Curriculum and Syllabus

Bachelor of Technology

in

Electrical and Instrumentation Engineering

(Applicable for 2022-23 batch and onwards)

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

Curriculum

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., SH: Applied Science and Humanities, EC: Electronics and Communication Engineering, IE: Electrical and Instrumentation Engineering, EE: Electrical 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/ M: Mandatory/ L: Life Skills and Personality Development) 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. **Elective Courses:**
   Elective courses are provided in V, VI, VII and VIII semesters to provide student with flexibility to choose courses of their interest from a list of offered electives. These Electives are the courses offered by the same department or other departments for the students.

3. **MOOC Courses:**
   "MOOCs" means Massive Open Online Courses (MOOCs) are such online courses which are developed and made available on the SWAYAM platform of Government of India. MOOCs guidelines on online learning issued by the MHRD vide orders dated 11th March 2016 and subsequent addendums issued by the MHRD.
   Any student can be permitted to opt for only up to 20% of the total courses being offered in a particular program in a semester through the online learning courses provided through SWAYAM platform. Any student can opt, with the permission of the department, the course of the SWAYAM platform, which is available/ offered in the same term (even or odd).

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/ Multidisciplinary	SET/SH/BT/C101	Mathematics I	3	1	-	4	4
2		SET/SH/BT/C102	Physics	3	1	-	4	4
3	Core Basic Engineering Subjects	SET/EE/BT/C103	Basic Electrical Engineering	3	1	-	4	4
4		SET/EC/BT/C104	Basic Electronics	3	1	-	4	4
5		SET/IT/BT/C105	Fundamental of Information Technology	3	1	-	4	4
6	Core/ Basic Engineering Subjects Labs	SET/SH/BT/C107	Physics Lab	-		1	2	1
7		SET/ME/BT/C108	Engineering Graphics and Workshop Practice			1	2	1
8	Extracurricular Courses/ CC		*Understanding and Connecting with Environment	2	-	-	2	2
9	Skill Course	SET/IE/BT/S106	Basic Electrical Engineering Lab	-	-	1	4	2
Total				17	5	3	30	26

*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/ Multidisciplinary	SET/SH/BT/C201	Mathematics II	3	1	-	4	4
2		SET/SH/BT/C203	Chemistry	3	1	-	4	4
3	Core Basic Engineering Subjects	SET/ME/BT/C202	Basic Mechanical Engineering	3	1	-	4	4
4		SET/ME/BT/C204	Engineering Mechanics	3	1	-	4	4
5		SET/CS/BT/C205	C Programming	3	1	-	4	4
6	Core/ Basic Engineering Subjects Labs	SET/SH/BT/C208	Chemistry Lab	-		1	2	1
7		SET/CS/BT/C209	C Programming Lab			1	2	1
8	Life Skills and Personality Development		*Life Skills and Personality Development	2	-	-	2	2
9	Skill Course	SET/EC/BT/S206	Basic Electronics Lab	-	-	1	4	2
Total				17	5	3	30	26

*Common syllabus for all UG courses of the university.

Semester III

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	Basic Science/ Multidisciplinary	SET/SH/BT/C301	Mathematics III	3	1	-	4	4
2	Core Subjects	SET/EC/BT/C302	Electronic Circuits	3	1	-	4	4
3		SET/IE/BT/C303	Signals and Systems	3	1	-	4	4
4		SET/IE/BT/C304	Electrical Measurements and Instrumentation	3	1	-	4	4
5	Interdisciplinary Core Subject	SET/EC/BT/C303	Digital Electronics	3	1	-	4	4
6	Core Subjects Based Labs	SET/IE/BT/C305	Signals and Networks Lab	-	-	1	2	1
7		SET/IE/BT/C306	Electrical Measurements and Instrumentation Lab	-	-	1	2	1
8	Indian Knowledge System-I (IKS-1)		*Indian Knowledge System-I	2	-	-	2	2
9	Skill Course	SET/EC/BT/S307	Electronic Circuits Lab	-	-	1	4	2
Total				17	5	3	30	26

*Common syllabus for all UG courses of the university.

Semester IV

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	Core Subjects	SET/IE/BT/C401	Sensors and Transducers	3	1	-	4	4
2		SET/IE/BT/C402	Microprocessors and Interfacing	3	1	-	4	4
3		SET/IE/BT/C403	Electrical Machines	3	1	-	4	4
4		SET/IE/BT/C404	Circuit Theory	3	1	-	4	4
5	Interdisciplinary Core Subject	SET/EC/BT/C402	Analog Integrated Circuits	3	1	-	4	4
6	Core Subjects Based Labs	SET/IE/BT/C405	Sensors and Transducers Lab	-	-	1	2	1
7		SET/IE/BT/C406	Electrical Machines Lab	-	-	1	2	1
8	Indian Knowledge System-II (IKS-2)		*Indian Knowledge System-II	2	-	-	2	2
9	Skill Course	SET/IE/BT/S407	Microprocessors Lab and Mini Project	-	-	1	4	2
Total				17	5	3	30	26

*Common syllabus for all UG courses of the university.

Semester V

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	Core Subjects	SET/IE/BT/C501	Power Systems	3	1	-	4	4
2		SET/IE/BT/C502	Control Systems	3	1	-	4	4
3		SET/IE/BT/C503	Industrial Instrumentation	3	1	-	4	4
4			Program Elective-1	3	1	-	4	4
5	Open Elective/ Interdisciplinary Subject		#Open Elective-1	3	1	-	4	4
6	Core Subjects Based Labs	SET/IE/BT/C504	Power Systems Lab	-	-	1	2	1
7		SET/IE/BT/C505	Industrial Instrumentation Lab	-	-	1	2	1
8	Extracurricular Course/ Compulsory Course	SET/IE/BT/M506	*Culture, Traditions and Moral values/ Yoga Practices	-	-	1	4	2
9	Skill Course	SET/IE/BT/S507	MATLAB and Mini Project	-	-	1	4	2
Total				15	5	4	32	26

#Courses offered by any other department of School of Engineering and Technology.
*University will prepare a course with focus on Indian/ Regional culture studies. In case no syllabus is prepared by the university then Yoga Practices course will be offered.

	S. No.	Code	Course Title
Program Elective-1	1	SET/IE/BT/E501	Power Electronics
	2	SET/IE/BT/E502	Electrical Drives
	3	SET/IE/BT/E503	Mathematics and Statistics for Data Science

Semester VI

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	Core Subjects	SET/IE/BT/C601	Analytical Instrumentation	3	1	-	4	4
2		SET/IE/BT/C602	PLC and Automation	3	1	-	4	4
3		SET/IE/BT/C603	Process Control	3	1	-	4	4
4			Program Elective-2	3	1	-	4	4
5	Open Elective/ Interdisciplinary Subject		#Open Elective-2	3	1	-	4	4
6	Core Subjects Based Labs	SET/IE/BT/C604	Analytical Instrumentation Lab	-	-	1	2	1
7		SET/IE/BT/C605	Process Control Lab	-	-	1	2	1
8	Communication Skills/ CC	SET/IE/BT/M606	* Communication Skills Course/ Technical Seminar	-	-	1	4	2
9	Skill Course	SET/IE/BT/S607	Industrial Automation Lab	-	-	1	4	2
Total				15	5	4	32	26

#Courses offered by any other department of School of Engineering and Technology.
*University will prepare communication courses in Modern/Indian languages from which student will select one language course. The course will be more on applied side with giving students a chance to develop their soft skills. In case no syllabus is prepared by the university then Technical Seminar course will be offered.

	S. No.	Code	Course Title
Program Elective-2	1	SET/EC/BT/C601	Digital Signal Processing
	2	SET/IE/BT/E602	Power Plant Instrumentation
	3	SET/IE/BT/E603	Python for Data Science

Semester VII

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	Core Subjects	SET/IE/BT/C701	Vacuum Instrumentation and Thin Film Deposition Techniques	3	1	-	4	4
2			Program Elective-3	3	1	-	4	4
3			Program Elective-4	3	1	-	4	4
4	Open Elective/ Interdisciplinary Subject		#Open Elective-3	3	1	-	4	4
5	Core Subjects Based Labs	SET/IE/BT/C702	Vacuum Instrumentation and Thin Film Deposition Techniques Lab	-	-	1	2	1
6		SET/IE/BT/C703	Biomedical Instrumentation Lab	-	-	1	2	1
7		SET/IE/BT/C704	Industrial Training Seminar	-	-	1	2	1
8	Life Skills and Personality Development	SET/SH/BT/L701	Essential Management Practices	2	-	-	2	2
9	Skill Course	SET/IE/BT/S705	Project Stage-1	-	-	1	4	2
Total				14	4	4	28	23

Courses offered by any other department of School of Engineering and Technology.

	S. No.	Code	Course Title
Program Elective-3 and 4	1	SET/IE/BT/E701	Biomedical Instrumentation
	2	SET/IE/BT/E702	Embedded Systems
	3	SET/IE/BT/E703	Optical Instrumentation
	4	SET/IE/BT/E704	Introduction to Machine Learning

Semester VIII

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	Core Subjects	SET/IE/BT/C801	Renewable Energy Engineering	3	1	-	4	4
2			Program Elective-5	3	1	-	4	4
3			Program Elective-6	3	1	-	4	4
4	Open Elective/ Interdisciplinary Subject		#Open Elective-4	3	1	-	4	4
5	Life Skills and Personality Development	SET/SH/BT/L801	Disaster Management	-	-	1	4	2
6	Skill Course	SET/IE/BT/S802	Project Stage-2	-	-	1	10	5
Total				12	4	2	30	23

Courses offered by any other department of School of Engineering and Technology.

	S. No.	Code	Course Title
Program Elective-5 and 6	1	SET/IE/BT/E801	Virtual Instrumentation
	2	SET/IE/BT/E802	Introduction to Soft Computing
	3	SET/IE/BT/E803	Introduction to Internet of Things
	4	SET/EC/BT/E803	Wireless and Mobile Communication

Detailed Syllabi

Semester I

SET/SH/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/SH/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/EE/BT/C103. 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", Mc Graw 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", Mc Graw Hill. 5. H. Cotton, "Advanced Electrical Technology", Wheeler Publishing.	

SET/EC/BT/C104. 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/IT/BT/C105. FUNDAMENTALS OF INFORMATION TECHNOLOGY		
Course Objective	1. Take on significant positions In various IT work. 2. Collaborate in diverse team environments. 3. Contributions in the field of IT. 4. Work effectively in the IT field to make a positive contribution to society.	
Course Outcome	1. Develop information technology solutions by evaluating user requirements in the systems development environment. 2. Apply knowledge of IT requirements for technology solutions in cutting edges applications. 3. Analyze a problem and identify and define the computing requirements for the appropriate solutions. 4. Create, select and apply appropriate techniques, resources, and modern engineering and IT tools.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction	Definition of Electronic Computer, Generations, Classification of Computers, Computer Hardware and Basic Computer Organization: CPU- ALU, CU; RAM/ROM, Various I/O devices, Peripherals, Storage Media.	**4**
Computer Languages	Binary, Hexadecimal Number System; Basic Binary Logic Operations; Binary Addition and Subtraction; Generation of Languages, Assembly Language, High level language; Translators, Interpreters, Compilers, Compilers; Flow Charts, Dataflow Diagram.	**6**
OS & Office	Software- System and Application Software; Elementary Concepts in Operating System; Textual Vs GUI, Introduction to DOS, MS Windows, UNIX/Linux.	**4**
Computer Networks	Elements of Communication system; Brief Introduction to Computer Networks- Introduction of LAN and WAN. Network Topologies, Client-server Architecture, IoT, Cloud Computing.	**6**
Internet	Internet & World Wide Web, Hypertext Markup Language, DHTML, Python, WWW, Gopher, FTP, Telnet, Web Browsers, Net Surfing, Search Engines, Email; Introduction to Web Development, Static and Dynamic Pages.	**6**
IT Application and Multi media	Basic Awareness of NICNET and ERNET; E Commerce, E governance; Brief Introduction to Different Formats of Image, Audio, Video.	**6**
Information Concepts & Processing	Definitions of Information, Need of information, quality of information, value of information, concept of information, Entropy category and Level of information in Business Organization, Data Concepts and Data Processing, Data Science, Data Representation, Application of IT to E-commerce, Electronic Governance, Multimedia, Entertainment, Introduction to Information System.	**8**
	Total No. of Teaching Hours	**40**
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/SH/BT/C107. 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/ME/BT/C108. ENGINEERING GRAPHICS AND WORKSHOP PRACTICE		
Course Objective	The Engineering Graphics course aims at the following educational objectives: Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views (principal, auxiliary, sections). Dimension and annotate two-dimensional engineering drawings. The application of industry standards and best practices applied in engineering graphics. Emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.	
Course Outcome	1. Sketch engineering objects, lettering and dimensioning by freehand. 2. Create geometric constructions; drawing parallel and perpendicular lines, and to construct circles, arcs, tangencies, and irregular curves. Apply orthographic projection method to obtain: Multiview, auxiliary view and section view of an object.	
Module Name	**Content**	**No. of Hrs.**
Introduction to Engineering Graphics & Projection of Points	Drawing instruments and their use, Different types of lines, Lettering & dimensioning Familiarization with current Indian Standard Code of Practice for Engineering Drawing. Scales, Plain scales, Diagonal scales, Vernier scales. First angle and third angle projections Projection of points in different coordinates, Projections of lines inclined to one of the reference planes.	**08**
Projections of lines and planes	Projections of lines inclined to both the planes, True lengths of the lines and their angles of inclination with the reference planes, Traces of lines. Projection of plane lamina of geometric shapes inclined to one of the reference planes, inclined to both the planes, Traces of planes. Projections on auxiliary planes.	**08**
Projections of polyhedral and solids	Projections of polyhedral and solids of revolution, projection of solids with axis parallel to one of the planes and parallel or perpendicular to the other plane, Projections with the axis inclined to one of the planes.	**08**
Orthographic Projection	Concept of orthographic projection, Rules of Drawing orthographic projection, Conversion of pictorial views into orthographic projection, Drawing of orthographic projection of Machine components.	**08**
Carpentry, Fitting and Black smithy	Minimum two experiments from Carpentry, Fitting and Black smithy. And Development of jobs carried out and soldering, Black Smithy, House Wiring, Foundry (Molding only), Plumbing.	**08**
Welding & Machining	Practice of minimum two experiments of welding joints. Overview of Lathe, Shaper, Milling and Drilling machine. Perform one job on each machine.	**08**
	Total No. of Hours	**48**
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.	

Understanding and Connecting with Environment
As prescribed by the University

SET/IE/BT/S106. 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.	15x4
Total No. of Hours	**60**

Semester II

SET/SH/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 Hrs.	**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/SH/BT/C203. 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. 11. F. Carey, "Organic Chemistry", 5th Edition, McGraw Hill Publishers, Boston, 2003.	

SET/ME/BT/C202. BASIC MECHANICAL ENGINEERING		
Course Objective	1. To use mechanical principles to solve real-world engineering issues. 2. To identify appropriate structural system for studying a given problem and isolate it from its environment. 3. Develop a simple mathematical model for an engineering problem and perform a static analysis. 4. To carry out kinematics and Kinetics analysis for practices and system of particles.	
Course Outcome	1. Students will be able to apply and demonstrate the concept of mechanics to practical engineering problems. 2. Students will be able to determine the properties of planes and solids. 3. Students will be able to apply the basic concept of dynamics to practical problems.	
Module Name	**Content**	**No. of Teaching Hrs.**
Fundamental concept of thermodynamics	Definition of thermodynamics, System, Surrounding and Universe, Phase, Concept of continuum, Macroscopic & microscopic point of view. Thermodynamic equilibrium, Property, State, Path, Process, Cyclic and non-cyclic processes, Reversible and irreversible processes, Quasi static process, Energy and its forms, Enthalpy, Zeroth law, first law, second law and third law of thermodynamics, Steady flow energy equation, Limitations of first law of thermodynamics, Essence of second law, Thermal reservoir, Heat engines. COP of heat pump and refrigerator, Carnot cycle, Carnot theorem, Clausius inequality, Concept of entropy.	**8**
Properties of gases and steam	Boyle's law, Charles's law, Gay-Lussac's law, Avogadro's law, Combined gas law, Gas constant, Relation between c_p and c_v, Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Polytropic process. Steam formation, Enthalpy, Specific volume, Internal energy and dryness fraction of steams, steam calorimeters.	**5**
Thermodynamic Cycle	Rankine cycle, Actual vapour cycle processes, Comparison of Rankine and Carnot cycles, Air standard cycles - Otto, Diesel, dual and Brayton cycles, Vapour compression refrigeration cycles.	**8**
Introduction to Mechanics of Solid	Normal and shear Stress, strain, Hookes' law, Poisson's ratio, elastic constants and their relationship, stress-strain diagram for ductile and brittle materials, factor of safety. Basic Numerical problems, temperature stresses, shear stress, complementary shear stress, shear strain.	**8**
Compound Stresses and Strains	State of stress at a point, oblique stress, simple tension, pure shear, general two dimensional stress system, principal planes, principal stresses and strains, maximum shear stress.	**8**
Bending Stress and Torsion	Pure bending, moment of inertia, section modulus, bending stresses, combined bending and direct stress, beam of uniform strength, middle third and middle quarter rules for rectangular and circular sections, Circular shafts, torsional shear stress, strain energy in torsion, shafts under varying torque, compound shafts, combined bending and twisting.	**8**
	Total No. of Teaching Hours	**45**
Textbooks	1. R S Khurmi, "Engineering Mechanics". 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), Mc Graw Hill book Co. NY. 3. Holman, J.P., Thermodynamics, Mc Graw Hill book Co. NY. 4. Yadav R., Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad. 5. Yadav R., Steam & Gas Turbines. 6. Kshitish Chandra Pal, Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta. 7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi. 8. G. H. Ryder, "Strength of Materials". 9. F. L. Singer, "Strength of Materials". 10. Timoshenko, "Strength of Materials". 11. Beer, Johnson, Statics.	

SET/ME/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. 7. To understand virtual work method and solve simple problems.	
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 and bodies. 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. 5. Interpret the simple given dynamic problems and solve them for positions, velocities and accelerations, etc., 6. Understand the kinetics of the rigid bodies and solve simple problems using work-energy method. 7. Understand virtual work method and solve simple problems.	
Module Name	**Content**	**No. of Teaching Hrs.**
Force System	Introduction: Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems.	**8**
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.	**8**
Centre Of Gravity And Moment Of Inertia	Centroid, Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems, Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects.	**10**
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.	**7**
Kinematics And Dynamics	Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problems. Particle Dynamics: Energy methods and momentum methods, Newton's laws, work energy equation for a system of particles, linear and angular momentum equations, projectile motion, problem.	**12**
	Total No. of Teaching Hours	**45**
Textbooks	1. R S. Khurmi, "Engineering Mechanics". 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 Kenneth: Thermodynamics (2nd edition), Mc Graw Hill book Co. NY. 3. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY. 4. Yadav R.: Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad. 5. Yadav R.: Steam & Gas Turbines. 6. Kshitish Chandra Pal: Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta. 7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi. 8. G. H. Ryder: "Strength of Materials". 9. F. L. Singer: "Strength of Materials". 10. Timoshenko: "Strength of Materials". 11. Beer, Johnson, Statics.	

SET/CS/BT/C205. C PROGRAMMING		
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 Sizeof 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/SH/BT/C208. 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/CS/BT/C209. C PROGRAMMING 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**

Life Skills and Personality Development
As prescribed by the University

SET/EC/BT/S206. 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**

Semester III

SET/SH/BT/C301. MATHEMATICS-III		
Course Objective	To provide essential knowledge of methods to analytical and approximate solutions for different types of ordinary and partial differential equations which leads to complex variables.	
Course Outcome	Solutions of different types of ordinary and partial differential applications leads to the analysis of complex problems in engineering such as hydraulic flow, heat transfer, level controller of a tank, vibration isolation, electrical circuits, etc.	
Module Name	**Content**	**No. of Teaching Hrs.**
Ordinary Differential Equations	Introduction to order, degree and arbitrary constants, linear differential equations of n^{th} order with constant coefficient, complimentary functions and particular integrals, Homogeneous differential equations, Cauchy's and Euler's equations, Method of variation of parameters, equations of the form $y'' = f(y)$, applications to engineering problems.	**12**
Partial Differential Equations	Linear PDE with constant coefficients of 2nd order and their classifications, Initial and boundary value problems, PDE of parabolic, elliptic and hyperbolic type. Separation of variables method for solving PDE, heat equations, wave equations and Laplace equations.	**10**
Numerical Methods	Direct and iterative methods to solve of linear algebraic equations, numerical integration, integration by trapezoidal and Simpson's rules.	**8**
Complex Variables	Analytic functions; Cauchy-Riemann equations; Harmonic functions, Cauchy's integral theorem and integral formula; sequences, series, convergence tests, Taylor and Laurent series, poles and singularity of zeros, residue theorem.	**12**
	Total No. of Teaching Hrs.	**42**
Textbooks/ References	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/EC/BT/C302. ELECTRONIC CIRCUITS		
Course Objective	1. To understand the basic circuit operation of diode, BJT, MOSFET and amplifiers. 2. To understand the construction, operating principle of Feedback and Power amplifiers.	
Course Outcome	After Completion of this course the student would be able to 1. Develop skills in the basics of the electronic devices and associated circuits. 2. Identify the components and design the circuits. 3. Incorporate the circuits with the software like PSPICE.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction and Diode Circuits	Natural signals and need of amplification; linearity, gain, decibel, bandwidth, power dissipation; amplifier biasing and small signals; dc and ac analysis; small signal model of diode; input impedance, output impedance, and methods for their estimation; Circuit models for different amplifier types: voltage, current, transconductance, trans-resistance; Introduction to octagon of tradeoffs in analog circuits; Diode Circuits: Rectifiers, Clippers, Clampers; Zener diode and its application.	**8**
BJT and MOSFET Amplifiers	Small signal model of BJT; BJT Amplifiers: Operating point analysis: simple biasing, resistive divider biasing, biasing with emitter degeneration, self-bias; Small Signal Analysis of different topologies: CE, CE with emitter degeneration, CB, CC (Emitter follower); examples of amplifier design procedures, Multi-stage amplifier; basic BJT current mirror circuit, BJT differential amplifier; Small signal model of MOSFET, MOS Amplifier topologies and their comparison; Operating point and small signal analysis of CS, CS with current source load, CS with diode connected load, CS with source degeneration, CG, CD (source follower); basic MOS current mirror circuit, MOS differential amplifier.	**10**
Frequency Response	Frequency domain analysis: transfer function, poles and zeroes in circuits, Bode plot, miller's theorem, high-frequency models for BJT and MOSFET; transit or cut-off frequency of device; frequency response of CE and CS amplifier and calculation of their poles, zeroes; bandwidth, effect of frequency on I/O impedances.	**9**
Feedback Amplifiers and Oscillators	Negative feedback: gain desensitization, bandwidth extension, modification of I/O impedances, linearity improvement; types of amplifiers: voltage, trans-impedance, trans-conductance, and current amplifiers; Sense and return techniques; polarity of feedback; feedback topologies: voltage-voltage feedback, voltage-current feedback, current-voltage feedback, current-current feedback; Stability in feedback systems: problem of instability, stability condition, Nyquist stability criterion, phase margin, frequency compensation; Barkhousen condition for Oscillations, Sinusoidal oscillators: RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.); non-sinusoidal oscillators.	**9**
Power Amplifiers	Distortion and efficiency; emitter follower as power amplifier; push-pull stage, high fidelity design using feedback; heat dissipation, thermal runaway; efficiency of emitter follower and push-pull stage; power amplifier classes; Tuned Amplifiers: basics, inductor losses, transformer coupled amplifiers, amplifier with multiple tuned circuits, class C tuned amplifier.	**9**
	Total No. of Teaching Hours	**45**
Textbooks	1. Sedra, Smith, "Microelectronic Circuits", Oxford University Press. 2. Behzad Razavi, "Fundamental of Microelectronic Circuits", Wiley.	
References	1. Millman, Halkias, "Electronic Devices and Circuits". 2. B. G. Streetman, "Solid state Devices", Pearson. 3. David A. Bell, "Electronic Devices and Circuits". 4. R. L. Boylestad, L. Nashelsky, "Electronics Devices & Circuit Theory" PHI.	

SET/IE/BT/C303. SIGNALS AND SYSTEMS		
Course Objective	1. To provide the fundamental knowledge of different signals and systems. 2. To analyze the various systems using Fourier, Laplace and Z-transforms.	
Course Outcome	After Completion of this course the student would be able to 1. Classify systems based on their properties and determine the response of LSI system using convolution. 2. Use the Laplace and Fourier transforms to analyze continuous and discrete time signal and system. 3. Apply the Z – transform to analyze the discrete – time signals and systems.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction to Signals	Classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable. Sampling, Quantization, Encoding; Sampling theorem.	**8**
Introduction to Systems	Properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions; Impulse response of a physical system, Introduction to convolution, Convolution integral, numerical convolution, auto correlation function, properties of auto correlation function, cross correlation functions, properties of cross correlation functions.	**8**
Fourier Analysis	Representation of signals in terms of elementary signals, condition for orthogonality, representation of signals by elementary sinusoids, Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum, Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform.	**12**
Laplace Transform	Convergence of Laplace transform, Properties of Laplace transform, inversion of Laplace transform, solution of differential equation, bilateral Laplace transform.	**8**
Z-Transform	Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform, evaluation of system frequency response, applications of Z-transform.	**8**
	Total No. of Teaching Hours	**44**
Textbooks	1. Simon Haykin, "Signals & Systems", John Wiley publications. 2. Oppenheim, Wilskey, "Signals and Systems", PHI publications.	
References	1. B. P. Lathi, "Linear Systems and Signals", OUP publications. 2. Paopoulis, "Signal Analysis", TMH publications.	

SET/IE/BT/C304. ELECTRICAL MEASUREMENTS AND INSTRUMENTATION		
Course Objective	1. To know the construction and working principle of basic electrical instruments. 2. To understand the measurement methods of resistance, inductance, capacitance, and frequency using bridges.	
Course Outcome	After Completion of this course the student would be able to 1. Use, measure and analyze the instruments. 2. Understand the operation of different electrical instruments used for measurement purpose. 3. Identify the appropriate instruments for measurement of different quantities.	
Module Name	**Content**	**No. of Teaching Hrs.**
Electrical Instruments	D'Arsonval Galvanometer. Working principle and operation of PMMC, MI, electrodynamometer and rectifier type instruments. Wattmeters - introduction, electrodynamics type wattmeter, theory, shape of scale, errors. Potentiometers - DC potentiometer - introduction, basic potentiometer circuit, laboratory type, multi-range, precision type, Vernier type, volt ratio box, applications. AC potentiometer - introduction, types, applications. Instrument transformers - introduction, use, ratios, burdens. Current transformers - relationships, errors. Potential transformer - introduction, relationships, errors.	**16**
Measurements	Measurement of voltage, current, power, power factor and energy. Measurement of resistance - measurement of low (Kelvin double bridge method), medium (ammeter-voltmeter, substitution, Wheatstone bridge & Ohmmeter method) and high resistance (guard circuit, direct deflection, loss of charge and Megohm bridge method) and earth resistance measurement.	**16**
AC bridges	Sources and detectors, general equation for bridge balance, general form of AC bridge. Self inductance bridges - Maxwell's inductance, Maxwell's inductance-capacitance, Hay's, Anderson and Owen's bridge. Capacitance bridges - Desauty and Schering bridges. Mutual inductance bridges – Heaviside and Campbell bridges. Frequency bridge – Wien's bridge. Sources of errors in bridge circuits.	**13**
	Total No. of Teaching Hours	**45**
Textbooks/ References	1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation". 2. E. W. Golding & F. E. Widdis, "Electrical Measurements and Measuring Instruments". 3. David A. Bell "Electronic Instrumentation and Measurements", Prentice-Hall of India.	

SET/EC/BT/C303. DIGITAL ELECTRONICS		
Course Objective	1. To revise and extend the basic knowledge of number system and logic gates. Simplification of the complex Boolean expression using K-map. 2. To understand the combinational and sequential logic circuits. 3. To get the basic knowledge of logic families and semiconductor memories.	
Course Outcome	After Completion of this course the student would be able to 1. Describe and demonstrate the use of digital test equipments and its operating characteristics. 2. Identify and describe the combinational and sequential logic circuits. 3. Understand the different memory devices.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction	Positional number system; Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers. Definition and specification of combination logic; Truth table; Basic logic operation and logic gates; Binary coded decimal codes; Gray codes.	**6**
Boolean Algebra and Switching Functions	Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map.	**4**
Logic Families	Diode, BJT and MOSFET as a switch. Introduction to different logic families; Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product; circuit description and operation; RTL; DTL, HTL, TTL and sub families, Brief idea of ECL, CMOS BI-CMOS.	**10**
Combinational Logic	Arithmetic modules: adders, subtractors and ALU; Design examples. Decoders, encoders, multiplexers and de-multiplexers; Parity circuits and comparators.	**6**
Sequential Logic	Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop and their inter-conversions; Timing hazards and races; Meta-stability; Analysis of state machines using D flip-flops and JK flip-flops; Definition of state machines, synchronous sequential logic, shift register, counters-ripple and mod counters.	**12**
Semiconductor Memories	RAM, ROM, Content Addressable Memory, Charge Coupled Device Memory. PLAs, PALs and their applications; Sequential PLDs and their applications.	**4**
	Total No. of Teaching Hours	**42**
Textbooks	1. Morris Mano, "Digital Design".	
References	1. Taub, Schilieng, "Digital Integrated Electronics". 2. Anad Kumar, "Digital principles and application". 3. John F Wakerly, "Digital Design: Principles and Practices", Prentice Hall. 4. Thomas L. Floyd, "Digital Fundamentals", Pearson/ Prentice Hall. 5. Ronald J. Tocci, "Digital Systems: Principles and Applications", Pearson/ Prentice Hall. 6. Charles Roth, "Fundamentals of Logic Design", Jaico Publishing House.	

SET/IE/BT/C305. SIGNALS AND NETWORKS LAB	
Content	**No. of Hrs.**
1. Programming using MATLAB.	10x2
2. Verification of principle of superposition with dc and ac sources. 3. Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits. 4. Verification of Tallegen's theorem for two networks of the same topology. 5. Determination of transient response of current in RL and RC circuits with step voltage input. 6. Determination of frequency response of current in RLC circuit with sinusoidal ac input.	5x2
Total No. of Hours	**30**

SET/IE/BT/C306. ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB	
Content	**No. of Hrs.**
1. Calibration of instruments: AC voltmeter and ammeter. 2. Wheatstone bridge and Kelvin's bridge for measurement of resistance. 3. Maxwell's Inductance, Hay's, Anderson and Owen's bridges for self inductance measurement. 4. Schering and Desauty bridges for capacitance measurement. 5. Heaviside and Campbell bridges for mutual inductance measurement.	15x2
Total No. of Hours	**30**

SET/EC/BT/S307. ELECTRONIC CIRCUITS LAB		
Module Name	**Content**	**No. of Hrs.**
Experiments and Simulations	Hands-on experiments and simulations related to the contents of Electronic Circuits and Digital Electronics courses.	14x4
	Total No. of Hours	**56**

Indian Knowledge System-I
As prescribed by the University

Semester IV

SET/IE/BT/C401. SENSORS AND TRANSDUCERS		
Course Objective	To understand the construction and working principle of various instruments for the measurement of different physical quantities, and their signal conditioning.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the dynamics of the Sensors/ transducers. 2. Select a suitable transducer for a given application. 3. Design a sensor/transducer as per the requirement.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction	Sensors and Transducers; Types of sensors and transducers; Characteristics of transducers, static calibrations, mathematical model of transducers, 0, 1st, 2nd order transducers, response to step, ramp and impulse inputs.	**6**
Measurement & Error Analysis	Units and standards, calibration techniques, classification of errors. Static and dynamic characteristics - accuracy, repeatability, hysteresis, resolution, reproducibility, precision etc.	**5**
Displacement, Speed, Velocity and Acceleration Measurement	Resistive transducers, Potentiometric, metal and semiconductor strain gauges, strain gauge applications; inductive transducers, Transformer type, LVDT, synchros, eddy current transducers, proximity detectors; capacitive transducers; Relative velocity, translational & rotational velocity measurement, revolution counters & timers, magnetic & photoelectric pulse counting, Tacho generators, stroboscopic methods. Basics of Gyroscope; Accelerometers – seismic, piezoelectric; Hall effect sensors, Magnetostrictive transducers.	**12**
Force, Power, Torque, Shock & Vibration Measurement	Force measurement, analytical balance, weighing systems and weighers, spring balance, load cell, pneumatic load cell, magneto-elastic load cell, piezoelectric load cell, elastic load cell. Torque measurement - mechanical, optical and electrical methods. Power measurement-dynamometers. Vibration measurement, vibrators shaper, piezo-electric and variable reluctance pick-ups.	**10**
Signal Conditioning	Instrumentation amplifier, lock-in amplifier, charge amplifier; Active and Passive Filters- 1^{st}, 2^{nd} order filters, LP, HP, notch, all pass filters, Butterworth, elliptic, Bessel and chebyshev filters.	**12**
	Total No. of Teaching Hours	**45**
Textbooks	1. Murthy D. V. S., "Transducers and Instrumentation", Prentice Hall, New Delhi, 1995.	
References	1. Renganathan, S., "Transducer Engineering", Allied Publishers, 2003. 2. Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd., 2003. 3. C. S. Rangan, V. S. V. Mani & G. R. Sharma, "Instrumentation Devices and Systems", Mcgraw Hill Education. 4. A. K. Sawhney, "Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai Publication. 5. John P. Bentley, "Principles of Measurement Systems", 3rd Edition, Pearson Education. 6. H. K. P. Neubert, "Instrument Transducers", Oxford University Press. 7. E. O. Doebelin, "Measurement Systems Application and Design", McGraw Hill publications. 8. P. Horowitz & W. Hill, "The Art of Electronics", Cambridge Press publications.	

SET/IE/BT/C402. MICROPROCESSORS AND INTERFACING		
Course Objective	1. To understand the Assembly language programming using 8085 microprocessor instruction set. 2. To understand the concept of interfacing of 8085 microprocessor with different ICs.	
Course Outcome	After Completion of this course the student would be able to 1. Learn internal organization of some popular microprocessors. 2. Understand the hardware and software interaction and integration of different microprocessors. 3. Implement the 8085 programming for different field applications. 4. Understand the basic idea about data transfer schemes and its applications.	
Module Name	**Content**	**No. of Teaching Hrs.**
Architecture	Introduction to microcomputer, CPU, microprocessors (8085, Z-80, Motorola 6800 CPU), General 8-bit microprocessors, Architecture of 8085 microprocessor and its functional blocks. ALU, Timing and control unit, Interrupts, flag register, general purpose registers, PC and SP, and different pins.	**5**
Instruction set	Instruction set of 8085 CPU- Data transfer group; Arithmetic group; Logic group; Branching group; stack operation, I/O and Machine control group.	**7**
Memory interfacing	Memory and I/O interfacing, Interfacing of 8085 with 64K x8, 16K X8 , 8K X8, 4K X8 bit memory RAM/ROM chips. Consideration of loading effect.	**4**
Assembly Language Programming	Simple assembly language programming practices on data transfer, arithmetic, logic, stack and subroutines, I/O, etc.	**8**
Timing diagrams	T- state, Machine cycle, Instruction cycle, fetch and execution operations, timing diagrams, estimation of execution time.	**6**
Interfacing ICs	Different data transfer modes, PPI 8255, USART 8251; Architecture of PPI 8255 and its functional blocks; I/O ports; programming of 8255 in I/O and BSR mode; application of 8255 in different I/O modes. Architecture of USART 8251, and its programming in different modes. Idea of the use of 8279, 8259 chips.	**6**
Data Transfer & Interfacing applications	Data transfer schemes, programmed I/O, interrupt structure of 8085, and interrupt driven I/O, interfacing of A/D and D/A converters, Data acquisition systems, temperature control, waveform generation and stepper motor control.	**6**
	Total No. of Teaching Hours	**42**
Textbooks	1. R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with 8085", Penram International Publishing, 1996. 2. Ghosh and Shridhar, "0000 to 8085 Microprocessor".	
References	1. D. V. Hall, "Microprocessors and Interfacing", Mc Graw Hill Higher Education, 1991.	

SET/IE/BT/C403. ELECTRICAL MACHINES		
Course Objective	To obtain the constructional and operating knowledge of transformer, induction motor and synchronous machine, and DC generator and motor.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the construction, working principle and equivalent circuit diagram of transformers. 2. Analyze the construction, characteristics and applications of DC generator and motor. 3. Analyze the starting & speed control of DC, induction and synchronous Motors.	
Module Name	**Content**	**No. of Teaching Hrs.**
Transformers	Basics of transformer; Equivalent circuit of transformer; Transformer and its phasor diagram with and without load; Losses in transformer; Efficiency of transformer; Volt-second balance; Power handling capability of a transformer; Open circuit and short circuit test of transformer; Auto transformer.	**8**
DC Machines	Constructing feature and principle of operation of generators and motors; Armature circuit equation for motoring and generation; Types of field excitations: separately excited, shunt and compound; Torque-speed characteristics of separately excited, shunt, series and compound motors; Performance characteristics of generators and motors; Starting, speed control and braking of motors; Two quadrant and four quadrant operation of motors; Choice of dc motors for different applications; Losses and efficiency.	**12**
Induction Motors	Starters for cage and wound rotor type induction motors; Speed control and braking; Torque slip characteristics; Single phase induction motors and methods of starting; Principle and operation of three phase induction motor; Different methods of speed control.	**10**
Synchronous Machines	Construction, emf, effect of pitch and distribution; Armature reaction and determination of regulation of synchronous generators; Principle of motor operation, effect of excitation on line current (V-curves) method of synchronization; Typical applications of ac motors in industries.	**12**
	Total No. of Teaching Hours	**42**
Textbooks/ References	1. I. J. Nagrath and D. P. Kothari, "Electrical Machines", Tata McGraw Hill. 2. P. S. Bimbhra, "Electrical Machinery", Khanna Publications, Delhi. 3. B. L. Theraja, "Electrical Technology Vol-II", Tata McGraw Hill. 4. Cotton H., "Advance Electrical Technology", Wheeler & Co.	

SET/IE/BT/C404. CIRCUIT THEORY		
Course Objective	1. To make capable to the learner to solve any electrical network using network theorems, transient, and s-domain analyses. 2. To synthesize/realize any electrical network using Cauer and Foster methods.	
Course Outcome	After Completion of this course the student would be able to 1. Apply transformation of a network to analyze in time domain and s-domain. 2. Apply various network theorems and transient analysis to determine the circuit response/behavior. 3. Analyze the RC, RL and RLC networks with the help of Positive Real Function, Foster form, and Cauer form.	
Module Name	**Content**	**No. of Teaching Hrs.**
Networks and Transients	Basic elements of electrical network: Resistor, capacitor, inductor, voltage and current sources; Review of KVL, KCL, and network theorems: Thevenin's & Norton's theorem, superposition theorem, maximum power transfer theorem, reciprocity theorem, Tellegen's theorem, Millman's theorem, Star-Delta and Delta-Star Transformation; Transients in linear circuits: Initial conditions, complete response, analysis of RC and RL circuits with impressed DC voltage, RC network as differentiator and integrator, DC transients in RLC circuits; Introduction to network topology: Definition of basic terms, graph, oriented graph, tree and co-tree of the graph, tie-sets, cut-sets, and matrices, incidence and reduced incidence matrix.	**14**
S-Domain Analysis and Network Functions	S-domain analysis of circuits: Review of Laplace transform, transformation of a circuit into S-domain, transformed equivalent of inductance, capacitance and mutual inductance, impedance and admittance in the transformed domain; Network functions: Driving point and transfer functions, poles and zeros, restriction of pole and zero locations of network functions.	**8**
Two Port Networks	Characterization in terms of impedance, admittance, hybrid and transmission parameters, Inter relationships among parameter sets, Interconnection of two port networks: Series, parallel and cascade, Symmetrical two port networks: T and π Equivalent of a two port network; Symmetrical two port reactive filters: Filter fundamentals, constant-k low pass and high pass filters, band pass and band elimination filters, m-derived T and π sections and their applications for infinite attenuation and filter terminations.	**10**
Network Synthesis	Driving point functions, Hurwitz polynomials and its properties, Positive real function and its features, Testing of driving point functions, Driving point Synthesis of RC, RL and LC networks, Realization of networks using Foster and Cauer forms.	**10**
	Total No. of Teaching Hours	**42**
Textbooks/ References	1. D. Roy Choudhary, "Network and Systems", Wiley Eastern. 2. Abhijit Chakrabarti, "Circuit Theory: Analysis and Synthesis", Dhanpat Rai & Co. 3. Van Valkenburg M. E., "Network Analysis", 3rd Edition, Prentice Hall. 4. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013. 5. Franklin F. Kuo, "Network Analysis and Synthesis", John Wiley & sons.	

SET/EC/BT/C402. ANALOG INTEGRATED CIRCUITS		
Course Objective	1. To study the operation of operational amplifier and its various applications in different electronic circuits. 2. To obtain the basic knowledge of PLL and its applications. 3. To study the different power supply regulator circuits, and DACs and ADCs.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the operation of op-amp and its various applications, e.g., Instrumentation amplifiers, active filters, multivibrators and pulse shaping circuits. 2. Explain the concepts of PLL and its applications. 3. Design the different power supply regulator circuits, and different ADCs and DACs.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction	Operational Amplifiers, DC and AC characteristics; Applications of Op-amp: Precision rectifiers, Log and antilog amplifiers, four quadrant multipliers. Instrumentation amplifier, Sample and Hold Circuits.	**12**
Active Filters	Introduction to filters. Butterworth, Chebyshev & Bessel filter; LC ladder filter – prototype & synthesis; Frequency transformation of low pass filter. Impedance converters; Gm-C filters, Active-RC Filters; Switched capacitor filter.	**9**
Multivibrators and Pulse Shaping Circuits	Multivibrators using op amps; 555 timer; Triggering circuits for bistable and monostable multivibrators; Programmable timer; Pulse shaping circuits.	**6**
PLL	Analog multiplexer, PLL and its applications, Frequency synthesizers, Coherent synthesizers using PLL, Direct digital synthesis, Phase noise in oscillators.	**6**
Power Supply Regulators and DACs and ADCs	Voltage regulators, Regulators using op amps, IC regulators, Protection circuits, Foldback current limiting, current boosting of IC regulators, switching regulators. D/A Converter – General considerations, Static non-idealities and Dynamic non-idealities; Current-steering DAC – Binary weighted DAC, Design issues, Effect of Mismatches. A/D converter – General considerations, static and dynamic non-idealities; Flash ADC – Basic architecture, Design issues, Comparator and Latch, Effect of non-idealities, Interpolative and folding architectures. Successive Approximation ADC; Pipeline ADC.	**12**
	Total No. of Teaching Hours	**45**
Textbooks	1. S. Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", (3/e) TMH, 2003. 2. R. Gayakwad, "Op-amps and Linear Integrated Circuits", (4/e), PHI. 3. Coughlin, "Op-amps and Analog Integrated Circuits", PHI.	
References	1. D. A. Bell, "Solid State Pulse Circuits", (4/e), PHI. 2. M. E. Van Valkenburg, "Analog Filter Design", Oxford University Press, 1995. 3. R. Schaumann and M. . Van Valkenburg, "Design of Analog Filters", Oxford University Press, 2003. 4. Behzad Razavi, "Principles of Data Conversion System Design", Wiley-IEEE Press, 1995. 5. Rudy J. van de Plassche, "CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters", Springer, 2003. 6. Choudhury, R. and Jain, S., "Linear Integrated Circuits", 3rd Edition.	

SET/IE/BT/C405. SENSORS AND TRANSDUCERS LAB	
Content	**No. of Hrs.**
1. Displacement vs. output voltage characteristics of a LVDT. 2. Strain gauge characteristics. 3. Characteristics of RTD, Thermistor. 4. Hall Effect transducer. 5. Linear velocity measurement using proximity sensor. 6. Angular velocity measurement using stroboscope, tachometer. 7. Torque measurement.	14x2
Total No. of Hours	**28**

SET/IE/BT/C406. ELECTRICAL MACHINES LAB	
Content	**No. of Hrs.**
1. Speed control of DC shunt motor. 2. Brake test on DC shunt motor. 3. Load test on single - phase transformer. 4. Load test on three - phase induction motor. 5. Brake test on single - phase induction motor. 6. Open and short circuit test of transformer. 7. Speed control of three phase induction motor.	14x2
Total No. of Hours	**28**

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SET/IE/BT/S407. MICROPROCESSORS LAB AND MIINI PROJECT	
Content	**No. of Hrs.**
1. Familiarization with 8085 microprocessor kit and its keyboard. 2. Exercises with entry and manipulation of data (Different addressing modes). 3. Programming exercises using 8051 microcontroller. 4. Programming exercises to interface LCD with microcontroller. 5. Programming exercises using timers, counters, interrupts; Memory Interfacing. 6. Interfacing serial communication with PC using 8051. 7. Interfacing Stepper motor with 8051. 8. Simulation of traffic lights. 9. Interfacing LCD with Arduino and display of a message. 10. Temperature monitoring and display on LCD. 11. RTC Initialization and display of clock on LCD. 12. Driving Stepper motor. 13. Speed control of DC motor using Arduino. 14. Line following cart. 15. Analog to digital conversion.	15x4
Total No. of Hours	**60**

Semester V

SET/IE/BT/C501. POWER SYSTEMS		
Course Objective	1. To understand the structure of power systems and its load characteristics. 2. To understand the concepts of transmission line parameters, i.e., resistance, inductance, capacitance, etc. 3. To understand the practical aspects of power systems using the concepts of load flow and fault analysis.	
Course Outcome	After Completion of this course the student would be able to 1. Learn the characteristics, design and operating criteria of modern power system. 2. Understand the transmission line parameters, configurations and their calculations. 3. Analyze the practical issues using load flow and fault analysis.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction to Power System	Structure of power systems and few other aspects; Load characteristics: Types of load, Definition of commonly used terms in power systems such as demand factor, diversity factor, load diversity, load factor, loss factor, etc; Brief description of power system elements such as transformer, busbar, circuit breaker etc; Per unit system and their application to power system network.	**8**
Transmission Lines	Conductor materials, types of conductors; Resistance, inductance and capacitance parameters of lines, Current distortion effects: Skin, Proximity, etc; Mathematical analysis of transmission lines; Interference with communication lines, reduction methods; Characteristic and performance of transmission lines.	**10**
Load Flow Analysis	Complex power; Y bus and Z bus formulation; Load flow analysis: Newton Raphson and fast decoupled methods.	**6**
Symmetrical Fault	Symmetrical three phase fault; Short circuit capacity; Systematic fault analysis using bus impedance matrix; Formation of Z_{bus} using singular transformation and algorithm.	**6**
Symmetrical Components and Unsymmetrical Fault	Fundamentals of symmetrical components; Sequence impedances and sequence networks; Analysis of single line to ground fault, line-to-line fault and double line to ground fault on an unloaded generators and power system network with and without fault impedance.	**12**
	Total No. of Teaching Hours	**42**
Textbooks/ References	1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994. 2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995. 3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999. 4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003. 5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012. 6. Hadi Saadat, "Power Systems Analysis", McGraw Hill, 1999.	

SET/IE/BT/C502. CONTROL SYSTEMS		
Course Objective	1. To learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective. Representation of system by transfer function and block diagram reduction method. 2. To learn time response analysis and demonstrate their knowledge to frequency response. 3. To learn stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot. 4. To understand the concept of state space variable using state equation and state transition matrix.	
Course Outcome	After Completion of this course the student would be able to 1. Identify open and closed loop control system, and formulate mathematical model for physical systems. 2. Simplify the complex systems using reduction techniques. 3. Analyze the performance characteristics and stability of system using frequency response methods. 4. Build the state space model of system in different forms.	
Module Name	**Content**	**No. of Teaching Hrs.**
Basics of Control	Definitions of control systems, Closed loop and open loop control systems, system components, basic elements in control systems - open and closed loop system, electrical analogy of physical system, transfer function, mathematical modeling and transfer function of different physical systems, block diagram, reduction techniques, signal flow graph.	**8**
Time Response Analysis	Time domain specifications, types of test inputs, I and II order system response, error coefficients, generalized error series, steady state error, PID controller response for first and second order system. Concepts of Rise Time, Peak Time, Maximum Peak Overshoot and Settling Time.	**10**
Stability of Control Systems	Characteristic equation, location of roots in S-plane for stability, Routh Hurwitz criterion, roots locus techniques.	**8**
Frequency Response Analysis	Frequency response - definition, bode plot, polar plot, gain margin and phase margin, Nyquist stability criterion and application.	**10**
State space analysis	Concepts of state, state variable and state model, state space models for linear control systems, solution of state equation, state transition matrix, concept of controllability and observability.	**8**
	Total No. of Teaching Hours	**44**
Textbooks	1. I. G. Nagrath, M. Gopal, "Control Systems", Wiley, New York, 1983.	
References	1. K. Ogata, "Modern Control Engg", PHI publications. 2. B. C. Kuo, "Automatic Control Systems", Prentice Hall.	

SET/IE/BT/C503. INDUSTRIAL INSTRUMENTATION		
Course Objective	1. To make capable to study the properties of density, viscosity, humidity and moisture content. 2. To acquire extensive knowledge of pressure, temperature measurement techniques. 3. To acquire the knowledge of variable head, variable area, and mass flow meters.	
Course Outcome	After Completion of this course the student would be able to 1. Explain the construction and working principle of instruments used to measure the density, viscosity, humidity and moisture content. 2. Understand the measurement system used for pressure and temperature measurements. 3. Determine the coefficient of discharge using variable head, variable area, and mass flow meters.	
Module Name	**Content**	**No. of Teaching Hrs.**
Density & Viscosity Measurement	Definition of density, units and its representation, specific gravity scales used in different industries; Density measurement methods- strain gauge load cell, LVDT type, buoyancy method, air-pressure balance method, gamma ray method, vibrating probe method; Basic definition and units of Viscosity; Viscosity measurement methods- falling sphere, rotating cylinder type, Saybolt, Redwood, Engler, rotameter type, cone and plate viscometer; Industrial consistency meter- rotating wane, oscillating type.	**6**
Humidity and Moisture Measurement	Humidity measurement- dry and wet psychrometer, hair hygrometer, resistance element type, saturated-salt dew-point sensor, electrolytic hygrometer, aluminium oxide sensor, quartz crystal type; Moisture measurement- thermal drying, distillation method, chemical reaction methods, electrical methods.	**6**
Pressure Measurement	Basic definition and classification of pressure measurement, units of pressure; Manometers; Elastic type of pressure gauges- Bourdon tubes, bellows and diaphragms; Bell type and slack diaphragm pressure gauges; Electrical methods of pressure measurement- pressure gauges based on resistive, capacitive, inductive and piezo-electric principles, differential pressure transmitters; Testing & calibration of pressure gauges- manometric and dead weight tester methods.	**10**
Temperature Measurement	Temperature scales; Filled-in system- liquid filled, gas filled, vapour pressure thermometer, sources of errors, compensation techniques; Bimetallic thermometers; Electrical methods of temperature measurement- Construction, working principles and applications of RTDs and Thermistors; Thermocouples- working & construction, types of thermocouples, laws of thermocouples, compensation methods; Pyrometers & miscellaneous- basic principles, radiation pyrometer, thermal detectors, pyroelectric detectors, optical pyrometers, selection of temperature sensors.	**10**
Flow Measurement	Physical properties of flow, fundamentals of flow measurements; Differential pressure flow meters- operating principles of orifice, venturi meter, pitot tube; Mechanical type flow meters- principle of operation, element of construction and application of inferential flow meter, rotameter, turbine flow meters, target flow meter, etc; Electrical type flow meters- principle of operation, construction and applications of electromagnetic flow meters; Ultrasonic flow meters, cross correlation flow meters, vortex shedding flow meters; Open channel flow measurement- weirs and flumes; Mass flow meters.	**12**
	Total No. of Teaching Hours	**44**
Textbooks/ References	1. Doebelin E. O., "Measurement Systems: Application and Design", McGraw Hill. 2. Patranabis D., "Principles of Industrial Instrumentation", Tata McGraw Hill. 3. Holman P., "Experimental Methods for Engineers", 6th Edition, McGraw – Hill Book Coy. 4. Douglas M. Considine, "Process / Industrial Instruments & Controls Handbook", McGraw Hill. 5. Eckman, D. P., "Industrial Instrumentation", Wiley Eastern Limited. 6. A. K. Sawhney, "Mechanical Measurements and Instrumentation", Dhanpat Rai & co. 7. K. Krishnaswamy, "Industrial Instrumentation", New Age International Publishers.	

SET/IE/BT/E501. POWER ELECTRONICS		
Course Objective	1. To provide the detailed overview about operation of power semi conductor devices. 2. To provide the knowledge to design protection circuits for power semiconductor devices used in power converters.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the fundamental concepts and techniques used in power electronics. 2. Analyze the basic operation and characteristics of SCR, DIAC, TRIAC, MOSFET, GTO, IGBT and UJT. 3. Analyze the various single phase and three phase power converter circuits and understand their applications. 4. Understand the working principle of chopper and series resonant inverter.	
Module Name	**Content**	**No. of Teaching Hrs.**
Characteristics of Power Devices	Characteristics of SCR, DIAC, TRIAC, SCS, GTO, PUJT, power transistors, power FET's LASCR, two transistors model of SCR, thyristor turn on time- spread, delay and rise time, protection of thyristors against over voltage and over current, dv/dt and di/dt. Commutation Circuits - Turn on circuits for SCR triggering with single pulse and train of pulses - synchronizing with supply, different commutation techniques, series and parallel operation of SCR.	**16**
Converter Single Φ	Converters - single phase, half controlled and fully controlled rectifiers, waveforms of load voltage and line current under constant load current, dual converter.	**10**
Inverters Single Φ	Line commutated and forced commutated inverters, voltage source and current source inverters, parallel inverter, series inverter, PWM inverters, AC & DC choppers, step-up and step-down, cyclo converters.	**10**
Applications	AC and DC motor speed control, battery charger, switching mode power supply, uninterruptible power supply, induction and dielectric heating.	**8**
	Total No. of Teaching Hours	**44**
Textbooks	1. P. S. Bhimra, "Power Electronics", Khanna Publication, Delhi. 2. M. H. Rashid, "Power Electronics", PHI Private Ltd. New Delhi.	
References	1. N. Mohan, T. M. Undeland & W. P. Robbins, "Power Electronics" John Wiley & Sons, Inc, 2003. 2. M. D. Singh & K. B. Khanchandani, "Power Electronics", Tata McGraw-Hill Education.	

SET/IE/BT/E502. ELECTRICAL DRIVES		
Course Objective	1. To give the overview about the basics of industrial drives. 2. To understand the implementation of power semi conductor devices in industrial drives applications. 3. To know the design and selection of drives in industrial application.	
Course Outcome	After Completion of this course the student would be able to 1. Analyze the different speed control methods of AC and DC motors using power devices. 2. Understand the construction and operation of traction drives and switched reluctance motor.	
Module Name	**Content**	**No. of Teaching Hrs.**
DC motor characteristics	Introduction to Electrical Drives; Dynamics of Electrical Drives; Review of Torque-Speed Characteristics of DC Motors (Shunt and Series) including Motoring and Braking.	**5**
Converter fed DC drive	Converter (Half Controlled Converter, Full Controlled Converter, Dual Converters); Control of DC Motor Drives; Torque Speed Characteristics of Converter-fed DC Drives.	**5**
Chopper controlled DC motor	Chopper Controlled DC Drives (Single and Multi-quadrant Converters), Motoring and Braking operations.	**5**
Induction motor drives	Induction Motor Drives – Equivalent circuits; Torque-speed characteristics; Operation of Induction Motor with Unbalanced Source Voltages; Analysis of Induction Motor from Non-sinusoidal Voltage Supply; Starting and Braking of Induction Motor.	**6**
Induction motor control	Stator Voltage Control of Induction Motor; Variable Voltage/ Current; Variable Frequency Control of Induction Motor Fed from VSI and CSI; Control of Slip-ring Induction Motor.	**8**
Synchronous motor drives	Synchronous Motor Characteristics (Cylindrical and Salient Pole); CSI-fed Synchronous Motor Drive; Permanent Magnet Synchronous Motor Drive; Brushless DC Motor Drives	**5**
Traction drives	Traction Drives – Characteristics of Traction Drives; Drive Power Requirement; DC and AC Traction.	**5**
Switched Reluctance and stepper Motor	Switched Reluctance Motor – Construction; Analysis and Closed-loop Control; Various Types of Stepper Motor and their Characteristics.	**5**
	Total No. of Hours	**44**
Textbooks	1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989.	
References	1. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001. 2. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002. 3. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.	

SET/IE/BT/E503. MATHEMATICS AND STATISTICS FOR DATA SCIENCE		
Course Objective	1. To build the basic knowledge of random variables to understand the concepts of data science. 2. To acquire the knowledge of differential statistics utilized in data science.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the different random variables and functions. 2. Understand the concepts of descriptive statistics, frequency distribution, central tendency of data, association of variables, etc.	
Module Name	**Content**	**No. of Teaching Hrs.**
Random Variables	Multiple random variables - Two random variables, Multiple random variables and distributions, Multiple random variables - Independence, Functions of random variables - Visualization, functions of multiple random variables, Expectations Casino math, Expected value of a random variable, Scatter plots and spread, Variance and standard deviation, Covariance and correlation, Inequalities, Continuous random variables Discrete vs continuous, Weight data, Density functions, Expectations, Multiple continuous random variables - Height and weight data, Two continuous random variables, Averages of random variables - Colab illustration, Limit theorems, IPL data - histograms and approximate distributions, Jointly Gaussian random variables Probability models for data - Simple models, Models based on other distributions, Models with multiple random variables, dependency, Models for IPL powerplay, Models from data.	**22**
Differential Statistics	**Introduction to descriptive statistics, frequency distribution:** Objectives, steps and basic definitions, variables and types of data, absolute frequency, relative frequency and frequency distribution, frequency distribution and cumulative distribution function. **Graphics and plots:** Bar diagrams, subdivided bar plots and pie diagrams, 3D pie diagram and histogram, Kernel density and stem- Leaf plots. **Central tendency of data:** Arithematic mean, median, quantiles, mode, range, interquartile range, quartile deviation. **Variation in data:** Absolute deviation and absolute mean deviation, mean squared error, variance and standard deviation, coefficient of variation and boxplots. **Moments, association of variables:** Raw and central moments, Sheppard's correction, absolute moments and computation of moments, skewness and kurtosis. **Association of variables:** Univariate and bivariate scatter plots, smooth scatter plots, Quantile- Quantile and three dimensional plots, correlation coefficient. **Association of variables, Fitting of Linear Models:** Rank correlation coefficient, measures of association for discrete and counting variables, least squares method-one variable.	**23**
	Total No. of Teaching Hours	**45**
Textbooks/ References	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". 5. Mercedes Orus Lacort, "Descriptive and Inferential Statistics: Summaries of Theory and Exercises Solved", 1st Edition, Lulu.com. 6. Zealure C. Holcomb, "Fundamentals of Descriptive Statistics", Taylor & Francis.	

SET/IE/BT/C504. POWER SYSTEMS LAB	
Content	**No. of Hrs.**
1. Testing of the earth fault ralay. 2. Testing of the transformer oil. 3. To demonstrate the power factor. 4. Transmission line trainer system. 5. Load flow/voltage drop, short circuit, optimal power flow, stability etc. analysis with the help of ETAP software.	14x2
Total No. of Hours	**28**

SET/IE/BT/C505. INDUSTRIAL INSTRUMENTATION LAB	
Content	**No. of Hrs.**
1. Verification of Bernoulli theorem. 2. Measurement of discharge coefficient and flow rate using Orifice. 3. Measurement of discharge coefficient and flow rate using Venturimeter. 4. Measurement of discharge coefficient and flow rate using Flow nozzle. 5. Measurement of flow rate using and Rotameter. 6. Pressure gauge calibration using Dead Weight Tester. 7. Temperature measurement using RTD, Thermistors. 8. Viscosity measurement using Falling Sphere method.	14x2
Total No. of Hours	**28**

SET/IE/BT/M506. YOGA PRACTICES	
Content	**No. of Hrs.**
1. Sookshm Vyayama **2. Surya Namaskar** **3. Shatkarm:** Tratak, Kapalbhati. **4. Standing Asana:** Tadasana, Tiryak Tadasana, Vrikshasana, Kati Chakrasana. **5. Sitting Asana:** Padmasana, Paschimottanasana, Ushtrasana, Gomukhasana. **6. Prone Asana:** Bhujangasana, Dhanurasana, Ardh Shalabhasana, Makarasana. **7. Supine Asana:** Pawan Muktasana, Uttanpadasana, Ardh Halasana, Shavasana. **8. Pranayama:** Nadi Shodhan, Bhramari, Bhastrika, Ujjayi. **9. Meditation** **10. Yognidra**	15x4
Total No. of Hours	**60**

SET/IE/BT/S507. MATLAB AND MINI PROJECT	
Content	**No. of Hrs.**
1. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results. 2. To study P, PI and PID temperature controller for an oven and compare their performance. 3. To design Lag, Lead and Lag-Lead compensators using Bode plot. 4. Determination of Transfer function, poles and zeroes. 5. Plots for Root Locus and determination for range of Gain. 6. Plots for polar plot and stability analysis through Nyquist criteria. 7. State space modal representation and analysis of system. 8. Real Time Temperature Graph using MATLAB. 9. DC Motor Control Using MATLAB. 10. Automatic Vehicle Counting using MATLAB. 11. Animations of Light through MATLAB. 12. Modelling a Dynamic Control System. 13. Frequency domain analysis Using Bode plot and determination of Gain margin Phase margin. 14. Serial Communication using MATLAB GUI.	14x4
Total No. of Hours	**56**

Semester VI

SET/IE/BT/C601. ANALYTICAL INSTRUMENTATION		
Course Objective	1. To acquire the knowledge of various techniques that occur in the various regions of the spectrum. 2. To understand the various qualitative and quantitative techniques for different type of samples. 3. To study various spectroscopic techniques and its instrumentation.	
Course Outcome	After Completion of this course the student would be able to 1. Get well versed with the principle, construction and working of various analytical instruments. 2. Get detailed information about the applications of analytical techniques in medicine, industry, etc. 3. Explain the various separation techniques and its instrumentation.	
Module Name	**Content**	**No. of Teaching Hrs.**
Analytical Methodology and sample preparation	Components of Analytical method, Technique selection, sample preparation and its importance. Microwave digestion.	**5**
EM Radiations and Spectrophotometers	Nature of EM radiation, EM spectrum. Atomic energy levels, Molecular electronic energy levels, vibrational energy levels. Beer Lambert law, Flame photometer, UV - Visible, IR spectrophotometers, sources of error in spectrophotometric measurements, calibration.	**5**
Atomic Absorption Spectrophotometers	Theoretical concepts, atomic absorption instrumentation, sources of interferences.	**5**
Mass Spectrometers	Basic mass spectrometer, different types of mass analyzers, components of a mass spectrometer, resolution. ICP-MS Introduction, working and major components, capabilities, applications.	**10**
X-Ray diffraction and Scanning electron microscopy	Introduction, how it works, powder diffraction, crystallite size and micro-strain. SEM: Construction, working, magnification, basics of sample preparation. Elemental detection.	**8**
Chromatography	Introduction to chromatography, how it works, types of chromatography, HPLC, construction and working. Applications of chromatography.	**10**
	Total No. of Teaching Hours	**43**
Textbooks	1. Willard, H. H., Merit, L. L., Dean J. A. and Seattle F. L., "Instrumental Methods of Analysis", CBS Publishing and Distribution. 2. R. S. Khandpur, "Handbook of Analytical Instruments".	
References	1. Settle, F. A., "Handbook of Instrumental Techniques for Analytical Chemistry", Prentice Hall. 2. Skoog D. A. and West D. M., "Principles of Instrumental Analysis".	

SET/IE/BT/C602. PLC AND AUTOMATION		
Course Objective	1. To give the basic idea of industrial automation using PLC, SCADA and DCS. 2. To provide the elementary knowledge of PLC ladder logic programming using timer, counter and various Instruction set.	
Course Outcome	After Completion of this course the student would be able to 1. Know the basics of PLC system and its components. 2. Learn the PLC ladder logic programming using timer, counter, and different instruction set. 3. Understand the structure of PLC communication.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction	About PLC, Parts of a PLC, PLCs versus computers, PLC size and application, Basic operation of PLC system, Basics of SCADA and DCS.	**6**
PLC Hardware	PLC hardware components: Input/output modules, processors, power supply, programming devices, Processor memory organization, Logical addressing.	**6**
PLC Programming	PLC programming languages, Ladder logic diagram (LLD), Implementation of logic gates and Boolean expressions using LLD, EXAMINE IF CLOSED and EXAMINE IF OPEN instructions, Switches: Manually and mechanically operated switches, Internal relay instruction, Seal-in circuit, Instructions of ladder programming: Program control instructions, data manipulation instructions, math instructions, sequencer and shift register instructions.	**14**
Timers and Counters	Introduction to timers and counters, Types of timers and counters, Retentive timers, Timers and counters programming, Cascading of timers and counters.	**10**
PLC Communication	Types of communication: Serial communication, industrial communication network, industrial I/O networks, different type of network communication protocol**.**	**6**
	Total No. of Teaching Hours	**42**
Textbooks/ References	1. W. Bolton, "Programmable Logic Controllers", Elsevier publications. 2. Krishna Kant, "Computer-based Industrial Control", Prentice Hall. 3. John. W. Webb Ronald A Reis, "Programmable Logic Controllers - Principles and Applications", Prentice Hall. 4. Lukcas M. P., "Distributed Control Systems", Van Nostrand Reinhold Co. 5. Frank D. Petruzella, "Programmable Logic Controllers", McGraw Hill. 6. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall.	

SET/IE/BT/C603. PROCESS CONTROL		
Course Objective	1. To understand the basic process dynamics involved in automatic process control system. 2. To study the construction and working of different discontinuous, continuous, pneumatic and electronic controllers, and their tuning methods. 3. To study the pneumatic, electric and hydraulic actuators, and different control valves.	
Course Outcome	After Completion of this course the student would be able to 1. Learn the necessity of process control, the mathematical modeling of different processes. 2. Learn different control actions and controllers like ON-OFF, P, P+I, P+I+D and about their tuning methods for setting optimum value. 3. Acquire the knowledge of final control elements.	
Module Name	**Content**	**No. of Teaching Hrs.**
Process Dynamics	Automatic process control system, process variables, process degree of freedom; Dynamics of simple pressure, flow, level and temperature processes; Interacting and non-interacting systems, continuous and batch process, self-regulation, servo and regulator operation, problems.	**8**
Controllers and Tuning	Basic control actions, Discontinuous controller modes: two position, multiposition, floating; Continuous controller modes: proportional, integral and derivative control modes; Composite controller modes: P+I, P+D and P+I+D control modes; Pneumatic, hydraulic and electronic controllers to realize various control actions; Optimum controller settings: evaluation criteria, $1/4^{th}$ decay ratio, ISE, IAE, ITAE; Controller tuning: process reaction curve method, continuous oscillation method, damped oscillation method, problems.	**14**
Multi Loop Control System	Feed forward control, ratio control, cascade control, split range, multivariable control and examples from distillation column & boiler system.	**10**
Final Control Element	I/P and P/I converters; Pneumatic, electric and hydraulic actuators; Valve positioner; Control valves: characteristics of control valves, valve body, globe, butterfly, diaphragm, ball valves; Control valve sizing; Cavitations and flashing problems.	**10**
	Total No. of Teaching Hours	**42**
Textbooks/ References	1. Wayne Bequette, "Process Control – Modeling, Design and Simulation", Prentice Hall. 2. Stephanopoulos, "Chemical Process Control", 2^{nd} edition, Prentice Hall. 3. Coughanowr, "Process Systems Analysis and Control", McGraw Hill. 4. Peter Harriott, "Process Control", Tata McGraw Hill. 5. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall. 6. Deshpande P. B. and Ash R. H., "Elements of Process Control Applications", ISA Press. 7. D. P. Eckman, "Automatic Process Control". 8. Smith C. L. and Corripio A. B., "Principles and Practice of Automatic Process Control", Wiley. 9. Pollard, "Process Control", Heinemann Educational Books. 10. Paul W. Murril, "Fundamentals of Process Control Theory", ISA press.	

SET/EC/BT/C601. DIGITAL SIGNAL PROCESSING		
Course Objective	1. To understand the properties of Z-transform. 2. To overview of DFT, FFT and problems in the fast Fourier transform. 3. To design IIR and FIR filters.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the properties of Z-transform. 2. Analyze the discrete Fourier transform and fast Fourier transform. 3. Design different digital filters (IIR and FIR).	
Module Name	**Content**	**No. of Teaching Hrs.**
Discrete Time Signals and Systems	Discrete time signals, discrete systems, difference equations, Discrete time Fourier transform (DTFT), Properties of DTFT, frequency domain representation of LTI systems, Sampling and reconstruction of analog signals.	**4**
Z- Transforms	Bilateral z-transform, important properties of the z-transforms, inverse z-transform, system representation in the z-domain, Implementation of discrete time systems, solution of the difference equations.	**6**
Discrete Fourier Transform	Discrete Fourier transform, properties of the discrete Fourier transform, linear & circular convolution using DFT, Fast Fourier Transform algorithm, inverse DFT using FFT algorithm.	**10**
Digital Filter Structures	Characteristics of prototype analog filters, analog-to-digital filter transformations, Basic elements, IIR filter structure, FIR filter structure, lattice filter structures.	**10**
Filter Design	Design of IIR & FIR filters; Butterworth, Chebyshev and Elliptic Approximations; Low pass, Band pass, Band stop and High pass filters, properties of linear-phase FIR filters, window design techniques, Park-McClellan's method.	**12**
	Total No. of Teaching Hours	**42**
References	1. A. Shalivahan, Digital Signal Processing, TMH. 2. A. V. Oppenheim & R.W. Schafer, Digital Signal Processing, Prentice Hall. 3. L. R. Rabiner & B. Gold, Theory and Applications of Digital Signal Processing, PHI. 4. A. Antoniou, Introduction of Digital Filters. 5. C. Emmanuel Ifeachor & W. Jervis Barrie, Digital Signal Processing, A Practical Approach. 6. Vinay K. Ingle & John G. Proakis, Digital Signal Processing.	

SET/IE/BT/E602. POWER PLANT INSTRUMENTATION		
Course Objective	1. To provide an overview on power generation through various methods. 2. To Acquire the knowledge of the various types of power plants and their instrumentation. 3. To learn how to operate the power system with economically.	
Course Outcome	After Completion of this course the student would be able to 1. Familiar with the basics of different power plants and power generation systems. 2. Understand the design of Analyzers and control loops used in power plants. 3. Learn the economic operation of the power system.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction to Conventional energy Sources	Steam, hydro, nuclear, diesel and gas, their scope and potentialities for energy conversion. Different factors connected with a generating station, load curve, load duration curve, energy load curve, base load and peak load plants.	**8**
Thermal power generation	Selection of site, size and no. of units, general layout, major parts, auxiliaries, generation costs of steam stations.	**7**
Hydro power generation	Selection of site, mass curve, flow duration curve, hydrograph, classification of hydro plants, types of hydro turbines, pumped storage plants.	**7**
Nuclear power generation	Main parts, location, principle of nuclear energy, types of nuclear reactors, reactor control, nuclear waste disposal.	**7**
Power station control and interconnection	Excitation systems and their types, excitation control, automatic voltage regulator action, interconnection of different power stations and their advantages.	**7**
Economic operation of power system	Introduction, distribution of load between units within the plant. Optimum generation scheduling considering transmission losses.	**6**
	Total No. of Teaching Hours	**42**
Textbooks	1. Sam. G. Dukelow, "The Control of Boilers", 2nd Edition, ISA Press. 2. Gill A. B, "Power Plant Performance", Butterworth. 3. P. C. Martin, I. W. Hannah, "Modern Power Station Practice", British Electricity International Vol. 1 & VI, Pergamon Press, London, 1992.	
References	1. David Lindsley, "Boiler Control Systems", McGraw Hill, New York, 1991. 2. Jervis M. J., "Power Station Instrumentation", Butterworth Heinemann, Oxford, 1993. 3. Modern Power Station Practice, Vol.6, "Instrumentation, Controls and Testing", Pergamon Press, Oxford, 1971.	

SET/IE/BT/E603. PYTHON FOR DATA SCIENCE		
Course Objective	To learn the basic programming of Python utilized in the field of data science.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the Jupyter setup, sequence data, Numpy, reading data, Pandas data frames, and exploratory data analysis. 2. Understand the confidence intervals, Gaussian distribution, Proportion and mean, and hypothesis testing.	
Module Name	**Content**	**No. of Teaching Hrs.**
Module-1	Introduction to Python for data science, Introduction to Python, Central tendency and dispersion, Introduction to probability, Sampling and sampling distribution, Variables and datatypes, Operators.	**8**
Module-2	Jupyter setup, Sequence data, Numpy, Reading data, Pandas data frames, Control structures and functions, Exploratory data analysis (EDA), Data Visualization: Matplotlib/ seaborn.	**12**
Module-3	Confidence Intervals, Normal distribution, Gaussian distribution, Uniform distribution, Proportion and mean, Hypothesis testing: Chi-Square test of independence, Chi-Square goodness of fit test, Anova test, P-test, T-test.	**12**
Module-4	Case Study: Implementing EDA, Drawing inference from the data, Hypothesis testing.	**10**
	Total No. of Teaching Hours	**42**
Textbooks/ References	1. Frank Kane, "Hands-On Data Science and Python Machine Learning", Packt Publishing Ltd. 2. Chantal D. Larose and Daniel T. Larose, "Data Science using Python and R", John Wiley & Sons, Inc. 3. Wes McKinney, "Python for Data Analysis", O'Reilly Media, Inc. 4. Kennedy Behrman, "Foundational Python for Data Science", Addison Wesley. 5. Prof. Raghunathan Rengasamy, "Python for Data science", NPTEL Lecture Series. 6. Prof. A. Ramesh, "Data Analytics with Python", NPTEL Lecture Series.	

SET/IE/BT/C604. ANALYTICAL INSTRUMENTATION LAB	
Content	**No. of Hrs.**
1. Verification of Beer Lambert law. 2. Determination of refractive index of $KMnO_4$ solution. 3. Determine the crystallite size and strain using powder x-ray diffraction. 4. Familiarization with ICP-MS instrument and working. 5. Familiarization with SEM instrument and working. 6. Determination of elements using Flame Photometer.	14x2
Total No. of Hours	**28**

SET/IE/BT/C605. PROCESS CONTROL LAB	
Content	**No. of Hrs.**
1. Study and demonstration of closed loop system with and without disturbance. 2. Study and demonstration of ON/OFF controller. 3. Study and demonstration of Proportional (P) controller. 4. Study and demonstration of Proportional-Integral (PI) controller. 5. Study and demonstration of Proportional-Derivative (PD) controller. 6. Study and demonstration of Proportional-Integral-Derivative (PID) controller. 7. Tuning of PID controller for mathematically described processes. 8. Study of complex control systems (Ratio, Feed forward, and Cascade). 9. Study of Process Control Training Plant and Compact Flow Control Unit.	14x2
Total No. of Hours	**28**

SET/IE/BT/M606. TECHNICAL SEMINAR	
Content	**No. of Hrs.**
Every Student shall deliver a seminar for 30 minutes. Topic for the seminar shall be decided in consultation with faculty. Topic can be related to an application or a technology which makes use of Electrical and Instrumentation engineering. Students should search for the related literature, submit a text report, and prepare a power point presentation. Evaluation shall be based on content, presentation and active participation.	14x4
Total No. of Hours	**56**

SET/IE/BT/S607. INDUSTRIAL AUTOMATION LAB	
Content	**No. of Hrs.**
1. Ladder logic program for logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR. 2. Ladder logic program for different Boolean expressions. 3. Implementation of EXAMINE IF OPEN and EXAMINE IF CLOSED instructions using ladder logic diagram. 4. Ladder logic program for sequential switching off motors. 5. Ladder logic program for traffic light control. 6. Ladder logic program for car parking system. 7. Ladder logic program for star-delta starter. 8. Ladder logic program to start a 3- phase induction with direct online starter. 9. Ladder logic program to control the process of piston movement. 10. Different ladder logic programs using simulation software.	14x4
Total No. of Hours	**56**

Semester VII

SET/IE/BT/C701. VACUUM INSTRUMENTATION AND THIN FILM DEPOSITION TECHNIQUES		
Course Objective	1. To understand the basic theory of different gaseous flow. 2. To study the various vacuum pumps and vacuum gauges to create and measure the vacuum pressure in a working chamber, respectively. 3. To learn about different leak detection techniques. 4. To know the physical and chemical methods for thin film deposition, and different methods for the measurement of film thickness.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the general terminology used in the vacuum system, i.e., throughput, mean free path, out gassing, vapor pressure, gettering, etc. 2. Understand the theory of gaseous flow (turbulent, viscous and molecular), and the effect of physical variable on the flow. 3. Understand the working, construction, characteristics curve and applications of various vacuum pumps. 4. Measure the vacuum pressure with the help of different vacuum gauges. 5. Understand the properties of materials used in the vacuum systems, and basic idea of designing the vacuum system. 6. Detect the leak in the vacuum systems. 7. Learn about the physical and chemical methods of thin film deposition, and the measurement of thickness of thin film.	
Module Name	**Content**	**No. of Teaching Hrs.**
Definitions and Gas laws	Pressure units, gas laws, throughput and speed, kinetic theory of gases, gas pressure, mean free path, partial pressures of gases, viscosity of gases, thermal conductivity, vapour pressure, ionization, sorption and desorption, out gassing, gettering.	**4**
Theory of Gaseous Flow	Impedance, conductance, effect on pumping speed due to a component, effect of speed in a vessel due to several pumps, mechanism of gas flow, turbulent flow, viscous flow, molecular flow, transitional flow, effect of temperature and nature of gas; conductance of the components, like, orifice, straight pipe of finite length, annular orifice, concentric cylinders, rectangular dent, right angled bends.	**4**
Vacuum Pumps	Rotary pump: Working and characteristics, ultimate pressure, removal of vapours: chemical, physical and gas ballasting techniques. Roots pump: Working and characteristics; Diffusion pump: Working and characteristics, multistage pumps and jet design, pump fluid, self fractionalization of the pump fluid, cooling, backing and roughening requirements, speed characteristics and ultimate pressure. Sorption pumps, cryogenic pumps, ion pumps, getter pumps, sputter-ion pumps, turbo-molecular pumps- their characteristics, merits and limitations.	**8**
Measurement of Vacuum	McLeod gauge, thermo conductivity gauges: Pirani, thermocouple. Ionization gauges; Penning gauge, hot cathode ionization gauge, Bayard Alpert gauge; capacitance gauges. Calibration of gauges.	**5**
Vacuum Materials	Properties of vacuum materials; vapour pressure, out gassing, permeability, mechanical strength. Seals: demountable, permanent, elastomers, metal gaskets, glass to metal seals, ceramic to metal seals. Vacuum grease, oils, cement and waxes. Idea of designing of a vacuum system.	**5**
Leak Detection	Bubble, soap solution, spark coil, discharge tube, ultrasonic, dye penetration, thermal conductivity and mass spectrometer methods.	**3**
Physical Methods of Thin Film Deposition	Basic idea of evaporation method: source materials, resistive evaporation, electron beam evaporation, flash evaporation, laser ablation, reactive evaporation. Sputtering: DC, bias, triode, rf, magnetron, ion beam sputtering, ion plating, MBE.	**5**
Chemical Methods of Thin Film Deposition	Basic idea of Electrolytic, electroless, anodization, sol-gel, spray pyrolysis, CVD, Plasma CVD.	**4**
Film Thickness Measurement & Characterization	In situ monitoring and post deposition methods, mechanical, micro balance, electrical resistance, capacitance, ionization, quartz crystal method.	**4**
	Total No. of Teaching Hours	**42**
References	1. A. Roth, "Vacuum Technology", North Holland. 2. Nigel Harris, "Modern Vacuum Practice". 3. Hablanian, "High Vacuum Technology" - A Practice Guide.	

SET/IE/BT/E701. BIOMEDICAL INSTRUMENTATION		
Course Objective	1. To study about the different bioelectric potential, and electrodes. 2. To understand the working of various instruments like ECG, EEG, EMG, X -Ray imaging and ultrasound imaging used in medical diagnosis.	
Course Outcome	After Completion of this course the student would be able to 1. Explain the bioelectric potentials and how they can be picked up. 2. Understand and explain the main biological organs of humans and their structure. 3. Use the ECG, EEG, EMG, X -Ray imaging and ultrasound imaging.	
Module Name	**Content**	**No. of Teaching Hrs.**
Electro physiology	Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and uni-polar electrodes, surface electrodes, physiological transducers. Systems approach to biological systems.	**8**
Bioelectric potential and cardiovascular measurements	EMG - Evoked potential response, EEG, ECG phonocardiography, vector cardiograph, Blood Pressure, Measurement of Blood Pressure, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia, pace makers, defibrillators.	**10**
Ultrasound	Physical principle, generation and detection of ultrasound. Application of ultrasound in bio-medical field. Block diagram of pulse-echo system. Scanner, A scan, echo-cardiograph, M-mode, B scanner, C-scan. Types of scan converter analog scan converter. Real time ultrasonic imaging systems.	**10**
Imaging techniques	Production of x-rays, block diagram of x-ray machine, x-rays Imaging techniques - CAT scan. Principle & image reconstruction techniques of NMR and MRI.	**10**
Safety	Grounding and isolation.	**6**
	Total No. of Teaching Hours	**44**
Textbooks	1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall.	
References	1. Geddes L. A. and Baker L. E., "Principles of Applied Biomedical Instrumentation", John Wiley. 2. Richard Aston, "Principles of Bio-medical Instrumentation and Measurement", Merril Publishing Company. 3. Kandpur R. S., "Handbook of Biomedical Instrumentation", Tata McGraw Hill.	

SET/IE/BT/E702. EMBEDDED SYSTEMS		
Course Objective	1. To learn the internal organization of some popular microcontrollers. 2. To learn hardware and software interaction and integration. 3. To learn the design of microcontroller based system. 4. To understand the application of microcontroller.	
Course Outcome	After Completion of this course the student would be able to 1. Explain the concept of real time embedded systems and their applications. 2. Handle the task of designing an embedded system and their programming. 3. Identify and apply the embedded systems to solve the different real life challenges.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction	Embedded Systems definition, characteristics, design consideration, microprocessors and microcontrollers, Introduction to 8051 microcontroller.	**8**
Architecture and Instruction set of 8051 microcontroller	Internal Architecture of 8051 microcontroller, Instruction set, IDE software Assembly language programming of I/O ports, interrupts, timer, counter, serial communication.	**10**
signal converters and communication	D/A converters and A/D converters, SPI, I2C and CAN bus protocol.	**10**
Sensors and actuators	Various types of sensors and actuators available and their use, LCD displays.	**10**
Interfacing sensors and actuators	Interfacing examples of available sensor and actuator modules and programming.	**6**
	Total No. of Teaching Hours	**44**
Textbooks	1**.** Kenneth J. Ayala, "The 8051 Microcontroller", Penram International. 2. Muhammad Ali Majidi & Janice G. Majidi, "The 8051 Microcontroller and Embedded Systems", Pearson.	
References	1. Tim Wilmshurst, "An Introduction to the Design of Small-Scale Embedded Systems", Palgrave. 2. Jack Ganssle, "The Art of Designing Embedded Systems", Elsevier, 1999. 3. J. W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000. 4. R. Gupta, "Co-synthesis of Hardware and Software for Embedded Systems", Kluwer 1995.	

SET/IE/BT/E703. OPTICAL INSTRUMENTATION		
Course Objective	1. To familiar with the basics of different optical materials. 2. To know the different methods for the testing of optical components. 3. To understand the working principles of laser and holography.	
Course Outcome	After Completion of this course the student would be able to 1. Analyze the testing of optical components, like Foucault-Knife edge test, Newton's ring method etc. 2. Explain the Laser and holography systems. 3. Explain the optical fibers, optic sensors etc.	
Module Name	**Content**	**No. of Teaching Hrs.**
Fabrication of optical components	Optical materials- properties; optical components- optical flats, wedges, mirrors, lenses, prisms, grating, compensating plates; Optical machining tools- abrasive materials, drilling, trepanning, curve generating tools. Making flats, mirrors, lenses, prisms: cutting, grinding, smoothing, surfacing, and polishing of glasses and crystals.	**6**
Testing of optical components	Refractive index measurement- glass slab, prism, Abbe's spectrometer; Wedge measurement- autocollimator, Fizeau interferometer, Measure of radius of curvature- Spherometer mothod, Newton's ring method, Rochi - grating test, Foucault-Knife edge test. Measure of flatness and surface accuracy- Principle and construction of Newton's, Fizeau, Twyman - Green interferroscope. Mach - Jehender, Michelson, Fabry - Perrot interferometer, distance measuring interferometer.	**9**
Optical fibre	Introduction to optical fibers, light guidance, acceptance angle, numerical aperture, different types of fibers, fiber losses, dispersion, manufacturing techniques, cabling, splicing, connectorization, light sources and detectors, noise, optical fibers for communication, optical fibers for instrumentation. Fiber optic sensors: Interferometer method of measurement of length, measurement of pressure, temperature, current, voltage, liquid level and strain.	**10**
Lasers	Theory of lasing action, Einstein's coefficients; He-Ne, CO_2 lasers, Q-switching, electro-optic, magneto-optic and acousto-optic modulators.	**10**
Holography	Theory and construction of holograms, holography and holographic interferometry, application to measurement and various physical parameters and properties.	**8**
	Total No. of Teaching Hours	**43**
References	1. R. Hradayanath, "Optical Workshop Technology", TMH publications. 2. M. Silfvast, "Fundamentals of Laser", Cambridge University Press, 1996. 3. K. Thaigarajan & A. K. Ghatak, "Lasers: Theory and Applications". 4. P. Das, "Lasers and Optical Engineering", Springer. 5. A. K. Ghatak & K. Thaigarajan, "Optical Electronics Foundation Books". 6. A. Yariv, "Introduction to Optical Electronics", Holt, Rinehart and Winston, 1971. 7. G.. P. Agrawal, "Fibre Optic Communication Systems", Wiley Series in Microwave and Optical Engineering. 8. G. Keiser, "Optical Fibre Communication", McGraw-Hill.	

SET/IE/BT/E704. INTRODUCTION TO MACHINE LEARNING		
Course Objective	1. To know the different type of learning. 2. To understand the concepts of logistic regression, support vector machine, etc. 3. To understand the concepts of computational learning theory, hypothesis, clustering, etc.	
Course Outcome	After Completion of this course the student would be able to 1. Explain the different learning, and Python exercise on decision tree and linear regression. 2. Understand Python programming based on SVM. 3. Understand Python programming based on K-means clustering.	
Module Name	**Content**	**No. of Teaching Hrs.**
Module-1	A brief introduction to machine learning, Different types of learning, Hypothesis space and inductive bias, Evaluation and cross-validation, Linear regression, Introduction to decision trees, Learning decision tree, Overfitting, Python exercise on decision tree and linear regression.	**10**
Module-2	k-Nearest Neighbour, Feature selection, Feature extraction, Collaborative filtering, Python exercise on kNN and PCA, Bayesian learning, Naive Bayes, Bayesian network, Python exercise on Naive Bayes.	**10**
Module-3	Logistic regression, Introduction of support vector machine (SVM), SVM: The dual formulation, Maximum margin with noise, Nonlinear SVM and Kernel function, Solution to the dual problem, Python exercise on SVM.	**12**
Module-4	Introduction to computational learning theory, Sample complexity, Finite hypothesis space, VC dimension, Introduction to ensembles, Bagging and boosting, Introduction to clustering, K-means clustering, Agglomerative hierarchical clustering, Python exercise on K-means clustering.	**10**
	Total No. of Teaching Hours	**42**
Textbooks/ References	1. Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, PHI, 2010. 2. P. Langley, "Elements of Machine Learning", Morgan Kaufmann, 1995. 3. Tom M. Mitchell, "Machine Learning", 1st Ed., McGraw Hill International Edition, 1997. 4. Prof. Balaraman Ravindran, "Introduction to Machine Learning", NPTEL Lecture Series.	

SET/IE/BT/C702. VACUUM INSTRUMENTATION AND THIN FILM DEPOSITION TECHNIQUES LAB	
Content	**No. of Hrs.**
1. Study of rotary pump. 2. Study of diffusion pump. 3. Study of LPCVD setup. 4. Study of Oven. 5. Creating a vacuum. 6. Measurement of Vacuum/ low pressure. 7. Deposition of thin film. 8. Characterization of thin film properties.	14x2
Total No. of Hours	**28**

SET/IE/BT/C703. BIOMEDICAL INSTRUMENTATION LAB	
Content	**No. of Hrs.**
1. Study of electrodes. 2. Measurement of BP. 3. Measurement of PH. 4. Study of EEG, ECG, CAT-SCAN. 5. Visit to Pathological Lab. 6. Hospital visit to see demonstration of EEG, ECG, and CAT-SCAN. 7. MATLAB Simulation for biomedical signal analysis.	14x2
Total No. of Hours	**28**

SET/IE/BT/C704. INDUSTRIAL TRAINING SEMINAR	
Content	**No. of Hrs.**
Student shall prepare a detailed report on her/his industrial training and deliver a power point presentation of 30 minutes.	14x2
Total No. of Hours	**28**

SET/SH/BT/L701. ESSENTIAL MANAGEMENT PRACTICES		
Course Objective	To acquire the knowledge of different streams of management, i.e., financial, marketing, human resource, operations management, etc.	
Course Outcome	After Completion of this course the student would be able to 1. Acquire the basic knowledge of different management fields. 2. Implement the knowledge of the different management branches to enhance his personality, and use it for his career growth.	
Module Name	**Content**	**No. of Teaching Hrs.**
General Management	Nature, scope and significance of management. Process and functions of management. Overview of the functional areas of the general management.	**4**
Financial Management	Traditional and modern concept of finance function, nature, scope and significance of finance and financial management, functions of financial managers and financial decisions, financial environment.	**4**
Marketing Management	Nature, concept, scope and significance of marketing management, functions of marketing management, marketing planning and marketing mix.	**4**
Product Development	Concept, nature, significance of product management, product value, types of products, new product development, product life cycle, functions of product managers.	**4**
Human Resource Management	Concept, nature, scope, importance of human factor in managing modern organizations, functions of human resource mangers; Planning, organizing, directing, motivation, control and co-ordination.	**4**
Operations Management	Concept of operations management, tools and techniques: PERT, CEPM, JIT, KANBAN, Inventory management, six sigma, TQM, SCM;	**4**
Production Management	Concept, nature and significance of production management, functions of production managers.	**4**
	Total No. of Teaching Hours	**28**
Textbooks	1. B. S. Goyal, "Production and Operations Management", Pragati Prakashan, 2002.	
References	1. O. D. W. Koontz, "Elements of Management", Tata McGraw Hill. 2. T. N. Chabara, "Principles and Practice of Management", Dhanpat Rai & Co. 3. M. Y. Khan, "Financial Management", Tata McGraw-Hill. 4. I. M. Pandey, "Financial Management", Vikas Publishing. 5. P. Kotler, Marketing Management: Analysis", The Prentice-Hall. 6. E. B. Flippo, "Principles of Personnel Management", New York, McGraw-Hill.	

SET/IE/BT/S705. PROJECT STAGE-1	
Content	**No. of Hrs.**
Project Stage-1 includes following assignments. • Survey and study of published literature on the assigned topic; • Working out a preliminary approach to the Problem relating to the assigned topic; • Conducting Preliminary Analysis/ Modeling/ Experiment/ Simulation/ Experiment/ Design/ Feasibility • Preparing a Written Report on the Study conducted for presentation to the Department; • Final Seminar, as oral Presentation before a Departmental Committee.	14x4
Total No. of Hours	**56**

Semester VIII

SET/IE/BT/C801. RENEWABLE ENERGY ENGINEERING		
Course Objective	To acquire the knowledge of various renewable energy sources and its instrumentation, i.e., solar, wind, hydro, chemical, etc.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the construction, working and applications of different renewable energy systems. 2. Explain the instrumentation involved in different renewable energy systems.	
Module Name	**Content**	**No. of Teaching Hrs.**
Introduction	Energy sources and their availability- conventional and renewable energy sources, prospects of renewable energy. Energy conservation and energy audit.	**6**
Solar Energy	Solar radiation and its measurement, solar constant, solar radiation at earth's surface, solar radiation geometry, estimation of average solar radiation, solar radiation at tilted surfaces. Photo-thermal conversion- Physical principles of solar radiation into heat, solar energy collectors- flat plate and focusing type, energy balance equation and collector efficiency, Selective absorbing coatings. Useful heat gained by collector fluid. Solar energy storage systems- solar ponds and extraction of thermal energy. Applications of photo-thermal energy, photo-voltaic: Principle and materials, solar cells, their combination, storage of photovoltaic energy.	**8**
Wind Energy	Nature of wind, power of wind, forces on rotor blades, wind energy conversion, energy estimation, site selection considerations, types of wind machines- horizontal axial and vertical axial machines, aerodynamic forces acting on blades, energy storage, applications of wind energy.	**8**
Geothermal Biomass energy	Biomass conversion technologies- wet and dry processes, photosynthesis, biogas plants, fuel properties of biogas, thermal gasification of biomass. Nature of geothermal fields, geothermal sources, energy estimation, application of geothermal energy.	**6**
Mini and micro hydro	Components, turbine and generators for small scale hydro, protection, control and management of equipments.	**6**
Chemical energy sources	Fuel cells, design and principle, types, conversion efficiency, types of electrodes, work output and EMF of fuel cells. Batteries- basic theory, types, characteristics, different batteries arrangements. Hydrogen energy- methods of hydrogen production, hydrogen storage.	**8**
	Total No. of Teaching Hours	**42**
Textbooks	1. D. P. Kothari, “Renewable Energy Resources”, PHI Publications.	
References	1. G. D. Rai, “Non- conventional sources of energy”, Khanna Publishers, Delhi.	

SET/IE/BT/E801. VIRTUAL INSTRUMENTATION		
Course Objective	1. To understand the fundamental of virtual instrumentation. 2. To understand the programming and data flow in virtual instrumentation. 3. To study about the graphical programming environment in virtual instrumentation. 4. Analysis tools and simple application used in virtual instrumentation.	
Course Outcome	After Completion of this course the student would be able to 1. Distinguish between virtual instruments and simple instruments. 2. Construct programs in graphical programming environment i.e. LabView software. 3. Propose and design a virtual instrument using LabView to solve the encountered problem.	
Module Name	**Content**	**No. of Teaching Hrs.**
Virtual Instrumentation	Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, and comparison with conventional programming. Introduction to LabView. Tools Palette , Controls Palette Controls and Indicators Numeric Controls and Indicators Boolean Controls and Indicators Configuring Controls and Indicators, Functions Palette	**9**
VI programming techniques	VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.	**8**
Data acquisition basics	Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.	**8**
VI Chassis requirements	Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.	**8**
Applications	VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.	**9**
	Total No. of Teaching Hours	**42**
Textbooks	1. Nadovich, C., "Synthetic Instruments Concepts and Applications", Elsevier. 2. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill. 3. Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall. 4. Jane W. S. Liu, "Real-time Systems", Pearson Education. 5. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-to-use Modules in C", CMP Books.	
References	1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes. 2. Jean J. Labrosse, "MicroC/OS-II: The Real-time Kernal", CMP Books. 3. Buchanan, W., "Computer Busses", CRC Press, 2000. 4. www.ni.com. 5. www.ltrpub.com.	

SET/IE/BT/E802. INTRODUCTION TO SOFT COMPUTING		
Course Objective	1. To study the Fuzzy logic and Defuzzyfication Techniques. 2. To study the different Heuristic algorithms. 3. To study the concepts of domination and artificial Neural network.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the supervised and unsupervised learning, Fuzzy logic and Defuzzyfication Techniques. 2. Explain the Heuristic algorithms, i.e., Genetic algorithms, Particles swarm optimization, etc. 3. Understand neural network, maps and theories.	
Module Name	**Content**	**No. of Teaching Hrs.**
Module-1	Introduction to soft computing, Supervised and unsupervised learning, Introduction to Fuzzy logic, Fuzzy membership functions, Operations on Fuzzy sets, Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences, Defuzzyfication Techniques, Fuzzy logic controller.	**11**
Module-2	Heuristic algorithm: Concept of Genetic algorithms, Genetic operators- Encoding scheme, Selection, Crossover techniques, Mutation, Genetic algorithms in problem solving; Particles swarm optimization (PSO); Ant colony optimization.	**6**
Module-3	Concept of domination, Introduction to EC, MOEA approaches: Non-Pareto based approaches to solve MOOPs, Pareto-based approaches to solve MOOPs.	**8**
Module-4	Introduction to Artificial Neural Network (ANN), Neural model and network architectures, Training ANNs.	**8**
Module-5	Multilayer neural network, Neural network and backpropagation algorithm, Deep neural network, Python exercise on neural network, Hopfield network Computing with Neural nets, Applications of ANN.	**12**
	Total No. of Teaching Hours	**45**
Textbooks/ References	1. Zurada, J. M., "Introduction to Artificial Neural Systems", Jaico Publication House, 2006. 2. Haykin, S.S., "Neural Networks and Learning Machines", 3rd ed., PHI Learning, 2013. 3. Lotfi A. Zadeh, "Advances in Fuzzy Systems: Application and Theory", First Edition. 4. Deb K., "Multi-Objective Optimization Using Evolutionary Algorithms", John Wiley and Sons, 2009. 5. Hagan M. T., Demuth H. B., and Beale M. H., "Neural Network Design", Vikas Publishing House, New Delhi, 2004. 6. S. Rajasekaran and G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications" Paperback – Import, 8 May 2017. 7. Lefteri H. Tsoukalas, Robert E. Uhrig, Lotfi A. Zadeh, "Fuzzy And Neural Approaches in Engineering". 8. Prof. Debasis Samanta, "Introduction to Soft Computing", NPTEL Lecture Series.	

SET/IE/BT/E803. INTRODUCTION TO INTERNET OF THINGS		
Course Objective	1. To understand the basic working principles of sensors and actuators. 2. To integrate the sensors and actuators with Arduino. 3. To study the fundamentals of cloud computing.	
Course Outcome	After Completion of this course the student would be able to 1. Identify the appropriate sensor and actuator for particular application. 2. Design the integrated circuit using sensors, actuators and Arduino. 3. Acquire the basic idea of cloud computing. 4. Implement the concept of IoT for industrial applications.	
Module Name	**Content**	**No. of Teaching Hrs.**
Module-1	Introduction to Internet of Things (IoT), Sensing, Actuation, Basics of IoT networking, Connectivity technologies.	**6**
Module-2	Sensor networks, Machine to machine communication, Interoperability in IoT, Introduction to Arduino, Integration of sensors and actuators with Arduino.	**10**
Module-3	Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to Software Defined Networking (SDN), SDN for IoT.	**10**
Module-4	Cloud computing: Fundamental, Service model, Service management and security, Case studies: Sensor cloud, Fog computing, Smart cities and smart homes, Connected vehicles, Smart grid.	**10**
Module-5	Industrial IoT, Data handling and analytics, Case study: Agriculture, Healthcare, Activity monitoring.	**8**
	Total No. of Teaching Hours	**44**
Textbooks/ References	1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014. 2. Peter Waher, "Learning Internet of Things", PACKT Publishing, BIRMINGHAM–MUMBAI. 3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", Springer. 4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willey Publications. 5. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1st Edition, VPT, 2014. 6. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on Wireless Communication and Mobile Computing, 2011. 7. Kazem Sohraby, Daniel Manoli, "Wireless Sensor Networks Technology, Protocols and Applications", Wiley Inter Science Publications, 2010. 8. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge University Press, 2005. 9. Resse, George, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O' Reilly, 2009. 10. Buyya, Rajkumar, James Broberg, and Andrzej Goscinski, "Cloud Computing–Principles and Paradigms", Wiley, 2011. 11. Prof. Sudip Misra, "Introduction to Internet of Things", NPTEL Lecture Series.	

SET/EC/BT/E803. WIRELESS AND MOBILE COMMUNICATION		
Course Objective	1. To understand the basic concepts of RF propagation, circuits and systems. 2. To understand the various modulation/demodulation techniques and multiple access techniques. 3. To study about mobile communication standards and applications.	
Course Outcome	After Completion of this course the student would be able to 1. Understand the concepts of RF propagation circuits and systems. 2. Explain multiple access techniques-FDMA, TDMA, CDMA, etc. 3. Analyze wireless data communication systems, wireless multimedia, and GSM systems.	
Module Name	**Content**	**No. of Teaching Hrs.**
Module-1	Introduction to RF propagation, multi-path fading, mobile channel description and analysis, RF circuits and systems.	**8**
Module-2	Mobile communication concepts, cellular engineering, cellular concepts, frequency allocation, spectrum efficiency, speech coding, modulation/demodulation techniques, multiple access techniques-FDMA, TDMA, CDMA, Spread Spectrum Techniques.	**11**
Module-3	Error control coding for mobile channel, communication applications, capacity of cellular communication networks, mobile communication standards.	**10**
Module-4	Wireless data communication systems, wireless multimedia, ATM and IP, paging, wireless local loops, Mobile satellite communication, third generation cellular systems, GSM systems, 4G, 5G, universal mobile telecommunication systems.	**13**
	Total No. of Teaching Hours	**42**
Textbooks	1. Rappaport, "Wireless Communication".	
References	1. William Stalling, "Wireless Communication and Networks". 2. D. R. Kamilo Fehar, "Wireless Digital Communication". 3. Haykin S & Moher M., "Modern Wireless Communication", Pearson.	

SET/SH/BT/L801. DISASTER MANAGEMENT	
Content	**No. of Hrs.**
1. Brief idea about different types of natural and manmade hazards. 2. Understanding of vulnerability and risk. 3. Key practices to face the different disasters. 4. Exercise related with field work and mock drill to face the situations of different disasters.	14x4
Total No. of Hours	**56**

SET/IE/BT/S802. PROJECT STAGE-2	
Content	**No. of Hrs.**
The Major Project(s) will be evaluated on the basis of the weightage of 20% of Report writing, 50% of the Project work and 30% for Presentation and Viva. There shall be two presentations for each Project evaluation and at least one outside expert will be the member of the evaluation committee for final evaluation.	14 x 10 = 140

Mandatory Induction Program for Electrical and 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 chose 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 everyday 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.