Curriculum and Syllabus

Bachelor of Technology

in

Instrumentation Engineering

(Applicable for 2026-27 batch and onwards)

Department of Instrumentation Engineering
School of Engineering and Technology,
H. N. B. Garhwal University,
Srinagar Garhwal, Uttarakhand- 246174

Curriculum

General Instructions

Mandatory Induction Program

3 weeks duration
• *Physical activity* • *Creative Arts* • *Universal Human Values* • *Literary* • *Proficiency Modules* • *Lectures by Eminent People* • *Visits to local Areas* • *Familiarization to Dept./Branch & Innovations*

Induction program for students is to be offered right at the start of the first year. Appendix –I sheet has attached for details.

1. **Code for Courses:**

   Code for a course consists of two alphabets followed by three digits and an optional alphabet.
   - First three alphabets represent the school name (SET: School of Engineering and Technology).
   - Next two alphabets in the code represent the subject area of the course, e.g., BS: Basic Science, EC: Electronics and Communication Engineering, IE: Instrumentation Engineering, ME: Mechanical Engineering, CS: Computer Science and Engineering, IT: Information Technology.
   - Next two alphabets in the code represent the name of program, e.g., BT: B. Tech., MT: M. Tech.
   - Then there will be subject code with 4 letters out of which first will tell the nature of subject(C: Core/ E: Elective/ S: Skill) and next three letters will tell the number according to the semester (for example 801 will tell its 8th semester subject). First digit represents the semester. Next two digits represent the sequence number of course in the list of courses of a semester.

2. For the slow learners, a remedial class of 1 hr., on each working day shall be conducted.

All the courses and course titles are subject to change at any stage as per directions of Authorities of the University.

Semester-wise List of Subjects(As per NEP 2020)

Semester I

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	Basic Science	SET/BS/BT/C101	Mathematics I	3	-	-	3	3
2		SET/BS/BT/C102	Physics	3	-	-	3	3
3		SET/BS/BT/C103	Physics Lab	-	-	1	2	1
4		SET/BS/BT/C104	Information Science	2	-	-	2	2
5	Humanities & Social Science		Communication Skill	3	-	-	3	3
6			Disaster Management	3	-	-	3	3
7	Engineering Science	SET/IE/BT/C105	Basic Electrical Engineering	3	-	-	3	3
8		SET/EC/BT/C106	Basic Electronics	3	-	-	3	3
9	Engineering Science (Skill)	SET/IE/BT/S107	Basic Electrical Engineering Lab	-	-	1	4	2
10	Mandatory Course		*Understanding and Connecting with Environment	-	-	-	-	-
Total				20	-	2	26	23

*Common syllabus for all UG courses of the university.

Semester II

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	Basic Science	SET/BS/BT/C201	Mathematics II	3	-	-	3	3
2		SET/BS/BT/C202	Chemistry	3	-	-	3	3
3		SET/BS/BT/C203	Chemistry Lab	-	-	1	2	1
4		SET/BS/BT/C204	Engineering Mechanics	2	-	-	2	2
5	Humanities & Social Science		Mental Health & Wellbeing	3	-	-	3	3
6	Engineering Science	SET/ME/BT/C205	Basic Mechanical Engineering	3	-	-	3	3
7		SET/CS/BT/C206	Problem Solving and Programming in C	3	-	-	3	3
8		SET/CS/BT/C207	Problem Solving and Programming in C Lab	-	-	1	2	1
9		SET/ME/BT/C208	Engineering Graphics and Workshop Practice	-	-	1	4	2
10	Engineering Science (Skill)	SET/EC/BT/S209	Basic Electronics Lab	-	-	1	4	2
11	Mandatory Course		*Life Skills & Personality Development	-	-	-	-	-
Total				17	-	4	29	23

*Common syllabus for all UG courses of the university.

Entry/Exit Option with Under Graduate Certificate in Instrumentation Engineering, may be allowed after completion of the 1st year, and as per requirements defined in the admission procedure and eligibility of the school.

Detailed Syllabi

Semester I

S. No.	Category	Course Code	Course Title	TA	CT	TOT	ESE	SUB. TOTAL
1	Basic Science	SET/BS/BT/C101	Mathematics I	10	20	30	70	100
2		SET/BS/BT/C102	Physics	10	20	30	70	100
3		SET/BS/BT/C103	Physics Lab	30	-	30	70	100
4		SET/BS/BT/C104	Information Science	10	20	30	70	100
5	Humanities & Social Science		Communication Skill	30	-	30	70	100
6			Disaster Management	30	-	30	70	100
7	Engineering Science	SET/IE/BT/C105	Basic Electrical Engineering	10	20	30	70	100
8		SET/EC/BT/C106	Basic Electronics	10	20	30	70	100
9	Engineering Science (Skill)	SET/IE/BT/S107	Basic Electrical Engineering Lab	30	-	30	70	100
10	Mandatory Course		*Understanding and Connecting with Environment	-	-	-	-	-

*Common syllabus for all UG courses of the university.

TA - Teacher's Assessment, CT - Class Test, TOT - Total, ESE - End Semester Examination.

SET/BS/BT/C101. MATHEMATICS I		
Course Objective	To provide essential knowledge of basic tools of Differential Calculus, Vector Calculus and Matrix Algebra for engineering students.	
Course Outcome	Implementation of calculus in designing the different structural and mechanical components while matrix algebra is applied in the study of electrical circuits, quantum mechanics and optics.	
Module Name	**Content**	**No. of Teaching Hrs.**
Differential Calculus	Limit, continuity and differentiability of single and two variables, mean value theorems, indeterminate forms; partial derivatives, total derivative, Euler's formula, Taylor series (in one and two variables), maxima and minima, Extrema of function of several variables, Lagrange's method.	**15**
Vector Calculus	Interpretation of vectors and scalars, directional derivatives, line, surface and volume integrals, gradient, divergence and curl of a vector and their physical interpretation, Gauss's divergence, Green's and Stoke's theorem.	**12**
Matrices	Vector space, basis, matrices, determinants, Elementary row and column transformation, linear dependence and independence, rank of matrix, consistency of system of linear equation and solution of linear system of equations. Characteristic equation, Cayley-Hamilton theorem, eigen values and eigen vectors, diagonalization, complex matrices.	**15**
	Total No. of Teaching Hours	**42**
Textbooks	1. R. K. Jain and S. R. K. Iyengar "Advanced Engineering Mathematics", Narosa Publications. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers. 3. H. K. Das, "Advanced Engineering Mathematics", S Chand. 4. Erwin Kreyszig, "Advanced Engineering Mathematics".	

SET/BS/BT/C102. PHYSICS		
Course Objective	1. To introduce the student to the basic of wave optics, lasers, and demonstrate their applications in technology. 2. To make students aware about quantum physics phenomena. 3. Give the beginning student an appreciation of recent developments in materials science &engineering within the framework of this class. 4. To review physics in the context of materials science & engineering. 5. Give an introduction to the relation between processing, structure, and physical properties. 6. To make the students aware about Electromagnetic wave fundamentals.	
Course Outcome	1. Demonstrate interference, diffraction and polarization of light and explain the working principle of Lasers. 2. Student will understand quantum mechanical aspects of physics. 3. Enable to explain the phenomenon of crystal structure and crystallographic, qualitatively description of X-ray diffraction and its general physical properties, as well as possible applications. 4. Students will understand the phenomenon of defects in solids and their physical properties, band theory of solids and classification of energy bands, electric and magnetic properties of solids and able to explain qualitative idea of superconductivity in materials. 5. This will enable the students to learn physical concepts associated with electromagnetic radiation and devices. 6. Use Maxwell's equations to describe propagation of EM waves in a medium.	
Module Name	**Content**	**No. of Teaching Hrs.**
Optics	Interference: Coherent Sources, Conditions of Interference, Fresnel's Biprism Experiment, Interference in Thin Films, Newton's Rings; Single and n-Slit Diffraction, Diffraction Grating, Raleigh's Criterion of Resolution, Resolving Power of Telescope, Phenomenon of Double Refraction, Ordinary and Extra-ordinary Rays, Nicol Prism, Circularly and Elliptically Polarized Light, Fresnel Theory, Optical Activity, Specific Rotation; Laser: Principle of Laser Action, Einstein's Coefficients, Construction and Working of He-Ne and Ruby Laser, Applications of Laser.	**15**
Origin of Quantum Mechanics and its Applications	Black body radiation, Planck's Radiation Law, Wave Particle Duality, de-Broglie hypothesis, Photoelectric effect, Wave Function and its Normalization, Born Interpretation, Schrodinger equation, Particle in a Box, Potential Step (E < Vo), Tunneling effect (Qualitative idea).	**10**
Basics Material Science	Introduction to crystal structure of materials, Miller indices for crystallographic planes and directions. Diffraction of X-Rays, Bragg's Law, Determination of crystal structure using X-rays Diffraction and its applications. Defects in solids: point, line and planar defects and their effect on properties of materials. Band theory of solids, conductors, semi-conductors and insulators, metals. Fermi Level. Magnetism: dipole moments, paramagnetism, Curie's law, magnetization and hysteresis, Ferromagnetism and Anti-Ferromagnetism. Ferro electricity and Piezoelectricity. Superconductivity in materials.	**15**
Electromagnetics	Ampere's Law and Displacement Current, Maxwell's Equations in Integral and Differential Forms, Electromagnetic Wave Propagation in Free Space and Conducting Media, Poynting Theorem.	**8**
	Total No. of Teaching Hours	**48**
Textbooks	1. Gaur, Gupta, "Engineering Physics". 2. Callister W.D., "Materials Science and Engineering: An Introduction", 6th Edition, John Wiley & Sons Inc., New York 2002.	
References	1. J. R. Taylor, C. D. Zafiratos and M. A. Dubson, "Modern Physics for Scientists and Engineers", 2nd Pearson. 2. Arthur Beiser, "Concepts of Modern Physics", 6th Ed., TMH, (2009). 3. D. J. Griffith: Electrodynamics. 4. Charles Kittel, Introduction to Solid State Physics. 5. S. O. Pillai, Solid State Physics. 6. Ajoy Ghatak, Optics.	

SET/BS/BT/C103. PHYSICS LAB		
Course Objective	To make students aware about experimental verification behind the theory, familiarize the student to the basic of spectroscopy, lasers, and semiconductor lab experiment and demonstrate their applications. Give the brief introduction about the Planck's constant, Hall Effect, Ohm's law, Thomson's experiment, conversion of Galvanometer to Voltmeter and Ammeter and unknown resistance using post office box.	
Course Outcome	1. After Demonstration the student will able to perform the experiment and learn about the practical knowledge of various theory part. 2. Student will enable to find the refractive index of material, wavelength of monochromatic source of light. 3. Enable to find the efficiency of electric kettle, band gap of materials, behaviour of semiconductor, charge density and hysteresis curve in ferromagnetic materials.	
Sr. No.	**Experiments**	**No. of Hrs.**
1.	To determine refractive index of glass and liquid using spectrometer.	1x2
2.	To determine the wavelength of spectral lines using plane diffraction grating (Use Hg source).	1x2
3.	To determine the wavelength of sodium light by Newton's Ring method.	1x2
4.	To measure an accessible (Horizontal and vertical) height using sextant.	1x2
5.	Determination of wavelength of He-Ne laser using single slit /N slit diffraction pattern.	1x2
6.	To study the photoelectric effect and determine the value of Planck's constant.	1x2
7.	To determine the heating efficiency of an electric kettle with varying voltage.	1x2
8.	To Determine the wavelength of the semiconductor diode laser.	1x2
9.	Measurement of forward/reverse saturation current in p-n-junction diode at various temperatures and to find the approximate value of energy gap.	1x2
10.	To study the Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material.	1x2
11.	To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility.	1x2
12.	Measurement of e/m of electron e/m- Thomson's Experiment.	1x2
13.	To verify Ohm's law.	1x2
14.	Conversion of Galvanometer into Voltmeter and Ammeter.	1x2
15.	To determine the unknown resistance by a post office box.	1x2
	Total No. of Hours	**30**
References	1. Practical Physics, C. L. Arora, S. Chand & Co. 2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd. 3. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House. 4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers. 5. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.	

SET/BS/BT/C104. INFORMATION SCIENCE		
Course Objective	The course aims to: 1. Introduce students to the fundamental concepts, scope and applications of Information Science. 2. Its relationship with Computer Science, Information Technology and Information Systems. 3. Develop an understanding of data, information, and knowledge including the collection, organization, processing, storage, retrieval and dissemination of information. 4. Develop the ability to understand and apply basic concepts of databases, metadata, information retrieval and information management. 5. Familiarize students with Information Systems and digital information resources, including their applications in education, business, healthcare, e-governance and other domains. 6. Create awareness about information security, privacy, ethics and emerging technologies.	
Course Outcome	After successful completion of the course student will able to: 1. Explain the fundamental concepts, scope and applications of Information Science 2. Understand and analyze the relationship among data, information, and knowledge. 3. Apply basic principles of databases, metadata and information retrieval. 4. Analyze Information Systems and their applications in different domains. 5. Evaluate information sources and use digital tools for effective data processing and analysis. 6. Demonstrate awareness of information security, privacy and ethics.	
Module Name	**Content**	**No. of Teaching Hrs.**
Unit I	Definition, nature, scope and evolution of Information Science; relationship between Information Science, Computer Science and Information Technology; Information as a resource; Characteristics and importance of information; Information life cycle; Types and sources of information; Data, Information, Knowledge and Wisdom (DIKW) hierarchy; Information needs and information users.	**7**
Unit II	Concepts of data and information; Data representation and organization; Structured, semi-structured and unstructured data; Data collection, validation, processing and storage, Introduction to databases and DBMS; Metadata and information organization; Basic concepts of data analytics and visualization.	**7**
Unit III	Binary, Hexadecimal Number System; Basic Binary Logic Operations; Binary Addition and Subtraction, Definition of Electronic Computer, Computer Hardware and Basic Computer Organization, Various I/O devices, Peripherals, Storage Media.	**7**
Unit IV	Concept, components and types of Information Systems; Information retrieval and search systems; Information and communication technologies; Internet, HTML, FTP, Web browsers, search engine, Email, IoT; Cloud Computing; AI, GenAI, LLM. Applications of Information Science in e-Governance, e-Commerce, education, healthcare, business and digital society; Information security, privacy, ethics and responsible use of information.	**7**
	Total No. of Teaching Hours	**28**
Textbooks	1. Sinha, Sinha, “Computer Fundamentals”. 2. Yadav R.P., “Information Technology”.	
References	1. D.S. Yadav, “Foundations of IT”, New Age, Delhi. 2. Rajaraman, “Introduction to Computers”, PHI. 3. Peter Nortans “Introduction to Computers”, TMH. 4. Patterson D.A. & Hennessy J.L., "Computer Organization and Design", Morgan Kaufmann Publishers.	

SET/IE/BT/C105. BASIC ELECTRICAL ENGINEERING		
Course Objective	1. To impart basic knowledge of electrical quantities and provide working knowledge for the analysis of DC and AC circuits. 2. To understand the construction and working principle of DC and AC machines. 3. To understand the construction and working principle of various instruments. 4. To understand the construction and working principle of 3- phase supply system.	
Course Outcome	1. Understand the basic electric and magnetic circuits. 2. Analyze DC and AC circuits. 3. Interpret the construction and working of different types of electrical machines and instruments. 4. Analyze basic electrical components and circuits.	
Module Name	**Content**	**No. of Teaching Hrs.**
DC Networks	Concepts of linear, nonlinear, active, passive, unilateral and bilateral elements; Ideal and practical voltage & current sources, conversion from one from the other; Kirchhoff's laws, statements; Mesh Analysis; Nodal Analysis; Delta-Star & Star-Delta conversion; Superposition principle; Thevenin's theorem, statement, advantages in case of complex networks; explanation & illustration with examples; Norton's theorem, Maximum power transfer theorem, Reciprocity Theorem and its application.	**10**
Single Phase AC Circuits	Generation of single phase AC voltage and determination of average (mean) and RMS (effective) values of voltage and current with special reference to sinusoidal waveforms; Form factor and peak factor for various waves; Representation of sinusoidal time varying quantities as phasors; concepts of reactance, impedance and their representation in complex forms using j operator; Steady state analysis of series R-L-C circuit & its phasor diagram; Concept of power & power factor; Concept of admittance, susceptance in parallel circuits; Analysis of series parallel circuits &phasor diagrams; Resonance in series and parallel circuits.	**10**
Three Phase Circuits	Generation of 3-phase balanced sinusoidal voltage; star & delta connections; line & phase quantities (current & voltage); Solution of 3-phase star/delta circuits with balanced supply voltage and balanced load; phasor diagram; 3-phase, 4-wire circuits; Measurement of three phase power by two wattmeter method; phasor diagram with balanced load and determination of load power factor from wattmeter readings.	**6**
Transformers and Rotating Machines	Transformers: Constructional features and principle of operation, concept of ideal transformer under no load & loaded conditions and its equivalent circuit; Practical transformer rating & its equivalent circuit; Autotransformer – principle of operation & relative advantages & disadvantages; Rotating Machine: construction features (stator, rotor & air gap), conditions for production of steady electromagnetic torque; Three phase Induction motor: constructional features and operation; DC Machines: construction features, EMF and Torque expression, Classification of DC motors and generators; Stepper motor.	**12**
Measuring Instruments	DC PMMC instruments – constructional feature and principle of operation; Moving iron meters construction and principle of operation; Dynamometer type wattmeter; Induction type energy meter construction & principle of operation.	**6**
	Total No. of Teaching Hours	**44**
Textbooks	1. I. J. Nagrath, "Basic Electrical Engineering," Tata Mc. Graw Hill.	
References	1. A. E. Fitgerald, D. E., Higginbotham and A. Grabel, "Basic Electrical Engineering", McGraw Hill. 2. Rizzoni, "Principles and Applications of Electrical Engineering", TMH. 3. V. Del Toro, "Principles of Electrical Engineering", Prentice Hall. 4. W. H. Hayt & J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill. 5. H. Cotton, "Advanced Electrical Technology", Wheeler Publishing.	

SET/EC/BT/C106. BASIC ELECTRONICS		
Course Objective	To familiarize the students with electronics field. To introduce semiconductor fundamentals, electronic devices, and elementary electronic circuits. To familiarize students with digital logics and gates.	
Course Outcome	1. Understand the working and current voltage characteristics of semiconductor devices e.g., diodes and transistor. 2. Perform dc analysis of amplifier circuits. 3. Design basic OP AMP circuits. 4. Understand and use basic digital electronic concepts.	
Module Name	**Content**	**No. of Teaching Hrs.**
Semiconductor Diodes	Semiconductor materials- intrinsic and extrinsic types, Ideal Diode as a switch, Terminal characteristics, and equivalent circuit of PN diode: p-n junction under open circuit condition, p-n junction under forward bias and reverse bias conditions, p-n junction in breakdown region; Zener diode and basic voltage regulator using Zener diode; Rectifier Circuits, Clipping and Clamping circuits; LED, Photo Diode.	**10**
Bipolar Junction Transistors	Physical structure, physical operation and current-voltage characteristics of NPN transistor; Use of Voltage-dependent Current source as a Voltage amplifier; Transistor as an amplifier: Characteristics of CE amplifier; Active region operation of transistor; D.C. analysis of Common Emitter Amplifier: load line analysis; Transistor as a switch: cut-off and saturation modes.	**10**
Field Effect Transistor	Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics; MOSFET as a Switch, MOSFET as a Voltage-dependent Current source and Common Source Amplifier.	**8**
Operation Amplifier	Ideal Op-amp; Properties of the ideal Operational Amplifier; op-amp application circuits (assuming ideal op amp): inverting amplifier, non -inverting amplifier, weighted summer, integrator, and differentiator.	**6**
Digital Logic and Gates	Binary, octal, and hexadecimal number systems; Methods of base conversions; Binary, octal, and hexadecimal arithmetic; Representation of signed numbers; Basic logic operations and logic gates; MOSFET Switch Implementation of Logic Gates, e.g., Inverter, NAND, NOR. Basic postulates and fundamental theorems of Boolean algebra.	**8**
	Total No. of Teaching Hours	**42**
Textbooks	1. Agarwal, Anant, Lang, Jeffrey H, "Foundations of Analog and Digital Electronic Circuits", Elsevier Science & Technology Books.	
References	1. V. Del Toro, "Principles of Electrical Engineering", PHI. 2. Rizzoni, "Principles and Applications of Electrical Engineering", TMH. 3. Malvino, Electronic Principles. 4. R. L. Boylestad & L. Nashelsky, "Electronics Devices & Circuit Theory", PHI. 5. Sedra, Smith, "Microelectronic Circuits", Oxford University Press.	

SET/IE/BT/S107. BASIC ELECTRICAL ENGINEERING LAB	
Content	**No. of Hrs.**
1. Study of multimeter, analog voltmeter and ammeter. 2. Study of CRO and function generator. 3. To understand the Line/circuit mechanism, phase and neutral points. 4. Familiarization of circuit breakers switches and loads. 5. Verification of KCL and KVL. 6. Verification of Thevenin and Norton theorem. 7. Verification of Superposition theorem. 8. Verification of Reciprocity theorems. 9. Verification of Maximum Power Transfer theorem. 10. Calibration of single phase AC energy meter. 11. Study of PMMC instrument. 12. Study of PMMI instrument. 13. Study of Electrodynamometer type instruments. 14. Study of regulated power supply. 15. Study of single phase AC transformer. 16. Transformer winding and load testing.	**14x4**
Total No. of Hours	**56**

Semester II

S. No.	Category	Course Code	Course Title	TA	CT	TOT	ESE	SUB. TOTAL
1	Basic Science	SET/BS/BT/C201	Mathematics II	10	20	30	70	100
2		SET/BS/BT/C202	Chemistry	10	20	30	70	100
3		SET/BS/BT/C203	Chemistry Lab	30	-	30	70	100
4		SET/BS/BT/C204	Engineering Mechanics	10	20	30	70	100
5	Humanities & Social Science		Mental Health & Wellbeing	10	20	30	70	100
6	Engineering Science	SET/ME/BT/C205	Basic Mechanical Engineering	10	20	30	70	100
7		SET/CS/BT/C206	Problem Solving and Programming in C	10	20	30	70	100
8		SET/CS/BT/C207	Problem Solving and Programming in C Lab	30	-	30	70	100
9		SET/ME/BT/C208	Engineering Graphics and Workshop Practice	30	-	30	70	100
10	Engineering Science (Skill)	SET/EC/BT/S209	Basic Electronics Lab	30	-	30	70	100
11	Mandatory Course		*Life Skills & Personality Development	-	-	-	-	-

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TA - Teacher's Assessment, CT - Class Test, TOT - Total, ESE - End Semester Examination.

SET/BS/BT/C201. MATHEMATICS II		
Course Objective	To introduce different types of integrations, transformations and distributions for graduate students.	
Course Outcome	Applying the Fourier series in signal processing and implementation of various transformations to solve complex engineering problems.	
Module Name	**Content**	**No. of Teaching Hrs.**
Multiple Integral	Evaluation of definite integral; double and triple integrals; change of order of integration. Change of variables, application to area, volume, centre of gravity, moment of inertia and product of inertia. Gamma and Beta functions, Dirichlet's integral and its application.	**12**
Fourier Series	Periodic functions, Fourier series of functions with period 2n, change of interval, half range sine and cosine series	**6**
Integral Transform	Laplace transforms, existence theorem, Laplace transform derivatives, inverse Laplace transform, application to solve linear differential equations, unit step function, Dirac delta function, Laplace transforms of periodic functions. Application of Laplace transforms. Definitions of Fourier transform and its simple applications	**14**
Probability and Statistics	Random variables. Uniform, normal, exponential, Poisson and binomial distributions. Mean, median, mode and standard deviation, Correlation and regression, Conditional probability and Bayes theorem	**12**
	Total No. of Teaching Hours	**44**
Textbooks	1. R. K. Jain and S. R. K. Iyengar "Advanced Engineering Mathematics", Narosa Publications. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers. 3. H. K. Das, "Advanced Engineering Mathematics", S Chand. 4. Erwin Kreyszig, "Advanced Engineering Mathematics".	

SET/BS/BT/C202. CHEMISTRY		
Course Objective	1. Apply the electrochemical principles in batteries, understand the fundamentals of corrosion. 2. Analysis of water for its various parameters and its significance in industrial and domestic Applications. 3. Analyze microscopic chemistry in terms of atomic, molecular orbitals and Intermolecular forces. 4. Analysis of major chemical reactions that are used in the synthesis of molecules. 5. Understand the chemistry of various fuels and their combustion.	
Course Outcome	1. Describe and understand the operation of electrochemical systems for the production of electric energy, i.e. batteries. 2. Explain the mode by which potable water is produced through the processes of screening, micro Straining, aeration, coagulation and flocculation, sedimentation, flotation, filtration and disinfection. 3. Recognize that molecular orbital theory is a method used by chemists to determine the energy of the electron in a molecule as well as its geometry. 4. Demonstrate an ability to design, implement, and evaluate the results of experimentation using standard scientific methodologies such as hypothesis formulation and testing. 5. Understand and analyze the combustion mechanisms of various fuels.	
Module Name	**Content**	**No. of Teaching Hrs.**
Advanced Theory of Chemical Bonding	Valence bond and molecular orbital theory. Structure of NH_3, H_2O, SO_3, PCl_5, XeO_2 molecules. Types of linkages, Hybridization, Hydrogen bonding, Metallic bonding.	**4**
Equilibrium on Reactivity	Bronsted and Lewis Acids, pH, pka, pkb scale, buffer solution.	**4**
Polymers	Structures of the following polymers, viz, Natural and synthetic rubbers, Polyamide and Polyester fibres, polymethylmethacrylate, poly acrylonitrile and polystyrene. A brief account of conducting polymers (polypyrrole & polytiphene) & their applications.	**3**
Complex Compounds	Introduction, Valence bond and crystal field theory.	**4**
Chemical Kinetics & Catalysis	Order of reactions, Parallel and reversible reactions. Catalysis- homogeneous and heterogeneous catalysis. Characteristics of catalytic reactions, catalytic promoters and poisons, auto catalysis and negative catalysis. Activation energy of catalysis, intermediate compound formation theory and adsorption theory.	**3**
Atmospheric Chemistry & Air Pollution	Environment and ecology, environmental segments, structure and composition of atmosphere, radiation balance of earth and Green House Effect, formation and depletion of Ozone layer, chemical and photochemical reactions of various species in atmosphere, air pollution- sources, reactions and sinks for pollutants, acid rains and smog formation. Pollution control methods.	**5**
Corrosion & Lubricants	Introduction, causes of corrosion, theories of corrosion- direct chemical attack, electrochemical theory of corrosion, factors influencing corrosion, corrosion inhibitors, passivity, types of corrosions, protection from corrosion and protective coatings. Theory, classification and mechanism of lubrication.	**5**
Water and Waste Water Chemistry	Introduction, hardness of water, characteristics imparted by impurities, analysis of contaminants, treatment of water by Zeolite, L-S process, boiler feed water, waste water treatment.	**6**
Fuels & Combustion	Classification of fuels, non-conventional energy, biogas, biomass and solar energy, calorific value – gross and net, characteristics of good fuel, determination of calorific value, solid fuels, analysis of coal, liquid fuels.	**5**
Stereochemistry of Organic-Compounds	Mechanism of chemical reaction, Beckman, Hoffman, Reimer Tiemann, Cunnizzaro, Diels-Alder and Skraup synthesis.	**3**
	Total No. of Teaching Hours	**42**
Textbooks	1. Jain, Jain, "Engineering Chemistry". 2. Sharma, Kumar, "Engineering Chemistry".	
References	1. R. T. Morrison and R N Boyd, "Organic Chemistry", 6th Edition, Prentice Hall, New Delhi. 2. J. D. Lee, "Concise Inorganic Chemistry", Chapman & Hall. 3. W. L. Jolly, "Modern Inorganic Chemistry", McGraw-Hill. 4. P. W. Atkins, "Physical Chemistry", 6th Edition, Oxford University Press. 5. Barrow, "Physical Chemistry". 6. Manahan, "Environmental Chemistry". 7. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R Vyvyan, I, "Spectroscopy", Cengage Learning India Pvt. Ltd, New Delhi, 2007. 8. R. M. Silverstein, F. X. Webster and D. J. Kiemle, "Spectrometric Identification of Organic Compounds", 7th edition, John-Wiley and Sons, New York, 2005. 9. William Kemp, "Organic Spectroscopy", 3rd edition, Palgrave, New York, 2005. 10. C.N. Banwell and E. M. McCash, "Fundamentals of Molecular Spectroscopy", McGraw- Hill, International, UK, 1995.	

SET/BS/BT/C203. CHEMISTRY LAB	
Content	**No. of Hrs.**
1. To determine the percentage of available chlorine in the supplied sample of bleaching powder. 2. To determine the ferrous content in the supplied sample of iron ore by titrimetric analysis against standard K2Cr2O7 solution using K3Fe(CN)6 as external indicator. 3. To determine the chloride content in supplied water sample using Mohr's method. 4. To determine the constituents and amount of alkalinity of the supplied water sample. 5. To determine the temporary and permanent hardness of water sample by complexometry. 6. To find chemical oxygen demand of a waste water sample using Potassium Dichromate. 7. To determine iron concentration in the sample of water by Spectrophotometric method. 8. To determine the molecular weight of a polystyrene sample by using viscometric method. 9. To determine pH of a solution by using digital pH meter and titration of such a solution pH metrically. 10. Analysis of a coal sample by proximate analysis method.	**3 x 10**
Total No. of Hours	**30**

SET/BS/BT/C204. ENGINEERING MECHANICS		
Course Objective	1. To understand distributed force systems, centroid/ center of gravity and method of finding centroids of composite figures and bodies. 2. To understand the moment of inertia and method of finding moment of inertia of areas and bodies. 3. To understand types of frames and analyze for the forces in the members of the truss by method of joints and method of sections. 4. To understand dynamics of a particle. 5. To interpret the simple given dynamic problems and solve them for positions, velocities and accelerations, etc. 6. To understand the kinetics of the rigid bodies and solve simple problems using work-energy method.	
Course Outcome	1. Identify the significance of centroid/ center of gravity and find centroids of composite figures and bodies. 2. Understand the moment of inertia and method of finding moment of inertia of areas andbodies. 3.Identify the type of frame and analyze for the forces in the members of the truss (frame) by method of joints and method of sections. 4. Understand dynamics of a particle	
Module Name	**Content**	**No. of Teaching Hrs.**
Force System	Introduction: Force system, dimensions and units in mechanics, , addition and subtraction of forces, moment of a force about a point and axis, couple and couple moment, resultant of a force system using vector method, Static and dynamic equilibrium, Lami's theorem, equilibrium of bodies under a force system.	**7**
Trusses and Frames	Truss and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, Analysis of perfect plane truss using method of joints and method of sections, Problems.	**5**
Centre of Gravity and Moment of Inertia	Centroid, Centre of mass and Centre of gravity, Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, product of inertia, principal axis	**6**
Friction and Virtual Work	Friction-characteristics of dry friction, problems involving friction of ladder, wedges and Connected bodies. Definition of virtual work, principle of virtual work for a system of connected bodies.	**6**
Kinematics and Dynamics	Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies Particle Dynamics: Energy methods and momentum methods, Newton's laws, work energy equation for a system of particles, projectile motion.	**6**
	Total No. of Teaching Hours	**30**
Textbooks	1. R.S. Khurmi, "Engineering Mechanics". 2. A.K. Tayal Engineering Mechanics: Statics and Dynamics.	
References	1. R.C. Hibbeler, Engineering Mechanics: Statics & Dynamics. 2. F.P. Beer & E.R. Johnston, Vector Mechanics for Engineers: Statics & Dynamics. 3. J.L. Meriam & L.G. Kraige, Engineering Mechanics. 4. I.H. Shames, Engineering Mechanics: Statics and Dynamics.	

SET/ME/BT/C205. BASIC MECHANICAL ENGINEERING		
Course Objective	1. To understand the fundamental principles of thermodynamics, thermodynamic processes, laws, and cycles. 2. To understand the stress, strain, deformation, and mechanical behaviour of engineering materials. 3. To analyze stress transformation, bending, torsion, and basic mechanical components. 4. To understand the principles, operations, and applications of basic manufacturing processes.	
Course Outcome	Students should be able to: 1. Apply fundamental thermodynamic principles, processes, gas relations, and cycles to solve basic engineering problems. 2. Analyze stress, strain, deformation, and mechanical behavior of engineering materials under different loading conditions. 3. Analyze stress transformation, principal stresses, bending, and torsion in basic mechanical components. 4. Explain the principles, operations, and applications of basic manufacturing processes, including machining, casting, sheet-metal operations, and welding.	
Module Name	**Content**	**No. of Teaching Hrs.**
Fundamental Concept of Thermodynamics	Definition of thermodynamics, System, Surroundings and Universe, Phase, Concept of continuum, Macroscopic and microscopic point of view, Thermodynamic equilibrium, Property, State, Path, Process, Cyclic and non-cyclic processes, Quasi-static process, Reversible and irreversible processes, Energy and its forms, Internal energy, Zeroth law of thermodynamics, First law of thermodynamics, heat and work interactions, Ideal gas equation, Non-flow processes including Isobaric process, Isochoric process, Isothermal process, Adiabatic process and Polytropic process, Enthalpy and Steady flow energy equation. Numerical.	10
Properties of Gases and Thermodynamic Cycle	Boyle's law, Charles's law, Gay-Lussac's law, Avogadro's law, Combined gas law, Gas constant, Relation between Cp and Cv, Limitations of First law of thermodynamics, Second law of thermodynamics, Essence of Second law, Thermal reservoir, Heat engines, Refrigerator and heat pump, COP of refrigerator and heat pump, Carnot cycle, Carnot theorem, Clausius inequality, Concept of entropy, Steam formation, Specific volume of steam, Dryness fraction of steam, Steam calorimeters, Rankine cycle, Comparison of Rankine and Carnot cycles, Air-standard cycles including Otto, Diesel, Dual and Brayton cycles and Vapour compression refrigeration cycle. Numerical.	10
Introduction to Mechanics of Solid	Normal and Shear stress, Strain, Hooke's law, Poisson's ratio, Elastic constants and their relationships, Stress-strain diagram for ductile and brittle materials, Mechanical properties such as strength, hardness, toughness, ductility, brittleness, malleability, etc., Deformation of prismatic bar under axial load, Composite bar, Factor of safety, Thermal stresses, Complementary shear stress, Numerical.	9
Compound Stresses and Strains	State of stress at a point, Simple tension, Pure shear, oblique stress, general two-dimensional stress system, Analytical method of stress transformation, Principal planes, Principal stresses and strains, Maximum shear stress, Mohr's Circle, Introduction to bending, Introduction to torsion. Numerical.	8
Introduction to Engineering Workshop	Introduction to manufacturing processes, Introduction to - lathe, Shaper, Slotter, Planer, Milling machine, Milling cutters etc., Basic principle of casting, Basic principle of forging, Sheet metal operations including blanking, piercing, punching, drawing, deep drawing and embossing, Arc welding, TIG and MIG welding, Resistance welding including spot and Seam welding.	8
	Total No. of Teaching Hours	**45**
Textbooks	1. R.K. Rajput, Element of Mechanical Engineering, Laxmi Publication (1st Edition), 2005. 2. P.K. Nag "Engineering Thermodynamics".	
References	1. Van Wylen G.J. & Sonnlog R.E., Fundamentals of classical thermodynamics, John Wiley & Sons, Inc. NY. 2. Wark Wenneth, Thermodynamics, (2nd edition), McGraw Hill book Co. NY. 3. Holman, J.P., Thermodynamics, McGraw Hill book Co. NY. 4. Yadav R., Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad. 5. Kshitish Chandra Pal, Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta. 6. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi. 7. G. H. Ryder, "Strength of Materials". 8. Timoshenko, "Strength of Materials".	

SET/CS/BT/C206. PROBLEM SOLVING AND PROGRAMMING IN C		
Course Objective	The course is designed to provide complete knowledge of programming in C language. Students will be able to develop logics which will help them to create programs and applications in C. Also, by learning the basic programming concepts in C, help them to learn any other programming language in future.	
Course Outcome	1. Develop programs in C programming language. 2. Analyze the problem and find appropriate solution. 3. Evaluate the correctness of the developed solution. 4. Develop basic and advanced level applications using C programming language.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction	Introduction, The C character set, Constants, Variables, Identifiers, Keywords, Data types, Declarations, The First C Program, Compilation and Execution.	**6**
Operators and Expressions	Arithmetic, Relational, Equality, Logical, Unary, Conditional, Bitwise, Assignment, Comma and Size of operator. Type Conversion and Typecasting.	**6**
Control Statements	if, if-else, while, do-while, for loop, nested loops, switch, break, continue and goto statements.	**5**
Functions & Pointers	Defining and accessing functions, Function prototype, Passing arguments, Recursion, Use of library functions. Introduction to pointers, Declarations, Passing to a function, Operations on pointers, Dynamic memory allocation, Array of pointers.	**11**
Arrays	Single and Multi-dimensional arrays, Row major and Column major form of an array, Character strings and arrays.	**4**
Storage Classes	Automatic, Register, Static and External storage class.	**4**
Structures and Unions	Basics of structures, Structures and functions, Arrays of Structures, Pointers to structures, Self-referential structures, Unions.	**4**
File Input/output	Opening a File, Reading from a file, closing the file, Writing to a file.	**4**
	Total No. of Teaching Hours	**44**
Textbooks	1. E. Balagurusamy, "Programming in ANSI C".	
References	1. Byron S. Gottfried, "Programming With C". 2. Yashwant Kanitker, "LET US C". 3. B. W. Kernighan and D. M. Ritchie, "The C Programming Language". 4. B. W. Kernighan, "The Practice of Programming", Addison-Wesley, 1999. 5. C. L. Tondo and S. E. Gimpel, "The C Answer Book", (2/e), Prentice Hall, 1988.	

SET/CS/BT/C207. PROBLEM SOLVING AND PROGRAMMING IN C LAB		
Course Objective	1. To make the student learn a programming language. 2. To learn problem solving techniques. 3. To teach the student to write programs in C and to solve the problems.	
Course Outcome	After Completion of this course the student would be able to 1. Read, understand and trace the execution of programs written in C language. 2. Write the C code for a given algorithm. 3. Implement Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor. 4. Write programs that perform operations using derived data types.	
Content		**No. of Hrs.**
This lab shall have minimum 25 programs in C. There shall be minimum two programs per module as taught in theory. Programming shall follow logic/algorithm and flowchart wherever applicable. Exercises shall also enhance analytical and debugging abilities.		**2x16**
	Total No. of Hours	**32**

SET/ME/BT/C208. ENGINEERING GRAPHICS AND WORKSHOP PRACTICE		
Module Name	**Content**	**No. of Hrs.**
Engineering Graphics	**Engineering Drawing:** **Introduction:** Drawing instruments, their types, uses, and proper handling. **Prepare any 5 sheets from the following:** 1. **Types of Lines and Conventional Symbols:** Different types of lines, materials, their symbols, and conventional representations used in engineering drawings. 2. **Lettering, Scale, and Dimensioning:** Principles of engineering lettering, lettering ratios, scales, methods of dimensioning, and standard practices. 3. **Orthographic Projections:** First-angle and third-angle projection methods and their applications. 4. **Projection of Points:** Projection of points located in different quadrants and coordinates with respect to the reference planes. 5. **Projection of Lines – Single Plane:** Projection of lines inclined to one of the reference planes and parallel to the other. 6. **Projection of Lines – Both Planes:** Projection of lines inclined to both the horizontal and vertical reference planes. 7. **Projection of Plane Lamina:** Projection of plane surfaces of different geometrical shapes in various positions. 8. **Projection on Auxiliary Planes:** Use of auxiliary planes for obtaining the true shape and size of inclined surfaces. 9. **Projection of Solids:** Projection of geometrical solids with their axes parallel or inclined to one of the reference planes. 10. **Orthographic Projection of Machine Components:** Preparation and interpretation of orthographic views of simple machine components using standard engineering drawing conventions.	**30**
Workshop Practice	**Workshop Practice:** **Introduction:** To develop practical skills and hands-on experience in various workshop Processes. **Perform any 5 experiments from the following:** 1. **Machine Tool Practice:** Overview and basic operation of lathe, shaper, milling, and drilling machines, including their components and applications. 2. **Lathe Machine Practice:** Overview and major operations perform- facing, plane turning, step turning, taper turning, etc. 3. **Drilling Practice**: Overview and major operations of machine, marking, centre punching, drilling, counter sinking, and tapping. 4. **Milling Practice:** Overview and major operations perform- facing, slot milling, keyway cutting, and finishing. 5. **Carpentry Practice:** Measuring, marking, sawing, chiselling, planning, filing, fitting, and finishing. 6. **Fitting Practice:** Marking, hack sawing, chipping, filing, drilling, tapping and assembling. 7. **Foundry Practice:** Pattern making, mould preparation, core making, melting, pouring, shake out and fettling. 8. **Gas Welding:** Edge preparation, gas flame adjustment, Tack welding, Gas welding, cleaning, and inspection. 9. **Arc Welding:** Electrode selection, current setting, tack welding, arc welding, slag removal, and visual inspection. 10. **Shaper/ Grinding Machine Practice:** Overview and major operations of squaring, step cutting, slotting, and grinding.	**30**
	Total No. of Hours	**60**
Textbooks	1. Bhatt N. D, Elementary Engineering Drawing, Charotar Publishing House, Anand, 2002. 2. Elements of Workshop Technology Vol-1 by Hazra Chaudhary.	
References	1. Narayana K L & Kannaiah P, Engineering Graphics, Tata McGraw Hill, New Delhi, 1992. 2. Luzadder W J, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi, 2001. 3. Thomas E French & Charkes J V, Engineering Drawing & Graphing Technology, McGraw Hill Book Co, New York, 1993. 4. Venugopal K, Engineering Drawing & Graphics, New Age International Pvt. Ltd., New Delhi, 1994. 5. Workshop Technology, Raghubanshi.	

SET/EC/BT/S209. BASIC ELECTRONICS LAB		
Module Name	**Content**	**No. of Hrs.**
Experiments	1. Identification and IV characteristic of PN diode. 2. Half wave rectifier circuit. 3. Full wave rectifier circuit. 4. Bridge rectifier circuit. 5. Input characteristic of BJT in CE configuration. 6. Output characteristic of BJT in CE configuration. 7. Inverting Amplifier using 741 OP AMP. 8. Non-inverting Amplifier using 741 OP AMP. 9. Verification of basic logic gates. 10. Hand-on exercise on soldering and assembly of circuits on PCB/ Breadboard. 11. Voltage regulator using Zener diode.	**11x4**
Simulations	12. IV characteristic of PN and Zener diodes. 13. Input and Output characteristic of BJT in CE configuration. 14. Simulating Inverting and Non-inverting amplifier using OP AMP. 15. Simulating weighted summer using SPICE. 16. Simulating basic logic gates using HDL simulator.	**5x4**
	Total No. of Hours	**64**

Appendix-I

Mandatory Induction Program for Instrumentation Engineering Branch

3 weeks duration
• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

***Induction program for students to be offered right at the start of the first year.**

1. Induction Program:

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

1.1 Physical Activity:

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

1.2 Creative Arts:

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

1.3 Universal Human Values:

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

1.4 Literary:

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

1.5 Proficiency Modules:

This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

1.6 Lectures by Eminent People:

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

1.7 Visits to Local Area:

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

1.8 Familiarization to Dept. /Branch & Innovations:

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.