tata McGraw Hill, 2010.

4.2 Reference Books:

1. Engineering Materials: Polymers, Ceramics and Composites, A.K. Bhargava, PHI Learning (P) Ltd.
2. Callister's Materials Science and Engineering, W.D.Callister, Jr, R. Balasubramaniam Wiley India, 2010

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.

Fluid Mechanics

1.1 Course Number- ME204
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	**Turbulence**	Turbulence: Transition from laminar to turbulent flows, Nature of turbulence, Isotropic turbulence, Reynolds stress, Eddy viscosity	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.

Manufacturing Technology –I

1.1 Course Number- ME205
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 understand some important primary and secondary manufacturing processes
ii) To be able to select methods, equipment and their specifications for manufacturing any object using these manufacturing processes.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Metal Casting Processes**	Sand Casting: Sand Mould – Type of patterns – Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell – investment – Ceramic mould – Pressure die casting – Centrifugal Casting – CO_2 process – Stir casting; Defects in Sand casting	8
2	**Joining Processes**	Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding – Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding – Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding – Plasma arc welding – Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure.	7
3	**Metal Forming Processes**	Hot working and cold working of metals – Forging processes – Open, impression and closed di forging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.	8
4	**Sheet Metal Processes**	Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations –Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Rubber pad	8

		forming – Metal spinning– Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming.	
5	**Manufacture Of Plastic Components**	Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding –Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.	8
Total			**39**

4. Readings:

4.1 Textbooks/ Reference Books:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008
2. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2013
3. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008
4. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice – Hall of India, 1997.
5. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH-2013
6. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
7. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2014.

5. Outcome of the Course:

1) Being able to calculate the energy and force required for metal forming operations
2) Being able to understand the various defects that can occur in casting, forging and welding with ways to avoid it.
3) Being able to design the manufacturing process of a given object with the processes covered.
4) Being able to operate with the help of an operator the machinery used in industrial production processes.

Engineering Thermodynamics

1.1 Course Number- ME206
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 thermodynamic property; Definition of specific heats and their	5

		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.

Strength of Materials

1.1 Course Number- ME208
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:

To give students a foundational understanding of material mechanics so they may create engineering systems and solve real engineering challenges.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**The deformation of a real body under static loads**	Basic of stress & strain, Generalized Hooke's law, Elastic constants and Relationship. Stresses and strains on oblique planes under uniaxial and biaxial loading., Analysis of plane stress and plane strain, Mohr's circle of stress and strain.	7
2	**Beams**	Shear force and Bending moments for different types of beams, Simple bending theory, bending stress analysis for symmetrical and unsymmetrical sections, Strain energy due to bending, Shear stress distribution in massive and thin-walled cross section, Shear centre, Strain energy due to shear.	8
3	**Slope and deflection of beams**	Relationship between curvature, deflection and slope, Method of Superposition, Macaulay's method, Moment-Area method, Conjugate Beam method.	9
4	**Torsion**	Torsional rigidity, Torsion of circular bars, Torsion in thin tubular section, Strain energy due to Torsion.	6
5	**Column and struts**	Elastic buckling concept, Euler's theory for crippling load, Empirical formulae for crippling load. Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure.	8
Total			**38**

4. Readings

4.1 Textbooks:

1. Ramamrutham, S. Strength of Materials, Dhanpat Rai Publishing Company
2. Bansal, R.K. Strength of Materials, Laxmi Publications Pvt. Ltd.
3. Nag, D., Chanda, A. Strength of Materials, Wiley-India.
4. Subramaniam, R. Strength of Materials, Oxford University Press.

5. Singh, S. Strength of Materials, Katson Book.

4.2 Reference Books:

1. Shames, I.H. Introduction to Solid Mechanics, Prentice Hall of India.
2. Rajput, R.K. Strength of Materials, Dhanpat Rai & Sons.
3. Singh, S. Strength of Materials, Khanna publications.

5. Outcome of the Course:

1. Recognize the concepts of stress and strain at a point along with the stress and strain relations for homogenous, isotropic materials.
2. Compute the stresses and strains that axially loaded, circularly torsionated, and flexure-laden members will experience.
3. Determine the stresses and strains related to pressure vessels with thin walls that are spherical and cylindrical.

Renewable and Alternative Energy Sources

1.1 Course Number- ME209
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 the various methods of electricity production from solar, wind, biomass and geothermal energy
ii) To be able to calculate the potential of solar or wind energy at a given location from weather data
iii) To understand the mechanisms of energy storage in large scale including in the form of hydrogen

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Solar Energy– Basics**	Sun as a source of energy. Sun earth radiation spectrums. Spectral energy distribution of solar radiation. Measurement of solar radiation. Empirical equations for estimating solar radiation availability. Solar collectors, comparison of concentrating and non-concentrating types of solar collectors. Effect of various parameters and performances. Solar water heaters, solar refrigeration and air conditioning systems, solar cooker, solar furnaces, solar greenhouse, solar dryer, solar distillation, solar thermo-mechanical systems. Solar cell fundamentals, classification of solar PV systems.	8
2	**Wind Energy**	Wind energy, energy estimation of wind, power extraction from wind, classification and description of wind machines. Elementary design principles; coefficient of performance of a wind mill rotor, aerodynamic considerations of wind mill design	7
3	**Biomass, Ocean Energy and Geothermal Energy**	Usable forms of bio mass, their composition and fuel properties. Bio gas production from waste biomass. Tidal energy technology, ocean thermal energy, origin and characteristics of resources. Application, types and analysis of geothermal resources.	8
4	**Batteries and Fuel Cells**	Basic Battery theory, definition of fundamental quantities, Battery fundamental characteristics, different types of battery	8

		arrangement, classification of batteries. Design and principle of operation of fuel cells, classification and types of fuel cells, advantages and disadvantages of fuel cells, conversion efficiency, types of electrodes, work output and EMF, application of fuel cells.	
5	**Hydrogen for Energy Storage**	Hydrogen production methods – electrolysis, thermos chemical, fossil fuel and solar energy, Hydrogen storage, Hydrogen transportation, Hydrogen as an alternative fuel for vehicles, Safety and management, Hydrogen technology development in India and the world.	8
Total			**39**

4. Readings

4.1 Textbooks/ Reference Books:

1. G.D Rai, Non-Conventional Energy Sources, Khanna Publishers.
2. Subhas P Sukhatme, Solar energy, Tata McGraw Hill.
3. N.K. Bansal, Manfred Kleeman & Mechael Meliss , Renewable Energy Sources and Conversion Technology ,Tata McGraw Hill
4. John W. Twidell Anthony D. Weir, Renewable Energy Resources, Taylor & Francis
5. P.K. Nag, Solar Power Engineering, Tata McGraw Hill.

5. Outcome of the Course:

1) After attending the course, the student shall be able to calculate the amount of solar or wind energy that can be extracted at a given area from weather data and also calculate the specifications of the required equipment.
2) Being able to choose from the various energy storage methods available for intermitted power sources.
3) Understanding of the mechanism of direct use of solar energy in dryers, water heaters refrigerators etc.

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

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

Theory of Machines

1.1 Course Number:ME211
1.2 Contact Hours: 3-1-0 Credits: 11
1.3 Semester-offered: 2nd Year - Even
1.4 Prerequisite: Diploma level Mathematics
1.5 Syllabus Committee Members: Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha, Dr. Naveen Mani Tripathi, and Dr. Karthik Babu NB

2. Objective:

i) To study analytical and graphical methods for understanding kinematics of mechanisms.
ii) To understand dynamics of various machine elements.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Terminology, Mechanisms and Inversions**	1.1 Introduction: Mechanisms and machines, applications, study of mechanisms, kinematics and kinetics, kinematic link or element, types of links, kinematic pairs, degrees of freedom, types of constrained motions, classification of kinematic pairs, chains, kinematic chain, unconstrained chain, locked chain, linkage, mechanism, structure. Mobility of planar mechanisms with lower and higher pairs, Kutzbach criterion, types of joints, Gruebler's criterion, determination of mobility using methods of joints and loops. 1.2 Kinematic Chains and Inversions: Inversions of four-link chain, single slider-crank chain and double slider-crank chain, Grashof's law. 1.3 Mechanisms with Lower Pairs: Quick return motion mechanisms, straight line motion, intermittent Motion mechanisms, toggle mechanism, pantograph, Ackerman steering gear mechanism.	8
2	**Velocity and Acceleration Analyses of Mechanisms**	2.1 Graphical Methods: Velocity analyses of four-link mechanisms by relative velocity method. Instantaneous centre, Aronhold Kennedy theorem, determination of linear and angular velocity using instantaneous center method. 2.2 Analytical Methods: Analysis of slider-crank chain using analytical expressions.	12

3	**Cams, Gears and Gear Trains**	3.1 Cams: Introduction, types of cams, types of followers, terminology, advantages and disadvantages. 3.2 Gears: Introduction and classification of gears, gear terminology, law of gearing, characteristics of involute action, interference in involute gears, methods of avoiding interference, back lash, comparison of involute and cycloidal teeth. 3.3 Gear Trains: Simple gear trains. Compound gear trains for large speed reduction. Planetary or epicyclic gear trains, algebraic and tabular methods of finding velocity ratio of epicyclic gear trains.	6
4	**Static & Dynamic Force Analyses and Balancing**	4.1 Static Force Analysis: Constraint and a0pplied forces, static equilibrium, force convention, free-body diagrams, two- and three-force members, members with two forces and a torque, four-force members. 4.2 Dynamic Force Analysis: D'Alembert's principle, equivalent offset inertia force, dynamic analyses of four-link mechanisms and slider-crank mechanisms. 4.3 Balancing: Static and dynamic balancing, balancing of reciprocating masses.	10
5	**Flywheels, Governors and Gyroscopes**	5.1 Flywheels: Turning-moment diagrams, fluctuations of energy, dimensions of flywheel rims. 5.2 Governors: Difference between a flywheel and a governor, types of governors, sensitiveness, hunting, isochronism, stability, controlling force of a governor. 5.3 Gyroscopes: Angular velocity and acceleration, gyroscopic torque or couple.	6
Total			**42**

4. Readings

i) S. S. Rattan, Theory of Machines, 4th Ed, Tata McGraw Hill, 2014.
ii) R. S. Khurmi and J. K. Gupta, Theory of Machines, 14th Ed, S. Chand, 2020.
iii) J. J. Uicker (Jr.), G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, 3rd Ed, Oxford International Student Edition, 2010.

5. Outcome of the Course:

1) Understand kinematic links, pairs, chains, mechanisms, structures and super-structures.
2) Calculate mobility of a kinematic chain.
3) Study graphical and analytical methods for kinematics of four-link and slider-crank mechanisms.
4) Understand kinematics of cams, gears and gear trains.

5) Study static and dynamic force analyses of four-link and slider-crank mechanisms.
6) Knowledge of balancing of reciprocating masses.
7) Understand dynamics of flywheels, governors and gyroscopes.

Heat and Mass Transfer

1.1 Course Number- ME212
1.2 Contact Hours- 3-1-0 Credits: 11
1.3 Semester Offered- 2nd Year Even
1.4 Prerequisite: Diploma level Mathematics
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 modes of heat transfer, *i.e.* conduction, convection and radiation.
ii) To study diffusion mass transfer.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	Modes of heat transfer, Relationship to thermodynamics, Analyses of heat transfer problems	4
2	**Thermal Conduction**	The thermal conductivity of solids, Liquids and gases, Factors influencing conductivity measurement. The general differential equation of conduction, One dimensional steady state conduction, Linear heat flow through a plane and composite wall.	10
3	**Forced and Natural Convection**	Physical Mechanism of Forced Convection, Dimensional analysis for forced convection, velocity and Thermal Boundary layer, Flow over plates, Flow in tubes, Reynolds's analogy, Physical Mechanism of Natural Convection Empirical relationship for natural convection.	10
4	**Thermal Radiation**	Introduction, absorption and reflection of radiant energy, Emission, Radiosity and irradiation, Black and non-black bodies, Kirchhoff's law, intensity of radiation, Radiation exchange between black surface, Geometric Configuration factors. Grey body relation exchange between surface of unit configuration factors, Electrical analogy to simple problems.	10
5	**Heat Exchangers**	Types of Heat Exchangers and their construction details, Parallel flow heat exchangers, Counter flow heat exchangers	4

6	**Diffusion Mass Transfer**	Basic concepts, Diffusion mass transfer, Fick's law of diffusion, Steady state molecular diffusion.	4
Total			**42**

4. Readings

4.1 Reference Books:

1. Bergman, Theodore L., Theodore L. Bergman, Frank P. Incropera, David P. Dewitt, and Adrienne S. Lavine. Fundamentals of heat and mass transfer. John Wiley & Sons, 2011.
2. J.P. Holman, Heat Transfer, 10th Ed., Tata McGraw Hill, 2011.
3. Yunus A. Cengel, Heat Transfer – A Practical Approach, 2nd Ed., McGrawHill, 2002.

5. Outcome of the Course:

1) Define heat flux and heat flow rate.
2) Understand Fourier's law, Newton's law and Stefan-Boltzmann law in the context of heat transfer.
3) Derive heat diffusion equation.
4) Study one dimensional heat conduction problems and lumped parameter analysis.
5) Understand heat transfer from extended surfaces.
6) Define Nusselt number, Prandtl number, Reynolds number and Grashof number.
7) Evaluate convective heat transfer based empirical correlations.
8) Understand Fick's law of diffusion mass transfer.

Applied Thermodynamics

1.1 Course Number- ME213
1.2 Contact Hours- 3-1-0 Credits: 11
1.3 Semester Offered- 2nd Year Even
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) Understand power producing cycles and refrigeration cycles with vapor and air as fluids.
ii) Understand different processes in IC Engines, calculate BP, IP, FP and prepare Heat Balance Sheet.
iii) Understand different laws governing gases and their mixtures.
iv) Understand steam boilers and their performance.
v) Understand steam turbines and their performance, Understand compressors and condensers and their performance.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Properties of Pure Substances**	P-V, P-T, T-S, H-S diagram for steam, different types of steam, Introduction to steam tables with tables with respect to specific volume, pressure, temperature, enthalpy and entropy.	8
2	**Steam Power Cycles**	Properties and processes of ideal vapour, Qualities of steam, Simple steam power cycle, Rankine Cycle, Actual Vapour Cycle, Actual Vapour Cycle Processes, Reheat cycle, ideal and Practical Regenerative Cycles, Characteristics of an ideal Working Fluid in Vapour Power Cycles, Binary Vapour Cycles.	8
3	**I.C. Engines**	Air Standard Assumptions, Otto Cycle, Diesel Cycle, Dual Cycle, Practical Gas Power Cycles	8
4	**Gas Turbines**	Brayton cycle, components of a gas turbine power plant, Co-generation cycle.	8
5	**Refrigeration and Airconditioning**	Types Refrigeration cycles, Reverse Carnot cycle, Vapour Compression Refrigeration cycle, Vapour Absorption Refrigeration cycle, Relative Humidity, Specific Humidity, Wet and dry bulb temperature.	8
Total			**40**

4. Readings

4.1 Textbooks:

1. P.K. Nag, Engineering Thermodynamics, TMH Publishers
2. J. Selwin Rajadurai, Thermodynamics & Thermal Engineering, New Age International Publishers

4.2 Reference Books:

1. C.P. Arora, Thermodynamics, TMH Pub.
2. D.S. Kumar, Thermal Science & Engineering, S.K. Kataria & Sons
3. S.C. Gupta, Thermodynamics, Pearson Education
4. Cengal & Boles, Thermodynamics- An Engineering Approach, Mc Graw Hill
5. K. Ramakrishna, Engineering Thermodynamics, Anuradha Agencies

5. Outcome of the Course:

1) Understanding thermodynamics and its applications.
2) Understand the applications of thermodynamics is systems.
3) Understanding of Turbine, IC engines and latest automobile technologies.
4) Understand the Applied Mechanics, Refrigeration and Air conditioning.

Design of Machine Elements

1.1 Course Number- ME215
1.2 Contact Hours- 3-1-0 Credits: 11
1.3 Semester Offered- 2nd Year Even
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:

1. Enable students to attain the basic knowledge required to understand, analyze, design and select machine elements required in transmission systems.
2. Impart design skills on static load and variable load problems.
3. Understand the working and function of each machine element and their uses in machinery.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Design against static & variable loads**	Selection of Materials, Design Stress, Factor of Safety, Stress concentration factor in tension, bending and torsion, Theories of failures. Notch sensitivity, Design for variable and repeated loadings, Fatigue stress concentration factor, Endurance diagrams, Introduction to fracture mechanics.	9
2	**Basic Elements Design**	Types of keys and Splines, Design of Socket-Spigot, Cotter joint, Sleeve and Cotter joint, Gib and Cotter joint, Design of Knuckle joint, Design of Splines. **Couplings:** Types of couplings, Design of flange and flexible couplings, Compression coupling, Muff coupling. **Shaft and Axles:** Transmission shaft, Design against static load, Design for strength, Rigidity and stiffness, Design under continuous loading for fatigue.	9
3	**Threaded fasteners**	Geometry of thread forms, Terminology of screw threads and thread standards, Specifications of steel bolts, Initial tension, Relation between bolt tension and torque, **Power Screws:** Power screws, Collar friction, Stresses in screw, Coefficient of friction, Efficiency of thread.	9
4	**Riveted & Welded Joints**	Types of rivet heads, Types of riveted joints, Failure of riveted joint, Strength of rivet joint, Efficiency of riveted joint, Design of riveted joint, eccentrically loaded riveted joint. Types of welded joints, Stresses in butt and fillet welds, Strength of welded joints, Location and dimension of weld design, eccentrically loaded joint, welded joint subjected to bending moment, Design procedure, Fillet welds under	9

		varying loads, Stress relieving techniques.	
5	**Pulley & Flywheel**	Flywheel Inertia, Stresses in Flywheel and pulleys, failure criterion. **Chain Drives:** Chain drives, Roller chains, Geometric relationships, Dimensions of chain components, Polygonal effect, Power rating of roller chains, Selection of Chain drives. **Belt & Rope Drive:** Design of Flat and Round belt drives, V-Belt, Timing belt, Wire Rope.	9
Total			**45**

4. Readings

4.1 Textbooks:

1. V.B. Bhandari,Design of Machine Elements, McGraw HILL Publications. 3rd edition,
2. K. Mahadevan / K.Balveera Reddy, Design Data Handbook for mechanical engineers, CBS publication, 4th Ed.,2013
3. Design of Machine Elements by V.B. Bhandari, McGraw HILL Publications. 3rdedition

4.2 Reference Books:

1. M.F Spotts, T.E Shoup, L.E. Hornberger, S.R Jayram and C V Venkatesh, Design of Machine Elements, 8th Ed., Person Education.
2. V. B. Bhandari, Design of Machine Elements, 2nd Ed., Tata Mcgraw Hill.
3. R. C. Juvinall and K. M Marshek, Fundamentals of Machine Component Design, 3rd Ed., Wiley Student Edition

5. Outcome of the Course:

1) Apply the knowledge of Indian Standard codes and engineering fundamentals of material selection and manufacturing considerations in design.
2) Design various members such as beams, levers, laminated springs for bending and stiffness.
3) Design various machine components under torsion such as shafts, shaft couplings, and keys.
4) Design various threaded fasteners, power screws and curved machine components.

Manufacturing Technology-II

1.1 Course Number- ME214
1.2 Contact Hours- 3-1-0 Credits: 11
1.3 Semester Offered- 2nd Year Even
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) Understand the importance, types, and important parameters in machining processes.
Study various types of cutting machines and mechanisms used to achieve cutting motion.
Learn about versatile machining processes, nomenclatures, tools motion and their applications (including milling, abrasive process, broaching)
ii) Learn basic CNC programming and usefulness in automation.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Theory of Metal Cutting**	Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.	8
2	**Turning Machines**	Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi automatic – single spindle : Swiss type, automatic screw type – multi spindle:	8
3	**Shaper, Milling and Gear Cutting Machines**	Shaper – Types of operations. Drilling, reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears.	7
4	**Abrasive Process and Broaching**	Abrasive processes: grinding wheel – specifications and selection, types of grinding process–cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications– concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines.	8
5	**CNC Machining**	Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC –manual	7

		part programming –micromachining – wafer machining.	
Total			**38**

4. Readings

4.1 Textbooks:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters 2014
2. Rao. P.N “Manufacturing Technology - Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013.

4.2 Reference Books:

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White “Machine Tool Practices”, Prentice Hall of India, 1998
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 1984
3. HMT, "Production Technology", Tata McGraw Hill, 1998.
4. Roy. A.Lindberg, “Process and Materials of Manufacture,” Fourth Edition, PHI/Pearson Education 2006.

5. Outcome of the Course:

1) Describe the geometry of single-point tools, the idea of oblique and orthogonal cutting, and the heat effects of metal cutting.
2) Adapt Taylor's tool life concepts and the Merchant narrow shear plane model of metal cutting to the particular issue at hand.
3) Calculate the machining time for turning, shaping, and milling operations and describe the constructional details, operating principles, and operations carried out on ordinary and special purpose machine tools.
4) Describe the various grinding techniques as well as the honing, lapping, and superfinishing procedures.
5) Explain the principles at work in the various high-velocity forming techniques.

Mechatronics and Industrial Automation

1.1 Course Number- ME216
1.2 Contact Hours- 3-0-0 Credits: 9
1.3 Semester Offered- 2nd Year Even
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) Recognize essential Mechatronics system components and depict them in the block diagram
ii) Comprehend the idea of the transmission elements, sensors, and actuators.
iii) Have knowledge of mechanical applications for electronic gadgets.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	Definition of Mechatronics, Multi-disciplinary scenario, origins. Evaluation of Mechatronics, an overview of mechatronics. Design of mechatronics system. Measurement system and function of main elements of measurement systems. Need for mechatronics in industries. Objectives, advantages and disadvantages of mechatronics. Microprocessor based controllers. Principle of working of automatic camera, engine management system, automatic washing machine. **Review Of Transducers and Sensors:** Definition and classification of transducers. Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall effect sensors.	8
2	**Elements of CNC Machines**	Structure, guide ways – Friction, Autifriction and Frictionless guide ways, Merits and demerits. Drives – Recirculating ball screw and nut. Advantages and disadvantages over conventional screw and nut. Concept of stick-slip phenomenon, Concept of preloading of ball nuts.Roller screw- planetary roller screw recirculation roller screw. Spindle and spindle bearings in machine tool. Various types of loads encountered by spindle and spindle bearing. Types of bearings – friction, antifriction and frictionless bearing. Merits and demerits of each. Selection of spindle and spindle bearing, preloading of bearings, different method of preloading in detail.	8
3	**Electrical Actuators**	Actuator and actuator system. Classifications of actuator system with examples. Mechanical switches, Concept of bouncing Methods of Preventing bouncing of mechanical	7

		switches. Solenoids, Relays. Solid state switches – Diodes, Thyristors, Triacs, Transistors, Darlington pair. Electrical actuator. Principle, construction and working of AC, DC motors, stepper motors, permanent magnet motors, servomotors, Servo systems and control.	
4	**Hydraulic Actuators**	Valves, Classification, Pressure Control valves-Pressure relief valves, Pressure regulating/reducing valves, Pressure sequence valve. Flow control valves – principle, needle valve, globe valve. Direction control valve-sliding spool valve, solenoid operated. Symbols of hydraulic elements. Hydraulic cylinders – constructional features, classification and applications. Hydraulic motors – Types, vane motors and piston	7
5	**Signal Conditioning**	Concept, necessity, op-amps, protection, filtering, wheat stone bridge digital signals- Multiplexer. Data acquisition-Introduction to digital signal processing-Concepts and different methods.	6
Total			**36**

4.Readings

4.1 Textbooks:

1.W. Bolton, Longman, Mechatronics, 2Ed, Pearson Publications.
2. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi

4.3 Reference Books:

1. G.W. Kurtz, J.K. Schueller, P.W. Claar. II, Machine design for mobile and industrial applications, SAE.
2. T.O. Boucher, Computer automation in manufacturing - an Introduction, Chappman and Hall.
3. Mechatronics, Intl. J. published by Pergamon Press

5. Outcome of the Course:

1) Students able to implement automation in simple mechanical processes.
2) Students able to clarify the function of transducers, actuators, and electrical motors.
3) Students able to construct fluid power circuits for various processes.

Workshop Technology Laboratory

1.1 Course Number- ME218L
1.2 Contact Hours- 0-0-3 Credits: 3
1.3 Semester Offered- 2nd Year Even
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 get acquainted with various carpentry and machine tools
ii) To learn hands-on manufacturing of wood turning items
iii) To learn to use milling, shaping, drilling, grinding machines and motorized hacksaw

3. Course Content:

Unit-wise distribution of content and number of Lab Sessions

Unit	Topics	Experiments	Lab Sessions
1	**Carpentry Shop**	Introduction and practice of Wood Turning Lathe operation along with a job preparation.	2
		Introduction and practice of wood Surface Planner operation along with a job preparation.	1
		Introduction and practice of wood sawing operations (circular & jig saw) along with a job preparation.	1
		Introduction and practice of wood grinding operation along with a job preparation.	1
		Introduction and practice of wood Disc Sander operation along with a job preparation.	1
		Study of different carpentry tools	1
2	**Machine Shop**	Introduction and practice of Shaper machining operation along with a job preparation.	1
		Introduction and practice of milling machining operation along with a job preparation	1
		Introduction and practice of drilling machining operation along with a job preparation	1
		Introduction and practice of grinding machining operation along with a job	1

		preparation	
		Introduction and practice of motorized hacksaw machining operation	1
Total			**12**

4. Readings

4.1 Textbooks:

1. P.N. Rao, Manufacturing Technology (Vol. - I & II), Tata McGraw Hill Pub. Company, New Delhi
2. P.C. Sharma, A Text Book of Production Technology (Manufacturing Processes & Technology), S. Chand and Company Ltd., New Delhi.

4.2 Reference Books:

1. Serope Kalpakjian & Schmid, Manufacturing Engineering and Technology, Pearson Education, Delhi.
2. Kibbe Richard R – PHI, Machine Tool Practices, New Delhi.

5. Outcome of the Course:

1) To be able to identify the common carpenter's tools
2) To be able to fabricate a workpiece using any of the following machines: milling machine, twist drill, grinding wheel and motorized hacksaw

Semester V

Pipe Hydraulics and Hydraulic Machinery

1.1 Course Number- ME301
1.2 Contact Hours- 3-0-0 Credits: 9
1.3 Semester Offered- 3rd 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) This course offers basic knowledge on fluid statics, dynamics and hydraulic machines.
ii) To enable the student to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Flow through Channel**	Open Channel Flow - Uniform Flow Introduction, Classification of flows, Types of channels; Chezy, Manning's, Bazin, Kutter's Equations; Hydraulically efficient channel sections - Rectangular, Trapezoidal and Circular channels; Velocity distribution; Energy and momentum correction factors; Pressure distribution.	8
2	**Turbines**	Momentum Principles Action of jets on stationery and moving flat plates and curved vanes; Angular momentum principle; Torque in roto dynamic machines. Hydraulic Turbines Classification; Impulse; Reaction; Radial, Axial, mixed and tangential flow turbines; Pelton, Francis turbines; Runner profiles; Velocity triangles; Head and efficiency; Draft tube theory; Selection of Turbines; Operational characteristics.	10
3	**Centrifugal Pumps**	Manometric head; Losses and efficiencies; Work done; Working Principle; Priming; Velocity triangles; Performance and characteristic curves; Cavitation effects; Dimensionless numbers: Reynold's, Froude, Euler, Mach and Weber numbers.	8
4	**Pipe Hydraulics**	Flow through pipes, Various losses when liquid flows through pipes, Laws of fluid friction, The equations for loss of head in pipes due to friction- Darcy's & Chezy's formula (without proof), The function of Siphon, study of pressure head variations at its different sections, minimum pressure at apex and its influence in causing separation (Numerical problems omitted).	8
Total			**34**

4. Readings

4.1 Textbooks:

1. Hydraulics and Fluid Mechanics including Hydraulic Machines by P. N. Modi and S. M. Seth; Standard Book house, New Delhi,2009.

2. Fluid Mechanics and Hydraulic Machines by R. K. Bansal,9th Edition, Laxmi Publications, 2011.

4.2 Reference Books:

1. Fluid Mechanics by A. K. Jain; Khanna Publishers, Delhi, 2008.
2. Flow in Open channels by K. Subramanya, 3rd Edition, Tata McGraw-Hill,2008.
3. Hydraulics & Hydraulic Machinery ByYeaple
4. Hydraulics and Pneumatics ByReya and Rao.

Web References:
www.nptel.iitm.ac.in
www.springerlink.com for e-journals

5. Outcome of the Course:

1) Identify importance of various fluid properties at rest and in transit.
2) Derive and apply general governing equations for various fluid flows
3) Understand the concept of boundary layer theory and flow separation.
4) Plot velocity and pressure profiles for any given fluid flow.
5) Evaluate the performance characteristics of hydraulic turbines and pumps.

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, 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.	7

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, behaviourist 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 Textbooks/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: MT301
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.	10
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.	8
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 (Revenue dominated cash flow diagram, cost dominated cash flow diagram) – Rate of return method – Examples all methods.	8
Total			**26**

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.

Applied Mechanics Laboratory

1.1 Course Number- ME306L
1.2 Contact Hours- 0-0-3 Credits: 3
1.3 Semester Offered- 3rd 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 learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials. Understanding of the fundamental concepts of applying equilibrium, compatibility, and force deformation relationships to structural elements with basic analysis and design skills.
ii) Apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force deformation, and stress-strain relationships to basic engineering structures.
iii) Develop a solid knowledge about deformation of axial members by physical insight into distribution of stresses and strains in structural members by determining stress, strain, and deformation of bars, trusses, and beams, and performing stress and strain transformations.
iv) Basic understanding of the method of superposition, flexibility method, and stiffness method as applied to statically determinate and indeterminate axial and torsional members, thin-walled tubes, bending of beams and buckling of columns.

3. Course Content:

Unit-wise distribution of content and number of Lab Sessions

Unit	Topics	Description	Lab Sessions
1	**Universal Tensile Testing Machine**	Determination of Ductility, Ultimate tensile strength, Elongation at Break, Type of Fracture	2
2	**Hardness Test**	Brinnel hardness test, Rockwell hardness test, Vicker's hardness test	2
3	**Impact Test (Chirpy and Izod)**	Determination of toughness and strength	2
4	**Experimental Mechanics**	Beams, support and reaction of a simply supported beam, Angle of Repose, Moment of Intertia of Flywheel	2
5	**Theory of Machines**	Cam and Governor, Balancing	2
Total			**10**

4.Outcome of the Course:

1) Evaluate the values of yield stress, breaking stress and ultimate stress of the given specimen under tension test.
2) Conduct the torsion test to determine the modulus of rigidity of given specimen.
3) Justify the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.
4) Examine the stiffness of the open coil and closed coil spring and grade them.
5) Analyze the microstructure and characteristics of specimen.

Advanced Workshop Technology Laboratory

1.1 Course Number- ME307L
1.2 Contact Hours- 0-0-3 Credits: 3
1.3 Semester Offered- 3rd 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 using a CNC machine.
ii) To understand the basics of smith forging and sand-casting processes.

3. Course Content:

Unit-wise distribution of content and number of Lab Sessions

Unit	Topics	Sub-Topic	Lab Sessions
1	**CNC Lathe**	Practice of different machining operations in all geared precision Lathe machine.	2
		Introduction and practice of CNC Lathe machining operation along with its coding & job preparation.	2
2	**CNC Milling**	Practice of different machining operations in all geared Universal Milling machine.	2
		Introduction and practice of CNC milling machining operation along with its coding & job preparation.	2
3	**Smithy and foundry shop**	Getting acquainted with various forging tools by practicing various forging operations such as drawing out, upsetting, bending and forge-welding	2
		Preparing a sand casting mould and casting and fettling using metal	2
Total			**12**

4. Readings

4.1 Textbooks:

1) P.N. Rao, Manufacturing Technology (Vol. - I & II), Tata McGraw Hill Pub. Company, New Delhi

2) P.C. Sharma, A Text Book of Production Technology (Manufacturing Processes & Technology), S. Chand and Company Ltd., New Delhi.

4.2 Reference Books:

1) Serope Kalpakjian & Schmid, Manufacturing Engineering and Technology, Pearson Education, Delhi.
2) Kibbe Richard R – PHI, Machine Tool Practices, New Delhi.

5.Outcome of the Course:

1) To be able to write a simple CNC programme for a CNC milling machine or lathe to produce simple items
2) To be able to produce an everyday object by blacksmith's tools
3) To be able to produce a small metal casting using sand moulding.

Departmental Elective/Open Elective

Power Plant Engineering

1.1 Course Number- ME302
1.2 Contact Hours- 3-0-0 Credits: 9
1.3 Semester Offered- 3rd Year Odd
1.4 Prerequisite: NA
1.4 Syllabus Committee members- Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha, Dr Naveen Mani Tripathi, Dr. Karthik Babu NB

2. Objective:

i) To understand the various conventional energy conversion methods
ii) To be able to identity the various component of a conventional power plant
iii) To be able to understand the mechanism of control the power production as per demand

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	General Sources of power, Importance of Central Power Stations, Types of power stations – steam, Nuclear, Diesel and hydro – Elements of modern power stations (Steams only) brief layout and arrangement of elements and complements, Sitting of different power stations, Foundation, Elements of Electric power systems primary and secondary distribution substations (in brief).	4
2	**Steam Power Plant and Steam Generators**	Steam power plants selection of working medium, Heat Balance in steam cycles, Heat rates, Comparison of efficiencies gas loop, Fuels and fuel handling System and Ash handling System, Air pre-heater, Feed water pre-heaters, Steam re-heaters, Dearators, Feed water treatment, Pumping and regulation water walls, Modern developments in steam boilers, Important instrumentation and piping of gas and water loop. Factors to be controlled from maximum efficiency and variable output.	12
3	**Steam Turbine**	Working Principle, Types, Velocity Diagrams, Compounding, Speed Control	10
4	**Hydro Electric Power Station**	Potential power with reference to rainfall and catchments area, Water storage, Equipment used in hydro electric power stations, Characteristics of hydraulic turbines, Comparison of the factors governing the cost of hydro steam and diesel power stations.	4
5	**Nuclear Power Station**	Evolution of nuclear energy from atoms by fission and fusion, Chain reactions, Fission materials, Types of	4

		reactors, gas cooled, Boiling water liquid, Metal cooled and fast reactor, Arrangements of various elements in a nuclear power station, Steam cycles and boilers coolant heat exchangers, Reactor control, Reactor shielding and safety methods.	
6	**Power Plant Economics**	Idealized and realized load curves, Effect of variable load on plant design and operation variable load operation and load dispatch. Source of income, Cost of plant and production, Elements of cost depreciation and replacement theory of rates.	5
Total			**39**

Readings

4.1 Textbooks:

1. P.K. Nag,Power Plant Engineering, 2nd Edn., Tata McGraw-Hill Pub.Com.
2. F.T. Morse Affiliated East ,Power Plant Engineering, West Press Pvt .Ltd

4.2 Reference Books:

1. M.M. E1 – Wakil ,Power Plant Technology , McGraw Hill, International Edition
2. R.Yadav, Fundamental of Power Plant Engineeering, Central Publishing House Allahabad.

5. Outcome of the Course:

1) To be able to calculate the capacity of power production from various system parameters of a power plant.
2) To be able to calculate the cost of power production as from various parameters.

Quality Control and Metrology

1.1 Course Number- ME303
1.2 Contact Hours- 3-0-0 Credits: 9
1.3 Semester Offered- 3rd Year Odd
1.4 Prerequisite: Diploma level Mathematics
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 statistical process control and improvement.
ii) To study measurement systems and Gage R&R.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	1.1 Quality Improvement in the Modern Business Environment: The Meaning of Quality and Quality Improvement, Statistical Methods, Management Aspects. 1.2 The DMAIC Process: Overview and Examples of DMAIC Process, Concept of Six-Sigma Process Quality.	6
2	**Modeling Process Quality**	2.1 Describing Variation: The Stem-and-Leaf Plot, The Histogram, Numerical Summary of Data, The Box Plot, Probability Distributions. 2.2 Important Distributions: Discrete and Continuous Probability Distribution Functions (PDFs). 2.3 Probability Plots: Normal and Other Probability Plots.	6
3	**Statistical Process Control (SPC)**	3.1 Methods and Philosophy: Chance and Assignable Causes of Quality Variation, Statistical Basis of the Control Chart, The Rest of the Magnificent Seven, Implementing SPC in a Quality Improvement Program. 3.2 Control Charts for Variables: Control Charts for $\bar{x}$ and R, The Shewhart Control Chart for Individual Measurements, Applications of Variables Control Charts. 3.3 Control Charts for Attributes: The Control Chart for Fraction Nonconforming, Control Charts for Nonconformities (Defects), Choice Between Attributes and Variables Control Charts, Guidelines for Implementing Control Charts.	12

4	**Process Capability Analysis**	4.1 Process Capability Analysis: Using the Histogram, Probability Plotting. 4.2 Process Capability Ratios: Centered and Off-Centered Processes, Normality and Process Centering. 4.3 Process Capability Analysis: Using Control Charts and Attribute Data.	6
5	**Engineering Metrology**	1.1 Introduction: Bias and Variance, Accuracy and Precision, General Measurement Concepts, Calibration of Measuring Instruments, Difference between Systematic and Random Errors. 1.2 Measurement Systems: Definition of Hysteresis, Linearity, Resolution, Threshold and Drift; Gauge Repeatability and Reproducibility (Gage R&R). 1.3 Linear and Angular Measurements: Difference between Line and End Measurements.	9
Total			**39**

4. Readings

4.1 Reference Books:

1. Montgomery, Douglas C. Statistical quality control. Vol. 7. New York: Wiley, 2009.
2. L. Krishnamurthy. Engineering metrology and measurements. Oxford University Press, 2013.

5. Outcome of the Course:

1) Understand the meaning of quality and quality improvement.
2) Knowledge of six-sigma process quality.
3) Describe variation in data and various PDFs.
4) Understand control charts for variable and attributes.
5) Define process capability ratios for centered and off-centered processes.
6) Differentiate between bias and variance & accuracy and precision.
7) Study techniques used in linear and angular measurements.

Offshore and Cross-Country Pipeline

1.1 Course Number- ME304
1.2 Contact Hours- 3-0-0 Credits: 9
1.3 Semester Offered- 3rd 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 develop skills to understand the basic fundamental of Pipeline Engineering principles.
ii) To enable the students to understand the various defects that are observed in maintenance of pipelines & corrective actions required to correct the deficiencies and subsequently identifying pipeline risk, its estimation & evaluation.
iii) To enable students to relate the reasons for various types of external & internal corrosion occurring in cross country pipelines and requirement of surface protection.
iv) Setting up the requirement for intelligent pigging to evaluate the corrosion occurring in pipelines.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Overview of offshore structures**	Introduction- Deepwater challenges- Functions of offshore structures- Offshore structure configurations- Bottom-Supported fixed structures- Compliant structures- Floating structures- Classification societies and industry standard groups.	5
2	**Novel and small field offshore structures**	Introduction- Overview of oil and gas field developments- Technical basis for developing novel offshore structures- Other considerations for developing novel offshore structures- Novel field development systems- Future field development options.	7
3	**Ocean environment**	Introduction, Ocean water properties- Airy's Wave theory, Wave kinematics along the depth of water.	6
4	**Elements of pipeline design**	Fluid properties, Environment - Effects of pressure and temperature - Supply/Demand scenario - Route selection - Codes and standards - Environmental and hydrological considerations – Economics - Materials/Construction – Operation - Pipeline protection - Pipeline integrity monitoring	8

5	**Receiving Terminals**	Receiving terminals in India – Main components and description of marine facilities – Storage capacity – Process descriptions.	5
6	**Petroleum or Oil & Gas Policies and Regulations**	Petroleum and Oil & Gas rules and regulations in India, The Oil fields regulations and development Act, New Exploration Licensing Policy (NELP), Functions of directorate general of hydrocarbons, Petroleum and Natural Gas Regulatory Board.	8
	Total		**39**

4. Readings

4.1 Textbooks:

1. Handbook of offshore engineering, S. K. Chakrabarti, Volume 1 & 2, Elsevier, 2005.
2. Hydrodynamics of offshore structures, S. K. Chakrabarthi, WIT Press. 3. Matrix methods of structural analysis, P. N. Godbole, R. S. Sonparote, S. U. Dhote, PHI Learning Private Limited, 2014.

4.2 Reference Books:

1. Structural Analysis: A Matrix Approach, G.S. Pandit and S.P. Gupta, 2nd Edition, Tata McGraw-Hill Education, 2001.
2. Ship Stability for Masters and Mates, Barrass, C. B. and D. R. Derret, 7th Edition, Butterworth-Heinemann, 2012.
3. Construction of Marine and Offshore Structure, Gerwick, Jr., C., 3rd Edition, CRC Press, 2007.

5. Outcome of the Course:

1) Should be able understand various construction steps of pipeline Construction, Project Management with knowledge of welding techniques.
2) Should be able to identify pipeline repair & rehabilitation methods for various leaks, Codes for repair, Maintenance procedures. PMP act.
3) Should have clear knowledge of metering, Storage and Calibration of products storage, line fill calculation and reconciliation, storage facilities,
4) Categorize various systems of SCADA for pipeline operation and Pipeline operation & scheduling.
5) Should be able to address various types of prime movers used in pipeline industry in stations for liquid LPG and Gas transportation CO
6) Should be able to address requirement of various Electrical Systems in pipelines and safety of installation.

Industrial Engineering and Management

1.1 Course Number- ME305
1.2 Contact Hours- 3-0-0 Credits: 9
1.3 Semester Offered- 3rd Year Odd
1.4 Prerequisite: Diploma level Mathematics
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 work system design associated with industrial engineering.
ii) To study production, planning and control (PPC) corresponding to industrial management.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction, Plant Location and Layout**	1.1 Introduction: Definition of Industrial engineering, History & development, Objective of Industrial Engineering, Contribution of Industrial Engineering, Function of Industrial engineer, Place of Industrial engineering in an organization. 1.2 Plant Location: Need for a suitable location, Urban, Suburban, Systems approach, Factors affecting location, Quantitative method for evaluation of plant location. 1.3 Plant Layout: Objectives & Principles of plant layout, Types of layout and their suitability, Software packages for layout analysis.	6
2	**Work, Method and Time Studies**	2.1 Work Study: Productivity and work study, Introduction and definition of Work-study, Prerequisites of conducting a work study. 2.2 Method Study: Introduction, definition, procedure, Recording techniques, Flow Process Charts, Critical examination by questioning technique, man-machine chart, Motion economy principles, Micro motion study – Therbligs. 2.3 Time Study: Definition, Objectives, Techniques of Work measurement, Selection & timing the job, Rating, Allowances, Normal and standard time determination, Work sampling.	9
3	**Value Analysis and Project Scheduling**	3.1 Value Analysis: Definition, Objectives and use of value analysis, Application & techniques. 3.2 Project Scheduling: Network analysis, Critical path	9

		method (CPM), Program evaluation and review techniques (PERT), Comparison between CPM and PERT.	
4	**Maintenance Management and Inventory Control**	4.1 Maintenance Management: Objectives and need for maintenance, Types of maintenance, Maintenance costs, Failure analysis, Overall equipment effectiveness (OEE), Total productive maintenance (TPM). 4.2 Inventory control: Deterministic models, safety stock inventory control systems.	9
5	**Ergonomics and New Industrial Engineering**	5.1 Ergonomics: Introduction to ergonomics and its application. 5.2 Information Technology (IT): Role of IT in Industry, increasing value of Information Technology, IT as a New Business tool, IT as Business Enabler, IT as business driver, Internet worked enterprise, Internet, Intranet and Extranet, Globalization and IT, Competitive advantage with IT. 5.3 Business Process Re-Engineering (BPR): Definition, Need & characteristics, Industrial Engineering & BPR, Framework for Re-engineering, Process of Re-engineering, Information Technology leverage in BPR, advantages of Re-engineering.	6
Total			**39**

4. Readings

4.1 Reference Books:

i) Martand Telsang, Industrial Engineering and Production Management, S Chand & Company.
ii) Philip E Hicks, Industrial Engineering & Management –A new perspective, McGraw Hill.

5. Outcome of the Course:

1) Understand need for suitable plant location and layout.
2) Understand work, method and time studies.
3) Apply value analysis and engineering.
4) Differentiate between CPM and PERT.
5) Knowledge of predictive and corrective maintenance schemes.
6) Define OEE and TPM.
7) Knowledge of inventory control methods.
8) Apply knowledge of ergonomics.
9) Role of IT on industrial engineering and management.
10) Define and characterize BPR.