Curriculum and Syllabus

B. TECH.

Electrical and Instrumentation Engineering

(Applicable for 2018-19 batch and onwards)

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

Curriculum

Definitions/ Descriptions

1. **Credit Equivalent**

	No. of Contact Hours per Week	Equivalent Credits
Lecture+ Tutorial	**4/3**	**3**
Practical	**2**	**1**

***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 to be offered right at the start of the first year. Appendix –I sheet has attached for details.**

2. **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, EI: Electrical and Instrumentation Engineering, EE: Electrical Engineering, ME: Mechanical Engineering, CS: Computer Science and Engineering, IT: Information Technology, AECC: Ability Enhancement Compulsory Courses, HS: Humanities and Social Sciences including Management courses, MC: Mandatory Course).
- 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 Enhancement/M: Mandatory Course/H: Humanities/A: Applied Science) 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.

Elective Course:

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.

Semester-wise list of subjects

Semester I

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/SH/BT/C101	Mathematics I	3	1	-	4	3
2	SET/SH/BT/C102	Physics	3	1	-	4	3
	SET/SH/BT/C203	Chemistry					
3	SET/EE/BT/C103	Basic Electrical Engineering	3	1	-	4	3
	SET/ME/BT/C202	Basic Mechanical Engineering					
4	SET/EC/BT/C104	Basic Electronics	3	1	-	4	3
	SET/ME/BT/C204	Engineering Mechanics					
5	SET/IT/BT/C105	Fundamentals of Information Technology	3	1	-	4	3
	SET/CS/BT/C205	Computer Programming					
6	AECC106	*Environmental Science	2	-	-	2	2
7	SET/SH/BT/C106	Physics Lab	-	-	2	2	1
	SET/SH/BT/C207	Chemistry Lab					
8	SET/EE/BT/C107	Basic Electrical Engineering Lab	-	-	2	2	1
	SET/ME/BT/C206	Basic Mechanical Engineering Lab					
9	SET/IT/BT/C108	Information Technology Lab	-	-	2	2	1
	SET/CS/BT/C208	Computer Programming Lab					
10	SET/ME/BT/S109	**Engineering Graphics	-	-	4	4	2
Total			17	5	10	32	22

* Ability Enhancement Compulsory course.

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

**Skill Enhancement Course.

Semester II

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/SH/BT/C201	Mathematics II	3	1	-	4	3
2	SET/ME/BT/C202	Basic Mechanical Engineering	3	1	-	4	3
	SET/EE/BT/C103	Basic Electrical Engineering					
3	SET/SH/BT/C203	Chemistry	3	1	-	4	3
	SET/SH/BT/C102	Physics					
4	SET/ME/BT/C204	Engineering Mechanics	3	1	-	4	3
	SET/EC/BT/C104	Basic Electronics					
5	SET/CS/BT/C205	Computer Programming	3	1	-	4	3
	SET/IT/BT/C105	Fundamentals of Information Technology					
6	AECC206	*General English	2	-	-	2	2
7	SET/ME/BT/C206	Basic Mechanical Engineering Lab	-	-	2	2	1
	SET/EE/BT/C107	Basic Electrical Engineering Lab					
8	SET/SH/BT/C207	Chemistry Lab	-	-	2	2	1
	SET/SH/BT/C106	Physics Lab					
9	SET/CS/BT/C208	Computer Programming Lab	-	-	2	2	1
	SET/IT/BT/C108	Information Technology Lab					
10	SET/ME/BT/S209	**Engineering Workshop	-	-	4	4	2
Total			17	5	10	32	22

* Ability Enhancement Compulsory course.

**Skill Enhancement Course.

Semester III

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/SH/BT/C301	Mathematics III	3	1	-	4	3
2	SET/EC/BT/C302	Electronic Devices and Circuits	3	1	-	4	3
3	SET/EC/BT/C303	Digital Electronics	3	1	-	4	3
4	SET/EI/BT/C304	Electrical Machines	3	1	-	4	3
5	SET/EI/BT/C305	Signals and Systems	3	1	-	4	3
6	SET/EI/BT/C306	Electrical Measurements and Instrumentation	3	1	-	4	3
7	SET/EC/BT/C307	Digital Electronics Lab	-	-	2	2	1
8	SET/EI/BT/C308	Signals and Networks Lab	-	-	2	2	1
9	SET/EI/BT/C309	Electrical Measurements and Instrumentation Lab	-	-	2	2	1
10	SET/EI/BT/C310	Electrical Machines Lab	-	-	2	2	1
11	SET/MC/BT/M311	Indian Constitution (*MC)	-	-	-	Self study	Qualifying
Total			18	6	8	32	22

*Mandatory Course.

Semester IV

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/EI/BT/C401	Sensors and Transducers	3	1	-	4	3
2	SET/EC/BT/C402	Analog Integrated Circuits	3	1	-	4	3
3	SET/EI/BT/C403	Microprocessors and Microcontrollers	3	1	-	4	3
4	SET/EI/BT/C404	Analytical Instruments	3	1	-	4	3
5	SET/EC/BT/C405	Electromagnetic Field Theory	3	1	-	4	3
6	SET/EI/BT/C406	Circuit Theory	3	1	-	4	3
7	SET/EC/BT/C407	Analog Integrated Circuits Lab	-	-	2	2	1
8	SET/EI/BT/C408	Microprocessors and Microcontrollers Lab	-	-	2	2	1
9	SET/EI/BT/C409	Sensors and Transducers Lab	-	-	2	2	1
10	SET/EI/BT/C410	Analytical Instruments Lab	-	-	2	2	1
11	SET/MC/BT/M411	Essence of Indian Traditional Knowledge (*MC)	-	-	-	Self study	Qualifying
Total			18	6	8	32	22

* Mandatory Course.

Semester V

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/EI/BT/C501	Power Systems	3	1	-	4	3
2	SET/EI/BT/C502	Control Systems	3	1	-	4	3
3	SET/EI/BT/C503	Industrial Instrumentation	3	1	-	4	3
4	SET/EI/BT/C504	Power Electronics	3	1	-	4	3
5		PE-01	3	1	-	4	3
6	SET/EI/BT/C506	Power Systems Lab	-	-	2	2	1
7	SET/EI/BT/C507	Control Systems Lab	-	-	2	2	1
8	SET/EI/BT/C508	Industrial Instrumentation Lab	-	-	2	2	1
9	SET/EI/BT/C509	Power Electronics Lab	-	-	2	2	1
10	SET/HS/BT/H510	Foundations of Yoga (*HSMC)	3	1	-	4	3
Total			18	7	8	32	22

* Humanities and Social Sciences including Management courses.

	S. No.	Code	Course Title
Professional Elective 01 (PE-01)	1	SET/EI/BT/E505 (i)	Electrical Drives
	2	SET/EI/BT/E505 (ii)	Line Commutated and Active PWM Rectifiers
	3	SET/EI/BT/E505 (iii)	Electrical Machine Design

Semester VI

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/EC/BT/C601	Digital Signal Processing	3	1	-	4	3
2	SET/EI/BT/C602	PLC and Automation	3	1	-	4	3
3	SET/EI/BT/C603	Process Control	3	1	-	4	3
4		PE-02	3	1	-	4	3
5		OE-01	3	1	-	4	3
6	SET/EI/BT/C606	PLC and Automation Lab	-	-	2	2	1
7	SET/EI/BT/C607	Process Control Lab	-	-	2	2	1
8	SET/EI/BT/C608	Seminar	-	-	-	4	1
9	SET/SH/BT/A609	Biology *	3	1	-	4	3
Total			18	6	4	32	21

* Applied Science and Humanities.

	S. No.	Code	Course Title
Professional Elective 02 (PE-02)	1	SET/EI/BT/E604 (i)	HVDC Transmission Systems
	2	SET/EI/BT/E604 (ii)	Industrial Electrical Systems
	3	SET/EI/BT/E604 (iii)	Industrial Drives and Controls
	4	SET/EI/BT/E604 (iv)	Electrical distribution System

	S. No.	Code	Course Title
Open Elective 01 (OE-01)	1	SET/EI/BT/E605 (i)	Power Plant Engineering
	2	SET/EI/BT/E605 (ii)	Optical Instrumentation
	3	SET/EI/BT/E605 (iii)	Analog and Digital communication

Semester VII

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/EI/BT/C701	Biomedical Instrumentation	3	1	-	4	3
2	SET/EI/BT/C702	Vacuum Instrumentation and Thin Film Deposition Techniques	3	1	-	4	3
3		PE-03	3	1	-	4	3
4		OE-02	3	1	-	4	3
5		OE-03	3	1	-	4	3
6	SET/EI/BT/C706	Biomedical Instrumentation Lab	-	-	2	2	1
7	SET/EI/BT/C707	Vacuum Instrumentation and Thin Film Deposition Techniques Lab	-	-	2	2	1
8	SET/EI/BT/C708	Project Preparation	-	-	2	2	1
9	SET/EI/BT/C709	Industrial Training Seminar	-	-	-	-	1
10	SET/HS/BT/H710	Principles of Management (*HSMC)	3	1	-	4	3
Total			18	6	6	30	22

* Humanities and Social Sciences including Management courses.

	S. No.	Code	Course Title
Professional Elective 03 (PE-03)	1	SET/EI/BT/E703 (i)	Electrical Energy Conservation & Auditing
	2	SET/EI/BT/E703 (ii)	Power Quality and FACTS
	3	SET/EI/BT/E703 (iii)	Control Systems II

	S. No.	Code	Course Title
Open Elective 02 and 03 (OE-02, OE-03)	1	SET/EI/BT/E704 (i)	Embedded Systems
		SET/EI/BT/E705 (i)	
	2	SET/EI/BT/E704 (ii)	Fuzzy Logic & Neural Network
		SET/EI/BT/E705 (ii)	
	3	SET/EI/BT/E704 (iii)	Introduction to Robotics
		SET/EI/BT/E705 (iii)	
	4	SET/EI/BT/E704 (iv)	Computer Architecture
		SET/EI/BT/E705 (iv)	

Semester VIII

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1		PE-04	3	1	-	4	3
2		OE-04	3	1	-	4	3
3		OE-05	3	1	-	4	3
4	SET/EI/BT/C804	Major Project	-	-	16	16	8
Total			9	3	16	28	17

	S. No.	Code	Course Title
Professional Elective 04 (PE-04)	1	SET/EI/BT/E801 (i)	Renewable Energy Engineering
	2	SET/EI/BT/E801 (ii)	Electrical Distribution System
	3	SET/EI/BT/E801 (iii)	Control Systems Design
	4	SET/EI/BT/E801 (iv)	Switchgear and Protection

	S. No.	Code	Course Title
Open Elective 04 and 05 (OE-04, OE-05)	1	SET/EI/BT/E802 (i)	Data Communication and Networking
		SET/EI/BT/E803 (i)	
	2	SET/EI/BT/E802 (ii)	Virtual Instrumentation
		SET/EI/BT/E803 (ii)	
	3	SET/EI/BT/E802 (iii)	Smart Grid Technology
		SET/EI/BT/E803 (iii)	
	4	SET/EI/BT/E802 (iv)	Mobile Communication and Networks
		SET/EI/BT/E803 (iv)	

Note

(1) Topic for the Seminar in 6^{th} semesters shall be chosen by students in consultation with faculty. Topic shall not be mentioned in the syllabus anywhere, however, it should be related to Electrical and Instrumentation Engineering.

(2) Students shall choose 2 professional & 2 open elective subjects in 7^{th} Semester and 1 professional & 2 open elective subjects in 8^{th} semester, each from the given Table. An elective subject shall be offered only when at least 30% of the intake opt for that subject.

(3) Major Project work shall be carried out during the 7^{th} and 8^{th} semester. Students can undertake Major Project individually or in group of not more than Four students, under the guidance of a faculty or a group of faculty. Students have to present Synopsis of Major Project during the 7^{th} semester. Feasibility of the Project shall be assessed by the project evaluation committee of the department before the end of 7^{th} semester. However, Major Project would be evaluated in the end of 8^{th} semester.

Detailed Syllabi

SEMESTER I

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/SH/BT/C101	Mathematics I	3	1	-	10	20	30	70	100	3
2	SET/SH/BT/C102	Physics	3	1	-	10	20	30	70	100	3
	SET/SH/BT/C203	Chemistry									
3	SET/EE/BT/C103	Basic Electrical Engineering	3	1	-	10	20	30	70	100	3
	SET/ME/BT/C202	Basic Mechanical Engineering									
4	SET/EC/BT/C104	Basic Electronics	3	1	-	10	20	30	70	100	3
	SET/ME/BT/C204	Engineering Mechanics									
5	SET/IT/BT/C105	Fundamentals of Information Technology	3	1	-	10	20	30	70	100	3
	SET/CS/BT/C205	Computer Programming									
6	AECC106	*Environmental Science	2	-	-	10	20	30	70	100	2
7	SET/SH/BT/C106	Physics Lab	-	-	2	30	-	30	70	100	1
	SET/SH/BT/C207	Chemistry Lab									
8	SET/EE/BT/C107	Basic Electrical Engineering Lab	-	-	2	30	-	30	70	100	1
	SET/ME/BT/C206	Basic Mechanical Engineering Lab									
9	SET/IT/BT/C108	Information Technology Lab	-	-	2	30	-	30	70	100	1
	SET/CS/BT/C208	Computer Programming Lab									
10	SET/ME/BT/S109	**Engineering Graphics			4	30	-	30	70	100	2
										Total	22

* Ability Enhancement Compulsory course.
**Skill Enhancement Course.

L - Lecture hours, T - Tutorial hours, P - Practical hours, T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

Induction program for students to be offered right at the start of the first year. For **Induction Program** please refer **Appendix-I** for guidelines.

SET/SH/BT/C101. MATHEMATICS I		
Module Name	**Content**	**No. of Hrs.**
Vector Calculus	Interpretation of Vectors & Scalars, Gradient, Divergence and Curl of a Vector and Their Physical Interpretation, Gauss Divergence Theorem and Stoke's Theorem.	9
Matrices	Elementary Row and Column Transformation, Linear Dependence, 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.	13
Differential Calculus	Libnitz theorem, Partial Differentiation, Euler's Theorem, Asymptotes, Curve Tracing, Envelops and Evolutes. Change of Variables, Jacobians, Expansion of Functions of One and Several Variables. Cylindrical and Spherical Coordinate System. Approximation of Errors. Extrema of Function of Several Variables, Langrange's Method.	13
Probability and Statistics	Binomial Distribution, Normal Distribution and Poisson's Distribution. Correlation and Regression.	9
	Total No. of Hours	**44**
Textbooks	1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers. 2. H K Das, "Advanced Engineering Mathematics", S Chand. 3. Erwin Kreyszig, "Advanced Engineering Mathematics".	
References	1. Shanti Narayan, "A Text Book of Matrices", S. Chand . 2. Finney Thomas, "Calculus and Analytical Geometry", Narosa Publication House. 3. N. Piskunov, "Differential and Integral Calculus".	

SET/SH/BT/C102. PHYSICS		
Module Name	**Content**	**No. of 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, microscope; Phenomenon of Double Refraction, Ordinary and Extra-ordinary Rays, Nicol Prism, Circularly and Elliptically Polarized Light, Fresnel Theory, Optical Activity, Specific Rotation.	13
Lasers and X-Rays	Laser: Principle of Laser Action, Einstein's Coefficients, Construction and Working of He-Ne and CO2 laser; Diffraction of X-Rays, Bragg's Law, Practical Applications of X-Rays, Compton Effect.	8
Basics Material Science	Introduction to crystal structure of materials, Miller indices for crystallographic planes and directions. X-ray diffraction for determination of crystal structure. 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 hysterisis, Ferromagnetism and Anti-Ferromagnetism. Ferroelectricity and Piezoelectricity. Superconductivity in materials.	14
Electromagnetism	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 Hours	**43**
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 Ed.,Pearson (2007) 2. Arthur Beiser, Concepts of Modern Physics, 6th Ed., TMH, (2009) 3. A.K. Ghatak : Optics 4. Subramanyam, Brijlal : Optics 5. Wehr Richords & Adiav : Physics of Atoms 6. O.Svelto : Lasers 7. D.J. Griffith : Electrodynamics 8. Robert Eisberg and Robert Resnick, Quantum Physics of atoms, Molecules, Solids, Nuclei and Particle, 2nd Ed., John Wiley(2006) 9. Raghavan V. " Materials Science and Engineering – A first course" 5th Edition, Prentice Hall, New Delhi, 1998 10. Van Vlack, LH, " Elements of Materials Science and Engineering". 6th Edition, Addison – Wesley Singapore, 1989 11. B. G. Streetman, Solid state Devices, 5th Ed., Pearson (2006) 12. Dekker, "Electrical Engineering Materials", PHI	

SET/EE/BT/C103. BASIC ELECTRICAL ENGINEERING		
Module Name	**Content**	**No. of 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 a.c. 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
Filter Circuits	Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter.	4
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 D.C. motors and generators; Stepper motor.	8
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 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		
Module Name	**Content**	**No. of Hrs.**
Semiconductor Diodes	Semiconductor materials- intrinsic and extrinsic types, Ideal Diode as switch, Terminal characteristics 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 applications e.g. voltage regulator; 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 an 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 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.	8
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 Hours	**44**
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.	

SET/IT/BT/C105. FUNDAMENTALS OF INFORMATION TECHNOLOGY		
Module Name	**Content**	**No. of Hrs.**
Introduction	Definition of Electronic Computer, History, Generations, Characteristic and Application of Computers, Classification of Computers, Computer Hardware and Basic Computer Organization: CPU- ALU, CU; RAM/ROM, Various I/O devices, Peripherals, Storage Media.	6
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, Pseudo codes; Assemblers, Introduction to 4GLs.	6
OS & Office	Software- System and Application Software; Elementary Concepts in Operating System; Textual Vs GUI Interface, Introduction to DOS, MS Windows.	6
Computer Networks	Elements of Communication system; Brief Introduction to Computer Networks- Introduction of LAN and WAN. Network Topologies, Client-server Architecture.	6
Internet	Internet & World Wide Web, Hypertext Markup Language, DHTML, 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 Representation, Application of IT to E-commerce, Electronic Governance, Multimedia, Entertainment, Introduction to Information System.	8
	Total No. of Hours	**44**
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.	

AECC106. ENVIRONMENTAL SCIENCE		
Module Name	**Content**	**No. of Hrs.**
Introduction to Environmental Sciences	Multidisciplinary nature of Environmental Sciences; Scope and importance; Concept of sustainability and sustainable development.	2
Ecosystems	What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems : a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	6
Natural Resources: Renewable and Non-renewable Resources	Land resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	8
Biodiversity and Conservation	Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	8
Environmental Pollution	Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution Nuclear hazards and human health risks Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	8
Environmental Policies & Practices	Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture Environment Laws: Environment Protection Act 1986; Air (Prevention & Control of Pollution) Act 1981; Water (Prevention and control of Pollution) Act 1974; Wildlife Protection Act 1972; Forest Conservation Act 1980. International agreements: Montreal protocol, Kyoto protocol and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.	7
Human Communities and the Environment	Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquake, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	6
Field work	Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, lake, forest patch, grassland, Delhi Ridge, etc.	5
	Total No. of Hours	**50**

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science,* 339: 36-37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29-64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University press

SET/SH/BT/C106. PHYSICS LAB	
Content	**No. of Hrs.**
1. To determine the wavelength of monochromatic light by Newton's ring method. 2. To determine the wavelength of monochromatic light by Fresnel's biprism. 3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points. 4. To determine the wavelength of spectral lines using plane transmission grating.	6x2
5. Measurement of Magnetic susceptibility- Quincke's Method / Gouy's balance. 6. Mapping of magnetic field.	2x2
7. Measurement of e/m of electron – Thomson's experiment. 8. Determination of Planck's constant.	2x2
9. To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility. 10. To study the Hall Effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material. 11. To determine the energy band gap of a given semiconductor material.	4x2
Total No. of Hours	**28**

SET/EE/BT/C107. BASIC ELECTRICAL ENGINEERING LAB	
Content	**No. of Hrs.**
1. Study of analog voltmeter, ammeter, digital multimeter and CRO. 2. Verification of KCL and KVL. 3. Verification of Thevenin, Norton Network theorems. 4. Verification of Superposition Network theorem. 5. Verification of MPT Network theorem. 6. Verification of KCL and KVL. 7. Verification of Thevenin, Norton Network theorems. 8. Verification of Superposition Network theorem. 9. Verification of MPT Network theorem. 10. Measurement of efficiency of a single phase transformer by load test. 11. Determination of parameters and losses in single phase transformer by OC and SC test. 12. Measurement of power in a three phase circuit by two wattmeter method. 13. Verification of Single Phase Energy Meter constant. 14. Study of thee phase induction motor. 15. Verification of junction diode, zener diode characteristics. 16. Verification of Clipping and clamping circuits. 17. Verification of H.W. and F.W. rectifier circuit: with and without filter circuit and to determine the ripple factor. 18. Verification of CE characteristics of BJT.	15x2
Total No. of Hours	**30**

SET/IT/BT/C108. INFORMATION TECHNOLOGY LAB	
Content	**No. of Hrs.**
1. Creation of a Word Document. 2. Creation of a Document in spreadsheet and using Formulae. 3. Use of Search Engine and World Wide Web. 4. Creation of email id and email. 5. Use of FTP service. 6. Creation of Static Web Pages using HTML. 7. Creation of Page Using Java Script. (Besides these additional experiments can be included to give hands on experience to students. Students can be provided opportunity to work on any Information System to give them better understanding of Information System)	14x2
Total No. of Hours	**28**

SET/ME/BT/S109. ENGINEERING GRAPHICS		
Module Name	**Content**	**No. of Hrs.**
Introduction to Engineering Graphics	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. Introduction to orthographic projections- Horizontal, vertical and profile planes – First angle and third angle projections – Projection of points in different coordinates – Projections of lines inclined to one of the reference planes.	12
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.	12
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. Projections of Solids with axis inclined to both the planes – Projections of spheres and combination of solids.	12
Sections of solids	Sections of solids by planes perpendicular to at least one of the reference planes – True shapes of sections. Developments, development of the lateral surface of regular solids like, prisms, pyramids, cylinders, cones and spheres, development of truncated solids Isometric projection – Isometric scale – Isometric views – Isometric projection of prisms, pyramids, cylinders, cones, spheres and solids made by combination of the above.	12
	Total No. of Hours	**48**
Textbooks	1. Bhatt N. D, Elementary Engineering Drawing, Charotar Publishing House, Anand, 2002.	
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.	

SEMESTER II

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE.	SUB. TOTAL	Credits
1	SET/SH/BT/C201	Mathematics II	3	1	-	10	20	30	70	100	3
2	SET/ME/BT/C202	Basic Mechanical Engineering	3	1	-	10	20	30	70	100	3
	SET/EE/BT/C103	Basic Electrical Engineering									
3	SET/SH/BT/C203	Chemistry	3	1	-	10	20	30	70	100	3
	SET/SH/BT/C102	Physics									
4	SET/ME/BT/C204	Engineering Mechanics	3	1	-	10	20	30	70	100	3
	SET/EC/BT/C104	Basic Electronics									
5	SET/CS/BT/C205	Computer Programming	3	1	-	10	20	30	70	100	3
	SET/IT/BT/C105	Fundamentals of Information Technology									
6	AECC206	*General English	2	-	-	10	20	30	70	100	2
7	SET/ME/BT/C206	Basic Mechanical Engineering Lab	-	-	2	30	-	30	70	100	1
	SET/EE/BT/C107	Basic Electrical Engineering Lab									
8	SET/SH/BT/C207	Chemistry Lab	-	-	2	30	-	30	70	100	1
	SET/SH/BT/C106	Physics Lab									
9	SET/CS/BT/C208	Computer Programming Lab	-	-	2	30	-	30	70	100	1
	SET/IT/BT/C108	Information Technology Lab									
10	SET/ME/BT/S209	**Engineering Workshop	-	-	4	30	-	30	70	100	2
										Total	22

* Humanities and Social Sciences including Management courses.

**Skill Enhancement Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

SET/SH/BT/C201. MATHEMATICS II		
Module Name	**Content**	**No. of Hrs.**
Multiple 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, Drichlet's integral and its application.	9
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 and Z-transform and its simple applications.	12
Ordinary Differential Equations	Introduction to order, degree and arbitrary constants, linear differential equations of n" order with constant coefficient, complimentary functions and particular integrals. Homogeneous differential equations, simultaneous linear differential equations. Solutions of second order differential equations by changing dependent and independent variables. Method of variation of parameters, equations of the form y" = f(y), applications to engineering problems.	12
Solutions of Equations and Curve Fitting	Solutions of cubic and bi-quadric equations. Method of least square and curve fitting.	6
	Total No. of Hours	**45**
Textbooks	1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers. 2. H K Das, "Advanced Engineering Mathematics", S Chand. 3. Erwin Kreyszig, "Advanced Engineering Mathematics".	
References	1. J. N. Kapoor, "A Text Book of Differential Equations".	

SET/ME/BT/C202. BASIC MECHANICAL ENGINEERING		
Module Name	**Content**	**No. of Hrs.**
Laws of Thermodynamics	Concept of temperature, equality of temperature, Zeroth law, principles of thermometry and temperature scale. First law of thermodynamics, concept of internal energy, application of first law to a closed system to various processes, flow processes and control volume, flow work, steady flow energy equation, mechanical work in steady flow process, throttling process, application of first law to open system. Essence of second law, thermal reservoir, heat engines and thermal efficiency. COP of heat pump and refrigerator, definition of available and unavailable energy. Statement of second law, Carnot cycle, Carnot's theorem, Clausius inequality, concept of entropy, entropy changes for ideal gases.	8
Properties of Steam	Generation of steam at constant pressure, various states of water, steam, properties of steam, use of property diagram, processes of vapour in closed and open system, determination of dryness fraction of steam by separating and throttling calorimeter, Rankine cycle.	5
Thermodynamic Cycle	Definitions of bore, stroke, clearance ratio, compression ratio, definition and calculation of mean effective pressure from the cyclic work (proof not required), indicated pressure, air standard cycle (Otto and diesel cycle), principle of working and description of two and four stroke S.I. and C.I. engine.	8
Strength of Material-Simple Stresses and Strains	Stress- tensile and compressive, strain, strain energy, stress-strain diagram, ductile and brittle material, elastic constants, impact loading, varying cross-section and load, 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, Mohr's stress circle, Poisson's ratio, 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 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/SH/BT/C203. CHEMISTRY		
Module Name	**Content**	**No. of Hrs.**
Thermodynamics	Terminology in Thermodynamics, Zeroth law of Thermodynamics, First law of Thermodynamics, Enthalpy, Reversible isothermal expansion of ideal gas, Adiabatic expansion of ideal gas, Joule-Thomson effect.	4
Lubricants	Theory, classification and mechanism of lubrication.	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 & polythiophene) & their applications.	3
Complex Compounds	Introduction, Valence bond and crystal field theory for bonding in complexes.	4
Chemical Kinetics & Catalysis	Order and molecularity of 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	Introduction, causes of corrosion, theories of corrosion- direct chemical attack, electrochemical theory of corrosion, factors influencing corrosion, passivity, types of corrosions, protection from corrosion (Cathodic and anodic protection) and protective metallic coatings (Galvanizing and tinning).	5
Water and Waste Water Chemistry	Introduction, Hardness of Water, Characteristics Imparted by Impurities, Determination of hardness by EDTA method, Treatment of Water by Zeolite, L-S Process, Boiler problems caused by use of hard Water, Reverse osmosis process for purification of water. Numerical based on hardness of water, zeolite process and Lime-soda process.	6
Fuels & Combustion	Classification of Fuels, Non-Conventional Energy, Biogas, and Solar Energy, Calorific value – Gross and Net, Characteristics of Good Fuel, Determination of Calorific Value by bomb calorimeter method (theory and numerical), Solid Fuels: Analysis of Coal (Proximate and ultimate analysis of coal theory and numerical), Liquid Fuels: mining and refining of petroleum, cracking (Thermal and catalytic), Knocking, octane and cetane number .	5
Stereochemistry of Organic-Compounds	Mechanism of Chemical Reaction, Beckman, Hoffman, Reimer Tiemann, Cunnizzaro, Diels- Alder and Skraup synthesis.	4
	Total No. of Hours	**43**
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, GM. Lampman, GS. 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/C204. ENGINEERING MECHANICS		
Module Name	**Content**	**No. of 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.	10
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.	10
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.	13
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 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. COMPUTER PROGRAMMING		
Module Name	**Content**	**No. of Hrs.**
Introduction	C Character Set, Identifiers and Keywords, Data Types, Declarations, Expressions, Statements and Symbolic Constants.	6
Operators and Expressions	Arithmetic, Unary, Relational, Logical, and Assignment Operators, Conditional Operator, Library Functions.	6
Control Statements	While, Do-while, For Statements, Nested Loops, If-Else, Switch, Break, Continue and Go to Statements, Comma Operator.	5
Functions	Defining and Accessing Functions, Function Prototypes, Passing Arguments, Recursion, and Use of Library Functions.	5
Program Structure	Storage classes, Automatic, External, Static Variables.	4
Arrays	Defining and Processing, Passing to a Function, Multidimensional Arrays, Arrays and Strings.	4
Pointers	Declarations, Passing to a Function, Operations on Pointers, Pointers and Arrays, Dynamic Memory Allocation, Array of Pointers.	6
Structures and Unions	Basics of Structures, Structures and Functions, Arrays of Structures, Pointers to Structures, Self Referential Structures, type definitions, Unions.	4
Data Files	Open, Close, Create, Process, Unformatted data files.	4
	Total No. of 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.	

AECC206. GENERAL ENGLISH		
Module Name	**Content**	**No. of Hrs.**
Introduction:	Theory of Communication, Types and modes of Communication	6
Language of Communication	Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication	6
Speaking Skills	Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech	7
Reading and Understanding	Reading and Understanding Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts	7
Writing Skills	Documenting Report Writing Making notes Letter writing	4
	Total No. of Hours	**30**
Textbooks	1. Fluency in English - Part II, Oxford University Press, 2006. 2. Business English, Pearson, 2008. 3. Language, Literature and Creativity, Orient Blackswan, 2013. 4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas	

SET/ME/BT/C206. BASIC MECHANICAL ENGINEERING LAB	
Content	**No. of Hrs.**
1. Study of boiler models – Babcock Wilcox, Lancashire and Locomotive. 2. Study of Steam Engine and Steam Turbine models. 3. Study of 2-Stroke and 4-Stroke ICE models. 4. Study of vapour compression Refrigeration unit tutor. 5. Study of window type air conditioner. 6. To conduct the tensile test on a UTM and determine ultimate tensile strength, percentage elongation for a steel specimen. 7. To conduct the compression test and determine the ultimate compressive strength for a specimen. 8. To conduct impact test (Izod/Charpy) on the impact testing machine and find the impact strength.To determine the hardness of the given specimen using Brinell/Rockwell/Vicker testing machine.	15x2
Total No. of Hours	**30**

SET/SH/BT/C207. CHEMISTRY LAB	
Content	**No. of Hrs.**
1. To determine Saponification value of given oil sample. 2. To determine the ferrous content in the supplied sample of iron ore by titrimetric analysis against standard $K_2Cr_2O_7$ solution using $K_3Fe(CN)_6$ as external indicator. 3. To determine the chloride content in supplied water sample using Mohr's method. 4. To determine acid value of given oil sample. 5. To determine the total hardness of water sample by EDTA titration. 6. To find chemical oxygen demand of a waste water sample using Potassium Dichromate. 7. Estimation of iron in plain carbon steel by redox titration. 8. Estimation of copper in brass by titration method. 9. Estimation of Zinc in brass by titration method. 10. Analysis of a coal sample by proximate analysis method.	15x2
Total No. of Hours	**30**

SET/CS/BT/C208. COMPUTER PROGRAMMING LAB	
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.	14x2
Total No. of Hours	**28**

SET/ME/BT/S209. ENGINEERING WORKSHOP		
Module	**Content**	**No. of Hrs.**
Module 1	Mechanical Engineering covering, the following trades for experiments (with a minimum of two exercises under each trade) - Carpentry, Fitting, Tin-Smithy and Development of jobs carried out and soldering, Black Smithy, House Wiring, Foundry (Molding only), Plumbing.	16X2
Module 2	Power tools in Construction, Wood working, Electrical and Mechanical Engineering practices.	8x2
	Total No. of Hours	**48**

SEMESTER III

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE.	SUB. TOTAL	Credits
1	SET/SH/BT/C301	Mathematics III	3	1	-	10	20	30	70	100	3
2	SET/EC/BT/C302	Electronic Devices and Circuits	3	1	-	10	20	30	70	100	3
3	SET/EC/BT/C303	Digital Electronics	3	1	-	10	20	30	70	100	3
4	SET/EI/BT/C304	Electrical Machines	3	1	-	10	20	30	70	100	3
5	SET/EI/BT/C305	Signals and Systems	3	1	-	10	20	30	70	100	3
6	SET/EI/BT/C306	Electrical Measurements and Instrumentation	3	1	-	10	20	30	70	100	3
7	SET/EC/BT/C307	Digital Electronics Lab	-	-	2	30	-	30	70	100	1
8	SET/EI/BT/C308	Signals and Networks Lab	-	-	2	30	-	30	70	100	1
9	SET/EI/BT/C309	Electrical Measurements and Instrumentation Lab	-	-	1	30	-	30	70	100	1
10	SET/EI/BT/C310	Electrical Machines Lab	-	-	1	30	-	30	70	100	1
11	SET/MC/BT/M311	Indian Constitution (*MC)	-	-	-	-	-	-	-	100	-
										Total	22

*Mandatory Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

SET/SH/BT/C301. MATHEMATICS III		
Module Name	**Content**	**No. of Hrs.**
Ordinary Differential Equations	ODE of 2nd order with constant coefficients both homogeneous and non-homogeneous types with applications to electrical and mechanical systems. Difference equations and their solutions by Z transform. Series solutions of ODE of 2nd orders with variable coefficients with special emphasis to the differential equations of Legendre, Bessel and Chebyser. Legendre's polynomials, Chabyshev polynomials and Bessel's functions and their properties.	14
Integral Transforms	Fourier transform and integral Hankel transforms and Hilbert transforms and their properties, some simple applications.	7
Partial Differential Equations	Linear PDE with constant coefficients of 2nd order and their classifications. PDE of parabolic, elliptic and hyperbolic type with illustrative examples. Separation of variables method for solving PDE, such as two dimensional heat equations, wave equations and Laplace equations.	10
Functions of a Complex Variable	Analytic functions, Cauchy Riemann equations, harmonic functions line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula derivatives of analytic function, Liouvilles theorem, fundamental theorem of algebraic representation of a function by power series, Taylor's & Laurant series, poles & singularity of zeros. Residue theorem, conformal mapping, linear fractional transformation, special linear tranctional transformations.	14
	Total No. of Hours	**45**
Textbooks	1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers. 2. H K Das, "Advanced Engineering Mathematics", S Chand. 3. Erwin Kreyszig, "Advanced Engineering Mathematics". wiley publications.	
References	1. Paopoulis, "Signal Analysis", TMH.	

SET/EC/BT/C302. ELECTRONIC DEVICES AND CIRCUITS		
Module Name	**Content**	**No. of Hrs.**
Introduction	Natural signals, need of amplification and linearity, concept of gain, decibel, bandwidth, power dissipation; Concept of biasing and small signal; dc and ac analysis, concept of small signal model, concept of input impedance, output impedance and their estimation; Circuit models for different amplifier types: voltage, current, transconductance, trans-resistance; Introduction to octagon of tradeoffs in analog circuits;	4
Diodes and application	Qualitative analysis of PN Junction diode in different bias conditions: no bias, forward, reverse, breakdown ; Current Voltage characteristic; Exponential Model, Piece wise linear model, constant voltage drop model, ideal diode model, Diode-large signal and small signal operation; Diode Circuits; Introduction and applications of Special Diodes: Zener Diode, Schottkey Diode, Photo Diode; Varactor Diode, Tunnel Diode, Light Emitting Diode;	5
BJT Amplifiers	BJT operation and characteristics: active mode, saturation mode; BJT Models: large signal model, transconductance, small signal model, hybrid $-\pi$ model, Ebres –Mall model; early effect; Amplifier: input impedance, output impedance, gain; Operating point analysis and design: simple biasing, resistive divider biasing, biasing with emitter degeneration, self bias, and design procedures; Analysis and Design of different topologies: CE, CE with emitter degeneration, CB, CC (Emitter follower); Multi-stage amplifier; Bipolar Cascode Amplifier, Bipolar current mirror; Bipolar differential amplifier;	10
MOSFET Amplifiers	MOSFET operation and characteristics: MOSFET as variable resistor, channel pinch off, derivation of I-V characteristics, triode and saturation region, transconductance; MOS device models: large signal model, small signal model, channel length modulation; comparison of Bipolar transistor and MOSFET; MOS Amplifier topologies and their comparison; DC and AC analysis of CS, CS with current source load, CS with diode connected load, CS with degeneration, CG, CD (source follower), and CMOS Cascode amplifier, MOS current mirror; MOS differential amplifier.	10
Frequency Response	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.	5
Feedback	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.	6
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, cascode and CC-CB cascade, tuning, class C tuned amplifier.	5
	Total No. of 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/EC/BT/C303. DIGITAL ELECTRONICS		
Module Name	**Content**	**No. of 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.	6
	Total No. of Hours	**44**
Textbooks	1. Morris Mano, “Digital Design”. Prentice Hall.	
References	1. Taub, Schilieng, “Digital Integrated Electronics”. McGraw-Hill Publication. 2. Anad Kumar, “Digital principles and application”. Prentice Hall. 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/EI/BT/C304. ELECTRICAL MACHINES		
Module Name	**Content**	**No. of Hrs.**
DC Machines	Constructing feature and principal of operation of shunt, series and compound generators and motors including emf equation and armature reaction. Performance characteristics of generators and motors, starting, speed control and breaking of motors. Two quadrant and four quadrant operation of motors, choice of dc motors for different applications, losses and efficiency.	14
Transformers	Basics of transformers, Equivalent circuit of transformers, Transformer and its phasor diagram with load, without load and Three phase transformers, Auto transformers, Instrument transformers.	8
Induction motors	Starters for cage and wound rotor type induction motors, speed control and breaking, 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 Hours	**44**
References	1. Nagrath &Kothari, Electrical Machines, Tata McGraw Hill. 2. P. S. Bimbhra, Electrical Machine, Khanna Publications, Delhi. 3. B. L. Theraja, Electrical Techonology Vol-II. Tata McGraw Hill. 4. Cotton H., Advance Electrical Techonology, Wheeler & Co.	

SET/EI/BT/C305. SIGNALS AND SYSTEMS		
Module Name	**Content**	**No. of 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 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/EI/BT/C306. ELECTRICAL MEASUREMENTS AND INSTRUMENTATION		
Module Name	**Content**	**No. of 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 Hours	**45**
References	1. A K Sawhney, "Electrical and Electronic Measurements and Instrumentation" 2. E. W. Golding & F. E. Widdis, "Electrical Measurements and Measuring Instruments"	

SET/EC/BT/C307. DIGITAL ELECTRONICS LAB		
Content		**No. of Hrs.**
1. Combinational Logic design using basic gates (Code Converters, Comparators). 2. Combinational Logic design using decoders and MUXs. 3. Arithmetic circuits - Half and full adders and subtractions. 4. Arithmetic circuits – design using adder ICs, BCD adder. 5. Flip flop circuit (RS latch, JK & master slave) using basic gates. 6. Asynchronous Counters. 7. Synchronous counters, Johnson & Ring counters. 8. Sequential Circuit designs (sequence detector circuit). 9. Transfer Characteristics, Measurement of Sinking and Sourcing currents etc. of TTL gates.		10x2
ModelSim Simulations	Writing and simulating programs for adder, decoder, multiplexer, de-multiplexer, up/down counter, universal shift register, Sequence Detector etc.	4x2
	Total No. of Hours	**28**

SET/EI/BT/C308. 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 Tellegin'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.	4x2
Total No. of Hours	**28**

SET/EI/BT/C309. ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB	
Content	**No. of Hrs.**
1. Study of electrical instruments: MI, PMMC, Dynamometer, wattmeter. Energy meter, potentiometer and instrument transformer. 2. Calibration of instruments: AC voltmeter and ammeter. 3. Wheatstone bridge and Kelvin's Bridge for Measurement of Resistance. 4. Schering Bridge for Capacitance Measurement and Anderson Bridge for Inductance Measurement. 5. Calibration of Single-phase Energy meter and Wattmeter. 6. Testing of Current Transformer.	14x2
Total No. of Hours	**28**

SET/EI/BT/C310. ELECTRICAL MACHINES LAB	
Content	**No. of Hrs.**
1. Open circuit characteristic of DC Shunt Generator. 2. Load test on DC Shunt Generator. 3. Speed control of DC Shunt Motor. 4. Brake test on DC Shunt Motor. 5. Load test on Single - phase Transformer. 6. Load test on three - phase Induction Motor. 7. Brake test on Single - phase Induction Motor. 8. Open Circuit test. 9. Short circuit test. 10. Speed control of three phase Induction motor.	14x2
Total No. of Hours	**28**

SET/MC/BT/M311. INDIAN CONSTITUTION		
Module Name	**Content**	**No. of Hrs.**
Introduction	Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy	6
Union Government and its Administration	Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha	6
State Government and its Administration	Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions	4
Local Administration	District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	8
Election Commission	Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women	6
	Total	**30**

SEMESTER IV

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/EI/BT/C401	Sensors and Transducers	3	1	-	10	20	30	70	100	3
2	SET/EC/BT/C402	Analog Integrated Circuits	3	1	-	10	20	30	70	100	3
3	SET/EI/BT/C403	Microprocessors and Microcontrollers	3	1	-	10	20	30	70	100	3
4	SET/EI/BT/C404	Analytical Instruments	3	1	-	10	20	30	70	100	3
5	SET/EC/BT/C405	Electromagnetic Field Theory	3	1	-	10	20	30	70	100	3
6	SET/EI/BT/C406	Circuit Theory	3	1	-	10	20	30	70	100	3
7	SET/EC/BT/C407	Analog Integrated Circuits Lab	-	-	2	30	-	30	70	100	1
8	SET/EI/BT/C408	Microprocessors and Microcontrollers Lab	-	-	2	30	-	30	70	100	1
9	SET/EI/BT/C409	Sensors and Transducers Lab	-	-	2	30	-	30	70	100	1
10	SET/EI/BT/C410	Analytical Instruments Lab	-	-	2	30	-	30	70	100	1
11	SET/MC/BT/M411	Essence of Indian Traditional Knowledge (*MC)	-	-	-	-	-	-	-	100	-
										Total	22

*Mandatory Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

SET/EI/BT/C401. SENSORS AND TRANSDUCERS		
Module Name	**Content**	**No. of 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- 1st, 2nd order filters, LP, HP, notch, all pass filters, Butterworth, elliptic, Bessel and chebyshev filters.	12
	Total No. of 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/EC/BT/C402. ANALOG INTEGRATED CIRCUITS		
Module Name	**Content**	**No. of 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.	9
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.	8
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	Voltage regulators, Regulators using op amps, IC regulators, Protection circuits, Foldback current limiting, current boosting of IC regulators, switching regulators.	6
DACs and ADCs	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.	7
	Total No. of Hours	**42**
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, Solidstate Pulse Circuits (4/e), PHI. 2.M.E. Van Valkenburg, Analog Filter Design, Oxford University Press, 1995. 3.R. Schaumann and M.E. Van Valkenburg, Design of Analog Filters, Oxford University Press, 2003. 4.BehzadRazavi, 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/EI/BT/C403. MICROPROCESSORS AND MICROCONTROLLERS		
Module Name	**Content**	**No. of Hrs.**
Fundamentals of Microprocessors	Fundamentals of Microprocessor Architecture. 8-bit Microprocessor and Microcontroller architecture. Internal Block Diagram of 8085 microprocessor, Introduction and architecture of to 8086 microprocessor, CPU, ALU, address, data and control bus, Working registers, Stack and Stack Pointer, Program Counter. Instruction set and simple ALP exercises. PPI 8255- architecture, programming and interfacing.	7
The 8051 Architecture	Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles. Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.	8
Instruction Set and Programming	Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and Debugging tools.	8
Memory and I/O Interfacing	Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, and memory devices.	6
External Communication Interface	Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.	7
Applications	LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, and sensor interfacing.	7
	Total No. of Hours	**43**
Textbooks	1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007. 2. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996	
References	1. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004. 2. R. Kamal, "Embedded System", McGraw Hill Education, 2009. 3. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013. 4. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.	

SET/EI/BT/C404. ANALYTICAL INSTRUMENTS		
Module Name	**Content**	**No. of Hrs.**
Colorimeters and Spectrophotometers	Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, UV - Visible, IR spectrophotometers, general sources of error, sources of error in spectrophotometric measurements, calibration.	7
Flame Photometer	Principle of flame photometry, constructional details of flame photometers, clinical flame photometers, interferences in flame photometry, procedure for determinations.	6
Atomic Absorption Spectrophotometers	Theoretical concepts, atomic absorption instrumentation, sources of interferences.	6
Environmental Pollution Monitoring Instruments and Gas Analyzers	Analysis of CO, NOx, SO2, hydrocarbons. Paramagnetic oxygen analyzer, thermal conductivity analyzers. Chromatography - HPLC.	7
Mass Spectrometers	Basic mass spectrometer, different types of mass spectrometers, components of a mass spectrometer, resolution.	5
Nuclear Magnetic Resonance	Principle of NMR, constructional details of NMR spectroscopy, sensitivity enhancement for analytical NMR spectroscopy.	5
Radiation Detectors	Ionization chamber, GM counters, proportional counter, scintillation counter, solid state detectors.	3
Other Instruments	pH meters, selective-ion electrodes; Principle, construction and working of SEM, XRD.	5
	Total No. of Hours	**44**
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". McGraw-Hill Education.	
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". J. Chem. Educ., 1981.	

SET/EC/BT/C405. ELECTROMAGNETIC FIELD THEORY		
Module Name	**Content**	**No. of Hrs.**
Transmission Lines	Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.	6
Maxwell's Equations	Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.	6
Uniform Plane Wave	Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.	9
Plane Waves at Media Interface	Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.	7
Waveguides	Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.	7
Antennas	Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.	8
	Total No. of Hours	**43**
References	1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill, 2005. 2. D. K. Cheng, "Field and Wave Electromagnetics**"**, Addison-Wesley, 1989. 3. M. N.O. Sadiku, "Elements of Electromagnetics**"**, Oxford University Press, 2007. 4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012. 5. C. A. Balanis, "Antenna Theory: Analysis and Design**"**, John Wiley & Sons, 2005.	

SET/EI/BT/C406. CIRCUIT THEORY		
Module Name	**Content**	**No. of Hrs.**
Networks and Transients	Review of Network Theorems: Thevenin's & Norton's theorem - Superposition theorem - Maximum power transfer theorem – Reciprocity Theorem - Millman's theorem; Introduction to Network Topology: Definition of basic terms – Incidence matrix – Tie-sets - Cut-sets: Analysis and formulation of network equations using tie-set and cut-set; Transients in linear circuits: Initial Conditions - Zero state response - Zero input response - Complete Response – Analysis of RC and RL circuits with impressed DC voltage – RC network as differentiator and integrator - Compensated Attenuators – DC transients in RLC circuits.	12
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 transform domain - Node analysis and mesh analysis of the transformed circuit; Network functions: Impulse response and Transfer function - Poles and Zeros – Restriction of pole and zero locations of network functions - Steady state response and Frequency response from Laplace transform.	12
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 - Pass and stop bands - Constant - k low pass filter - Constant - k high pass filter-m-derived T and π sections and their applications for infinite attenuation and filter terminations - Band pass and band elimination filters.	11
Network Synthesis	Synthesis: Positive real functions - Driving point functions - Brune's positive real functions - Properties of positive real functions. Testing driving point functions - Application of maximum modulus theorems - Properties of Hurwitz polynomials - Even and odd functions - Strum's theorem - Driving point synthesis - RC elementary synthesis operations - LC network synthesis - Properties of RC network functions - Foster and Cauer forms of RC and RL networks.	9
	Total No. of Hours	**44**
Textbooks	1. D. Roy Choudhary, Network and Systems, Wiley Eastern,.	
References	1. Van Valkenburg M E, Network Analysis 3rd Edition, Prentice Hall. 2. Van Valkenberg M.E., Introduction to Modern Network Synthesis, John Wiley and Sons. 3. Franklin. F. Kuo, Network Analysis and Synthesis, John Wiley & sons. 4. Hayt, Kimmerly, Engineering Circuit Analysis, McGraw Hill. 5. Desoer C.A. & Kuh E.S., Basic Circuit Theory, McGraw-Hill. 6. Ryder J.D., Networks, Lines and Fields, Prentice Hall. 7. B. P. Lathi, Linear Systema and Signals, Oxford University Press. 8. DeCarlo, R.A., & Lin, "Linear Circuit Analysis", 2 nd Edition, OUP Indian Edition 2003. 9. Mahmood Nahvi, Joseph, A. Edminister, "Theory and Problems of Electric Circuits – Schaum's outline series", McGraw Hill. 10. Donald E. Scott, "An Introduction to Circuit analysis: A System Approach" McGraw Hill Book Company. 11. A.Chakrabarti,"Circuit Theory" Dhanpat Rai & Co.	

SET/EC/BT/C407. ANALOG INTEGRATED CIRCUITS LAB	
Content	**No. of Hrs.**
1. Differential amplifier and Current Source. 2. Measurement of Op-Amp parameters – CMRR, Slew rate, Open loop. Gain, input and output impedances, Unity gain bandwidth. 3. Inverting non-inverting amplifiers, Integrator, Differentiator – frequency response. 4. Instrumentation Amplifier using Op-amps and IC – Gain, CMRR and Input impedance. 5. Op-amp in comparator application. 6. Waveform Generators –Sine, square, Triangular and Ramp. 7. Schmitt trigger & Precision rectifiers. 8. Astable and Monostable Multivibrators using op-amp and 555IC. 9. Phase Locked Loops. 10. Low Pass Filter and High Pass Filter realizations using op-amps. 11. Band Pass Filter and Band Stop Filter realizations using op-amps. 12. DAC and ADC circuits using op-amp/ICs. 13. Regulated power supply using op amp IC and zener diode.	15x2
Total No. of Hours	**30**

SET/EI/BT/C408. MICROPROCESSORS AND MICROCONTROLLERS LAB	
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.	14x2
Total No. of Hours	**28**

SET/EI/BT/C409. 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/EI/BT/C410. ANALYTICAL INSTRUMENTS LAB	
Content	**No. of Hrs.**
1. Study of flame photometer. 2. Calibration and Measurement of samples using flame photometer. 3. Calibration and Measurement of samples using PH meter. 4. Study of XRD instrument. 5. Study of SEM instrument. 6. Study of Ellipsometer instrument.	14x2
Total No. of Hours	**28**

SET/MC/BT/M411. ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE		
Module Name	**Content**	**No. of Hrs.**
Environment, Culture, Tradition &Practices	i) Historical overview ii) Oral &codified information on medicinal Plants iii) Water & Water Bodies iv) Fieldwork	5
Urbanization &Urbanism	i) Issues of settlements & Landscapes ii) Social differentiations iii) Communication networks	5
Social inequality &Gender	i) Status within Households: An overview ii) Present context iii) Issues of Violence	6
Cultural Heritage	i) Main components ii) Built Heritage iii) Historical Tourism iv) Cultural Forms	8
Cultural Forms &Cultural Expressions	i) Performing Arts ii) Fairs &Festivals ii) Fieldwork	8
	Total No. of Hours	**32**
References	1. Indu Banga, ed. The City in Indian History: Urban Demography, Society & Polity, Delhi, Manohar,,1991 2. Koch, E. Mughal Art & Imperial Ideology 3. Radha Kumar, History of Doing: An Illustrated Account of Movements for Women's Rights &Feminism in India 1880- 1990,Zubaan, 2007 4. V.Vasudev, Fairs &Festivals, Incredible India Series, 2007 5. V.Singh, The Human Footprint on Environment: Issues in India, New Delhi, and Macmillan, 2012 6. B. Parikh, Composite Culture in a multicultural Society, Delhi, NBT, 2007 7. N. Mehta, Introduction: Satellite Television, Identity & Globalization in Contemporary India in N.Mehta, ED, Television in India, New York, Routledge, 2008 8. R.C. Thakran & Sheo Dutt, ed Bhartiya Upmahaduip ki Sanskritiyan, University of Delhi	

SEMESTER V

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/EI/BT/C501	Power Systems	3	1	-	10	20	30	70	100	3
2	SET/EI/BT/C502	Control Systems	3	1	-	10	20	30	70	100	3
3	SET/EI/BT/C503	Industrial Instrumentation	3	1	-	10	20	30	70	100	3
4	SET/EI/BT/C504	Power Electronics	3	1	-	10	20	30	70	100	3
5		PE-01	3	1	-	10	20	30	70	100	3
6	SET/EI/BT/C506	Power Systems Lab	-	-	2	30	-	30	70	100	1
7	SET/EI/BT/C507	Control Systems Lab	-	-	2	30	-	30	70	100	1
8	SET/EI/BT/C508	Industrial Instrumentation Lab	-	-	2	30	-	30	70	100	1
9	SET/EI/BT/C509	Power Electronics Lab	-	-	2	30	-	30	70	100	1
10	SET/HS/BT/H510	Foundations of Yoga (*HSMC)	3	1	-	10	20	30	70	100	3
										Total	22

* Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Professional Elective 01 (PE-01)	1	SET/EI/BT/E505 (i)	Electrical Drives
	2	SET/EI/BT/E505 (ii)	Line Commutated and Active PWM Rectifiers
	3	SET/EI/BT/E505 (iii)	Electrical Machine Design

SET/EI/BT/C501. POWER SYSTEMS		
Module Name	**Content**	**No. of Hrs.**
Introduction	Characteristics of Modern Power Systems, Physical Structure, Operation and Control Functions and Hierarchies, Design and Operating Criteria.	8
Equipment and Stability Constraints	Capabilities and Constraints of Generators/Exciters/Turbines. Analysis of different types of transmission lines and computation of line constants/parameters, Transmission lines: Configurations, types of conductors, resistance of line, skin effect, Kelvins law, proximity effect. Elements (Lines, Transformers etc.) , Constraints of Energy Supply Systems, Load Characteristics, Introduction to Angle/Voltage Instability phenomena, Stability Constraints.	10
Frequency and Voltage Control	Primary Control of Frequency- Governors Secondary Control of Frequency- AGC Voltage control- Automatic Voltage Regulators (generators), Shunt Compensation, SVC.	8
Introduction to Power Flow Control	HVDC, FACTS Load Curves Unit Commitment Introduction to the use of Optimization Methods.	8
Load Dispatch Centre Functions	Contingency Analysis, Preventive, Emergency and Restorative Control.	9
	Total No. of Hours	**43**
Textbooks	1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.	
References	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.	

SET/EI/BT/C502. CONTROL SYSTEMS		
Module Name	**Content**	**No. of Hrs.**
Basics of Control	Definitions of control systems, Closed loop and open loop control systems, system components - mechanical, hydraulic, pneumatic, electrical and electronic, servos and synchros, stepper motors, 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(mechanical, pneumatic, thermal, hydraulic, electrical) block diagram, reduction techniques, signal flow graph.	10
Time Response	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.	10
Stability of Control Systems	Characteristic equation, location of roots in S-plane for stability, Routh Hurwitz criterion, roots locus techniques.	8
Frequency Response	Frequency response - definition, bode plot, polar plot, gain margin and phase margin, Nyquist stability criterion and application.	8
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 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/EI/BT/C503. INDUSTRIAL INSTRUMENTATION		
Module Name	**Content**	**No. of Hrs.**
Density & Viscosity Measurement	Density measurement - strain gauge load cell method, buoyancy method, air-pressure balance method, Gamma ray method, vibrating probe method. Viscosity measurement - units of viscosity, specific gravity scales used in petroleum industries, different methods of measuring consistency & viscosity, Saybolt, Redwood, Engler, Rotameter type, rotating cylinder, 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
Non - Electrical Methods of Pressure Measurement	Different types of pressure measurement, units of pressure, manometers, elastic type of pressure gauges, bellows, diaphragms and Bourdon tubes, bell type and slack diaphragm pressure gauges. Selection of pressure gauges - testing & calibration of pressure gauges, dead weight tester, installation and maintenance of pressure gauges, differential pressure transmitters. Electrical methods of pressure measurement - pressure gauges using strain gauges, capacitive, inductive and piezo – electric.	10
Methods of Temperature Measurements	Temperature scales, filled-in system, liquid filled, gas filled, vapour pressure thermometer, sources of errors, compensation techniques, bimetallic thermometers. Electrical methods of temperature measurement - RTDs, industrial construction, 3/4 wire RTDs, improved bridge circuits,. Thermistors - features, construction, linearize circuits, specific applications. Thermocouples - working & construction, types of thermocouples, laws of thermocouples, cold junction, compensation methods. ICs for temperature measurements - AD590, AD 540. Pyrometers & miscellanies - basic principles, radiation pyrometer, thermal detectors, pyroelectric detectors, optical pyrometers, selection of temperature sensors.	11
Flow Measurement	D. P. flow meters - physical properties of flow, fundamentals of flow measurements, differential pressure flow meters - operating principle, different types, orifice, Venturi meter, pitot tube. Mechanical type flow meters - principle of operation, element of construction and application of positive displacement meters, inferential flow meter, rotameters, turbine flow meters, target flow meter. Electrical type flow meters - principle of operation, construction, applications, of electromagnetic flow meters, ultrasonic flow meters, cross correlation flow meters, vortex shedding flow meters. Mass flow meters & open channel flow measurement - conventional methods, Coriolis flow meters, angular momentum, Weirs, Flumes, guidelines for flow meters selections, calibration of flow meters.	12
	Total No. of Hours	**45**
Textbooks	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.	
References	1. Douglas M. Considine, “Process / Industrial Instruments & Controls Handbook”, McGraw Hill. 2. Eckman, D.P., “Industrial Instrumentation”, Wiley Eastern Limited. 3. A. K. Sswhney, “Mechanical Measurements and Instrumentation”, Dhanpat Rai & co.	

SET/EI/BT/C504. POWER ELECTRONICS		
Module Name	**Content**	**No. of Hrs.**
Characteristics of Power Devices	Characteristics of SCR, DIAC, TRIAC, SCS, GTO, PUJT, power transistors, power FET's LASCR, two transistors model of SCR, 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, triggering with microprocessor, forced commutation - different 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 Hours	**44**
Textbooks	1. P.S.Bhimra, Power Electronics. Khanna Publication, Delhi. 2. M.H. Rashid, Power Electronics. P.H.I 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/EI/BT/E505 (i). ELECTRICAL DRIVES		
Module Name	**Content**	**No. of Hrs.**
DC motor characteristics	Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.	5
Chopper fed DC drive	Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.	5
Multi-quadrant DC drive	Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.	8
Closed-loop control of DC Drive	Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.	6
Induction motor characteristics	Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.	8
Scalar control or constant V/f control of induction motor	Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.	6
Control of slip ring induction motor	Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.	6
	Total No. of Hours	**44**
Textbooks	1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.	
References	2**.** R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001. 3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002. 4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.	

SET/EI/BT/E505 (ii). LINE COMMUTATED AND ACTIVE PWM RECTIFIERS		
Module Name	**Content**	**No. of Hrs.**
Diode rectifiers with passive filtering	Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap.	6
Thyristor rectifiers with passive filtering	Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.	8
Multi-Pulse converter	Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.	6
Single-phase ac-dc single-switch boost converter	Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.	6
Ac-dc bidirectional boost converter	Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.	8
Isolated single-phase ac-dc flyback converter	DC-DC flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.	10
	Total No. of Hours	**44**
Textbooks	1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.	
References	1. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley, 1991. 2. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009. 3. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design",John Wiley & Sons, 2007. 4. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001.	

SET/EI/BT/E505 (iii). ELECTRICAL MACHINE DESIGN		
Module Name	**Content**	**No. of Hrs.**
Introduction	Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.	8
Transformers	Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.	8
Induction Motors	Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.	10
Synchronous Machines	Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.	9
Computer aided Design (CAD)	Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.	8
	Total No. of Hours	**43**
Textbooks	1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.	
References	2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London. 3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006. 4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969. 5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979. 6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008. 7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.	

SET/EI/BT/C506. POWER SYSTEMS LAB	
Content	**No. of Hrs.**
Hands-on experiments related to the course contents. Visits to power system installations (generation stations, EHV substations etc.) are suggested. Exposure to fault analysis and Electro-magnetic transient program (EMTP) and Numerical Relays are suggested.	14x2
Total No. of Hours	**28**

SET/EI/BT/C507. CONTROL SYSTEMS LAB	
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 study and calibrate temperature using resistance temperature detector (RTD). 4. To design Lag, Lead and Lag-Lead compensators using Bode plot. 5. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads. 6. Related Simulations using MATLAB.	14x2
Total No. of Hours	**28**

SET/EI/BT/C508. INDUSTRIAL INSTRUMENTATION LAB	
Content	**No. of Hrs.**
1. Determination of Discharge coefficient of Orifice plate and Venturi meter. 2. Measurement of flow rate using Orifice, Venturimeter, Flow nozzle and Rotameter. 3. Verification of Bernoulli Theorem. 4. Pressure gauge calibration using Dead Weight Tester. 5. Temperature measurement using RTD, Thermistors. 6. Viscosity Measurement using Falling Sphere Method.	14x2
Total No. of Hours	**28**

SET/EI/BT/C509. POWER ELECTRONICS LAB	
Content	**No. of Hrs.**
1. Characteristics of SCR, DIAC and TRIAC. 2. SCR control for AC and DC loads. 3. Series inverter using SCR. 4. Fan regulator using DIAC and TRIAC. 5. Parallel inverter using SCR. 6. AC phase control using SCR. 7. Study of phase splitter. 8. Commutative circuits.	14x2
Total No. of Hours	**28**

SET/HS/BT/H510. FOUNDATIONS OF YOGA		
Module	**Content**	**No. of Hrs.**
General Introduction to Yoga	Brief about origin of Yoga: Psychological aspects and Mythological concepts; History and Development of Yoga: prior to the Vedic period, Vedic period, Medival period, modern era; Etymology and Definitions of Yoga, Aim and Objectives of Yoga, Misconceptions of Yoga; Brief about Streams of Yoga; Principles of Yoga, Importance of Yoga. Ashtang Yoga.	8
General Introduction to Indian Philosophy	Philosophy: meaning, definitions and scope; Indian Philosophy: Salient features, Branches (Astika and Nastika Darshanas), Distinction from Religion and Science, Brief introduction to Prasthanatrayee and Purushartha Chatushtaya; Relationship between Yoga and Indian Philosophy.	8
Brief about Yoga in texts – I	Brief to Upanishads and Yoga in Principal Upanishads, Yoga in Yogopanishad; Yogic perspective of Epics: Ramayana and Mahabharata; Yogic perspective: Bhagavad Gita, Yoga Vasishtha.	8
Brief about Yoga in texts – II	Yogic perspective: Smritis, Puranas with emphasis to Bhagavat Purana; Yogic perspective to Shad-darshanas; Brief: Agamas, Tantras, Shaiva Siddhanta.	8
	Total	**32**
Textbooks	1. Lal Basant Kumar : Contemporary Indian Philosophy, Motilal Banarsidas Publishers Pvt. Ltd, Delhi, 2013 2. Dasgupta S. N : History of Indian Philosophy, Motilal Banarsidas, Delhi, 2012 3. Singh S. P : History of Yoga, PHISPC, Centre for Studies in Civilization Ist, 2010 4. Singh S. P & Yogi Mukesh : Foundation of Yoga, Standard Publication, New Delhi, 2010	
References	1. Agarwal M M : Six systems of Indian Philosophy, Chowkhambha Vidya Bhawan, varanai, 2010 2. Swami Bhuteshananda : Nararad Bhakti Sutra, Advaita Ashrama Publication-Dept. Kolkata, II Edition, 2009 3. Hiriyanna M : Outlines of Indian Philosophy, Motilal Banarsidas, Delhi, 2009 4. Hiriyanna M: Essentials of Indian Philosophy, Motilal Banarsidas, Delhi, 2008 5. Radhakrishnan S: Indian Philosophy, Oxford University, UK (Vol. I & II) II Edition, 2008 6. Max Muller K. M : The six system of Indian Philosophy, Chukhambha, Sanskrit series, Varanasi, 6th Edition, 2008	

SEMESTER VI

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/EI/BT/C601	Digital Signal Processing	3	1	-	10	20	30	70	100	3
2	SET/EI/BT/C602	PLC and Automation	3	1	-	10	20	30	70	100	3
3	SET/EC/BT/C603	Process Control	3	1	-	10	20	30	70	100	3
4		PE-02	3	1	-	10	20	30	70	100	3
5		OE-01	3	1	-	10	20	30	70	100	3
6	SET/EI/BT/C606	PLC and Automation Lab	-	-	2	30	-	30	70	100	1
7	SET/EI/BT/C607	Process Control Lab	-	-	2	30	-	30	70	100	1
8	SET/EI/BT/C608	Seminar	-	-	-	-	-	-	100	100	1
9	SET/SH/BT/A609	Biology (*HSMC)	3	1	-	10	20	30	70	100	3
										Total	21

* Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Professional Elective 02 (PE-02)	1	SET/EI/BT/E604 (i)	HVDC Transmission Systems
	2	SET/EI/BT/E604 (ii)	Industrial Electrical Systems
	3	SET/EI/BT/E604 (iii)	Industrial Drives and Controls
	4	SET/EI/BT/E604 (iv)	Electrical distribution System

	S. No.	Code	Course Title
Open Elective 01 (OE-01)	1	SET/EI/BT/E605 (i)	Power Plant Engineering
	2	SET/EI/BT/E605 (ii)	Optical Instrumentation
	3	SET/EI/BT/E605 (iii)	Analog and Digital communication

SET/EC/BT/C601. DIGITAL SIGNAL PROCESSING		
Module Name	**Content**	**No. of 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; Lowpass, Bandpass, Bandstop and High pass filters, properties of linear-phase FIR filters, window design techniques, Park-McClellan's method.	12
	Total No. of 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/EI/BT/C602. PLC AND AUTOMATION		
Module Name	**Content**	**No. of Hrs.**
Introduction	About PLC, History of PLC, Introduction of PLC in manufacturing unit, PLC versus computer, Basic PLC components, Basic operation of PLC system, SCADA System and DCS.	5
PLC Hardware	PLC hardware components- input/output modules, Processors, Power supply, Programming devices, Memory organization- AB memory organization, Logical addressing.	8
PLC Programming	Ladder logic diagram, Implementation of Logic gates and Boolean expressions using LLD, Seal-in Circuit, Instructions of ladder programming-relay type instruction, Program control instructions, Data Manipulation Instructions, Math Instructions.	10
Timers and counters	Introduction to timers and counters, Types of timers and counters, Timers and counters programming, PLC sequencer and shift registers-sequencer, synchronous and asynchronous shift register, sequencer instruction.	14
PLC communication	Types of communication- serial communication, industrial communication network, industrial I/O networks, different type of network communication protocol**.**	7
	Total No. of Hours	**44**
Textbooks	1. W Bolton, "Programmable Logic Controllers". Elsevier publications. 2. Krishna Kant, "Computer-based Industrial Control", Prentice Hall.	
References	1. John.W. Webb Ronald A Reis, "Programmable Logic Controllers - Principles and Applications", Prentice Hall. 2. Lukcas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co. 3. Frank D. Petruzella, "Programmable Logic Controllers", McGraw Hill. 4. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall.	

SET/EI/BT/C603. PROCESS CONTROL		
Module Name	**Content**	**No. of Hrs.**
Process Dynamics	Process variables, load variables, 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.	10
Controllers and Tuning	Basic control actions, characteristics of two position, three position, proportional, single speed floating, integral and derivative control modes, on - off, P, P+I, P+D and P+I+D control modes, problems, pneumatic, hydraulic and electronic controllers to realize various control actions. Optimum controller settings*:* Evaluation criteria, $1/4^{th}$ decay ratio, IAE, ISE, ITAE determination of optimum settings for mathematically described process using time response and frequency response, Process reaction curve method, continuous oscillation method, damped oscillation method, problems.	14
Final control element	I/P converter, pneumatic, electric and hydraulic actuators, valve positioner, control valves, characteristics of control valves, valve body, globe, butterfly, diaphragm, ball valves, control valve sizing, cavitations, flashing problem.	10
Multi loop Control System	Feed forward control, ratio control, cascade control, split range, multivariable control and examples from distillation column & boiler system.	10
	Total No. of Hours	**44**
Textbooks	1. Wayne Bequette, "Process Control – Modeling, Design and Simulation", Prentice Hall. 2. Stephanopoulos, "Chemical Process Control, 2nd edition, Prentice Hall. 3. Coughanowr, "Process Systems Analysis and Control", McGraw Hill. 4. Peter Harriott, "Process Control", Tata McGraw Hill.	
References	1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., "Process Dynamics and Control", Wiley. 2. Smith C.L and Corripio.A..B, "Principles and Practice of Automatic Process Control", Wiley. 3. Shinskey, "Process Control Systems", 4th Edition, McGraw Hill. 4. Paul W.Murril, "Fundamentals of Process Control Theory", ISA press. 5. M.Chidambaram, "Applied Process Control", Allied Publishers. 6. Deshpande P.B and Ash R.H, "Elements of Process Control Applications", ISA Press. 7. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall. 8. D. P. Eckman, "Automatic Process Control". 9. Pollard, "Process Control", Heinemann Educational Books.	

SET/EI/BT/E604 (i). HVDC TRANSMISSION SYSTEMS		
Module Name	**Content**	**No. of Hrs.**
Module 1	1. Evolution of HVDC Transmission. 2. Comparison of HVAC and HVDC systems. 3. Type of HVDC Transmission systems. 4. Components of HVDC transmission systems.	8
Module 2	1. Analysis of simple rectifier circuits. 2. Required features of rectification circuits for HVDC transmission. 3. Analysis of HVDC converter. a. Different modes of converter operation. b. Output voltage waveforms and DC voltage in rectification. c. Output voltage waveforms and DC in inverter operation. d. Thyristor voltages. 4. Equivalent electrical circuit.	8
Module 3	1. HVDC system control features. 2. Control Modes. 3. Control Schemes. 4. Control comparisons.	6
Module 4	1. Converter mal-operations. 2. Commutation failure. 3. Starting and shutting down the converter bridge. 4. Converter protection.	6
Module 5	1. Smoothing reactor and DC Lines. 2. Reactive power requirements. 3. Harmonic analysis. 4. Filter design.	6
Module 6	1. Component Models for the Analysis of AC DC Systems. 2. Power flow analysis of AC-DC systems. 3. Transient stability analysis. 4. Dynamic stability analysis.	6
Module 7	1. Multi-terminal HVDC system. 2. Advances in HVDC transmission. 3. HVDC system application in wind power generation.	4
	Total No. of Hours	**44**
Textbooks	1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.	
References	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.	

SET/EI/BT/E604 (ii). INDUSTRIAL ELECTRICAL SYSTEMS		
Module Name	**Content**	**No. of Hrs.**
Electrical System Components	Low voltage system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices	8
Residential and Commercial Electrical Systems	Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.	8
Illumination Systems	Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.	6
Industrial Electrical Systems I	High voltage connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.	8
Industrial Electrical Systems II	DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.	6
Industrial Electrical System Automation	Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.	8
	Total No. of Hours	**44**
Textbooks	1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.	
References	2. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008. 3. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007. 4. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997. 5. Web site for IS Standards. 6. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.	

SET/EI/BT/E604 (iii). INDUSTRIAL DRIVES AND CONTROLS		
Module Name	**Content**	**No. of Hrs.**
Introduction to dc and ac motors	Motor lead system – steady state stability criteria – Braking and speed reversal of DC and AC motors – transfer function model of separately excited and series DC motor – Equivalent circuit of Induction motor – Torque slip characteristic – Synchronous motor model.	10
Control of dc drives	Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configuration - Problems on DC machines fed by converter supplies CLC and TRC strategies. - Analysis of series and separately excited DC motors fed from different choppers, effect saturation series motors – CLC and TRC strategies – Closed loop control schemes.	12
Control of ac drives	Operation of Induction motor with non - sinusoidal supply wave forms, variable frequency operation of three phase Induction motors, constant flux operation, current fed operations. Dynamic and regenerative braking of CSI and VSI fed drives. Types of rotor choppers, torque equations, constant torque operations, TRC strategies, combined stator voltage control and rotor resistance control, principle of vector control – Direct and indirect FOC.	12
Special machines	Modeling and control schemes for PMSM, PMBLDC, stepper motor and switched reluctance motor.	10
	Total No. of Hours	**44**
Textbooks	1. Dubey, G.K., "Power Semiconductor Controlled Drives", prentice hall. 2. Krishnan.R., "Electrical Motor Drives-Modeling, Analysis and Control", Prentice Hall.	
References	1. Bose.B.K. "Modern Power Electronics and AC Drives", Pearson Education, 2002. 2. Sheperd W., Hully L.N., "Power Electronics and Motor Control",Cambridge University press, Cambridge, 1987. 3. Dewan S.B., Slemon G.R., and Straughen A., "Power Semiconductor Drives", John Wiley and sons, New York, 1984. 4. Buxbaum A., Schierau K. and Staughen, "A Design of control system for DC drives", Springer – Verlag, Berlin, 1990. 5. Subharamanyam V., "Electric Drives – Concepts and Applications",Tata McGraw-Hill Publishing Co. Ltd, New Delhi 1994.	

SET/EI/BT/E604 (iv). ELECTRICAL DISTRIBUTION SYSTEM		
Module Name	**Content**	**No. of Hrs.**
General concepts	Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, Contribution factor loss factor-relationship between the load factor and loss factor. Classification of loads (Residential, Commercial, Agricultural and industrial) and their characteristics.	5
Distribution feeders	Design consideration of distribution feeders: Radial and loop types of primary feeders, Voltage levels, Feeder loading; Basic design practice of the secondary distribution system. Substations: location of substation, Rating of distribution substation, Service area within primary feeders. Benefits derived through optimal location of substations.	8
Underground Cables	Introduction, Insulation, Sheath, Armour and Covering, Classification of Cables, Pressurized Cables, Effective Conductor Resistance, Conductor Inductive Reactance, Parameters of Single Core Cables, Grading of Cables, Capacitance of Three Core Belted Cable, Breakdown of Cables, Cable Installation, Current Rating of Cables, System Operating Problems with Underground Cables, HVDC Cables.	10
System Analysis	Voltage drop and power-loss calculations, Derivation for voltage drop and power loss in lines, Manual methods of solution for radial networks, Three phase balanced primary lines.	10
Protection	Objectives of distribution system protection, Types of common faults and procedure for fault calculations. Protective devices: Principle of operation off uses, Circuit re-closures, Line sectionalizes, and Circuit breakers.	
Coordination	Coordination of protective devices: General coordination procedure. Compensation for power factor improvement, Capacitive compensation for power-factor control. Different types of power capacitors, Shunt and series capacitors, Effect of shunt capacitors (fixed and switched), Power factor correction, Capacitor allocation-economic justification, Procedure to determine the best capacitor location.	7
Voltage control	Equipment for voltage control, Effect of series capacitors, Effect of AVB/AVR, Line drop compensation.	4
	Total No. of Hours	**44**
Textbooks	1. Gonen, T., Electric Power Distribution System Engineering, 3rd ed.,CRC Press 2014. 2. Pabla, A.S., Electric Power Distribution, 6th ed., Tata McGraw Hill, 2012.	
References	1. Sivanagaraju, S. and Sankar, V., Electrical Power Distribution and Automation, Dhanpat Rai & Co, 2006. 2. Kamaraju, V., Electrical Power Distribution Systems, Tata McGraw Hill Education, New Delhi, 2011.	

SET/EI/BT/E605 (i). POWER PLANT ENGINEERING		
Module Name	**Content**	**No. of 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.	6
Thermal power generation	Selection of site, size and no. of units, general layout, major parts, auxiliaries, generation costs of steam stations.	6
Hydro power generation	Selection of site, mass curve, flow duration curve, hydrograph, classification of hydro plants, types of hydro turbines, pumped storage plants.	6
Nuclear power generation	Main parts, location, principle of nuclear energy, types of nuclear reactors, reactor control, nuclear waste disposal.	6
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.	5
	Total No. of Hours	**43**
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/EI/BT/E605 (ii). OPTICAL INSTRUMENTATION		
Module Name	**Content**	**No. of 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 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/EI/BT/E605 (iii). ANALOG AND DIGITAL COMMUNICATION		
Module Name	**Content**	**No. of Hrs.**
Module 1	Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.	10
Module 2	Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.	8
Module 3	Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.	10
Module 4	Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.	7
Module 5	Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.	8
	Total No. of Hours	**43**
Textbooks	1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.	
References	2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002. 3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001. 4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965. 5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004. 6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.	

SET/EI/BT/C606. PLC AND AUTOMATION LAB	
Content	**No. of Hrs.**
Related experiments on demonstration kits and Ladder Logic Programming using simulation software.	15x2
Total No. of Hours	**30**

SET/EI/BT/C607. PROCESS CONTROL LAB		
Module	**Content**	**No. of Hrs.**
Module 1	1. Study of Process Control Training Plant and Compact Flow Control Unit. 2. Level Control and Pressure Control in Process Control Training Plant. 3. Study and Demonstration of Closed loop system with Disturbance. 4. Study and demonstration of ON/OFF, P, PI, PD and PID Controllers. 5. Tuning of PID Controller for mathematically described processes. 6. Study of complex control systems (Ratio, Feed forward, and Cascade).	14x2
	Total No. of Hours	**28**

SET/EI/BT/C608. 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 and prepare a presentation. Evaluation shall be based on content, presentation and active participation.	14x2
Total No. of Hours	**28**

SET/SH/BT/A609. BIOLOGY		
Module	**Content**	**No. of Hrs.**
Introduction	Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. need to study biology, Brownian motion and the origin of thermodynamics.	3
Classification	Hierarchy of life forms at phenomenological level, classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (f) Molecular taxonomy- three major kingdoms of life.	4
Genetics	Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis, how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes, single gene disorders in humans.	4
Biomolecules	Molecules of life: monomeric units and polymeric structures, sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	4
Enzymes	How to monitor enzyme catalyzed reactions, enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. RNA catalysis.	4
Information Transfer	DNA, Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code Universality and degeneracy of genetic code, gene in terms of complementation and recombination.	4
Macromolecular analysis	protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
Metabolism	Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency, breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.	5
	Total No. of Hours	**33**
Textbooks	1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd.	
References	2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons. 3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company. 4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher. 5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers.	

SEMESTER VII

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/EI/BT/C701	Biomedical Instrumentation	3	1	-	10	20	30	70	100	3
2	SET/EI/BT/C702	Vacuum Instrumentation and Thin Film Deposition Techniques	3	1	-	10	20	30	70	100	3
3		PE-03	3	1	-	10	20	30	70	100	3
4		OE-02	3	1	-	10	20	30	70	100	3
5		OE-03	3	1	-	10	20	30	70	100	3
6	SET/EI/BT/C706	Biomedical Instrumentation Lab	-	-	2	30	-	30	70	100	1
7	SET/EI/BT/C707	Vacuum Instrumentation and Thin Film Deposition Techniques Lab	-	-	2	30	-	30	70	100	1
8	SET/EI/BT/C708	Project Preparation	-	-	2	-	-	-	-	100	1
9	SET/EI/BT/C709	Industrial Training Seminar	-	-	-	-	-	-	-	100	1
10	SET/HS/BT/H710	Principles of Management (*HSMC)	3	1	-	10	-	30	70	100	3
										Total	22

* Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Professional Elective 03 (PE-03)	1	SET/EI/BT/E703 (i)	Electrical Energy Conservation & Auditing
	2	SET/EI/BT/E703 (ii)	Power Quality and FACTS
	3	SET/EI/BT/E703 (iii)	Control Systems II

	S. No.	Code	Course Title
Open Elective 02 and 03 (OE-02, OE-03)	1	SET/EI/BT/E704 (i)	Embedded Systems
		SET/EI/BT/E705 (i)	
	2	SET/EI/BT/E704 (ii)	Fuzzy Logic & Neural Network
		SET/EI/BT/E705 (ii)	
	3	SET/EI/BT/E704 (iii)	Introduction to Robotics
		SET/EI/BT/E705 (iii)	
	4	SET/EI/BT/E704 (iv)	Computer Architecture
		SET/EI/BT/E705 (iv)	

SET/EI/BT/C701. BIOMEDICAL INSTRUMENTATION		
Module Name	**Content**	**No. of 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 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/EI/BT/C702. VACUUM INSTRUMENTATION AND THIN FILM DEPOSITION TECHNIQUES		
Module Name	**Content**	**No. of 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	Mc Leod 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 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/EI/BT/E703 (i). ELECTRICAL ENERGY CONSERVATION AND AUDITING		
Module Name	**Content**	**No. of Hrs.**
Energy Scenario	Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.	7
Basics of Energy and its various forms	Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.	7
Energy Management & Audit	Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.	7
Energy Efficiency in Electrical Systems	Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.	7
Energy Efficiency in Industrial Systems	Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.	8
Energy Efficient Technologies in Electrical Systems	Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.	6
	Total No. of Hours	**42**
Textbooks	1. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.	
References	1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects. 2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities. 3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)	

SET/EI/BT/E703 (ii). POWER QUALITY AND FACTS		
Module Name	**Content**	**No. of Hrs.**
Transmission Lines and Series/Shunt Reactive Power Compensation	Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.	4
Thyristor-based Flexible AC Transmission Controllers (FACTS)	Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.	6
Voltage Source Converter based (FACTS) controllers	Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.	8
Application of FACTS	Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.	5
Power Quality Problems in Distribution Systems	Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.	5
DSTATCOM	Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.	8
Dynamic Voltage Restorer and Unified Power Quality Conditioner	Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.	6
	Total No. of Hours	**42**
Textbooks	1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.	
References	2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007. 3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983. 4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012. 5. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991	

SET/EI/BT/E703 (iii). CONTROL SYSTEMS II		
Module Name	**Content**	**No. of Hrs.**
Review of State Space analysis	Concepts of state space and state variables. State space representation of systems described by scalar differential equations, solution of state equation; State transition matrix. State space representation of discrete systems, Controllability and observability of linear time invarient systems; conditions for complete controllability and complete observability.	16
Stability Analysis	Definition, first and second methods of Liapunov: stability analysis of linear system using Liapunov's second method. Stability analysis of Nonlinear system using second method of Liapunov – Liapunov's stability theorem, Generation of V-function using some formalized methods, Minimization of Vfunction, Computation of stability domain, Popov's stability criterion, Study of stability of Lur'e system using Liapunov – Popov method & exploiting the use of YKM – lemma.	8
Non-linear Systems	Introduction: Common physical non-linearities: Phase-plane method, system analysis by phase plane method: Describing functions: Stability analysis by describing function methods.	8
Sampled Data Systems	Sampling process: Impulse modulation: Mathematical analysis of sampling process; Z transform and its evaluation, theorems of Z-transform: Modified Z- transform: Mapping of S-Plane into Z plane, pulse transfer function: stability analysis in Z-plane using various methods. Introduction to Adaptive Control and Parameter Identification.	12
	Total No. of Hours	**44**
Textbooks	1. Ogata K, "Modern Control Engineering", PHI 4th Ed., New Delhi (2002). 2. Gibson J E, "Non Linear automatic Control", MGH (Int.) (1966). 3. Lindorf D P, "Theory of sampled data control systems", JW (1967).	
References	1. Atherton D P, "Non linear control engineering", Van Nostrand Reinhold, London (1975). 2. Kuo B C, "Analysis & Synthesis of S.D. Control Systems", PHI, New Delhi (1966).	

SET/EI/BT/E704 (i). EMBEDDED SYSTEMS SET/EI/BT/E705 (i). EMBEDDED SYSTEMS		
Module Name	**Content**	**No. of Hrs.**
Introduction	Overview, Characteristics of Embedding Computing Applications: Concept of Real time Systems, Challenges in Embedded System Design, Design Process, Requirements, Specifications, Architecture Design, Designing of Components, System Integration	4
Embedded System Architecture	Instruction Set Architecture: CISC and RISC, Basic Embedded Processor/Microcontroller Architecture: CISC Example: 8051, RISC Example: ARM , DSP Processors, Harvard Architecture, PIC, Memory System Architecture : Caches, Virtual Memory, Memory Management Unit and Address Translation, I/0 Sub-system, Busy-wait I/0, DMA, Interrupt driven I/0, Co-processors and Hardware Accelerators, Processor Performance Enhancement, Pipelining.	5
Designing Embedded Computing Platform	Using CPU Bus: Bus Protocols ,Bus Organization, Memory Devices and their Characteristics, RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM, I/O Devices, Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices, Component Interfacing, Memory Interfacing, I/O Device Interfacing, Interfacing Protocols, GPIB, FIREWIRE, USB, IRDA, Designing with Processors, System Architecture, Hardware Design, FPGA Based Design, Implementation Development Environment, Debugging Techniques, Manufacturing and Testing, Design Examples, Data Compressor, Alarm Clock	7
Programming Embedded Systems	Program Design, Design Patterns for Embedded Systems, Models of Program, Control and Data flow Graph, Programming Languages, Desired Language Characteristics, Introduction to Object Oriented Programming, Data Typing, Overloading and Polymorphism, Control, Multi-tasking and Task Scheduling, Timing Specifications, Run-time Exception handling, Use of High Level Languages, C for Programming embedded systems, Use of Java for Embedded Systems, Programming and Run-time Environment, Compiling, Assembling, Linking, Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing	8
Operating System	Basic Features of an Operating System , Kernel Features, Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System, Processes and Threads, Context Switching, Cooperative Multi-tasking, Pre-emptive Multi-tasking, Scheduling, Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling, nter-process Communication, Signals, Shared Memory Communication, Message-Based Communication, Real-time Memory Management, Process Stack Management, Dynamic Allocation, I/O, Synchronous and Asynchronous I/O, Interrupt Handling, Device Drivers, Real-time OS, VxWorks, RT-Linux, Evaluating and Optimizing Operating System Performance, Response-time Calculation, Interrupt latency, Time-loading, Memory Loading, Power Optimization Strategies for Processes.	10
Network Based Embedded Applications	Network Fundamentals, Layers and Protocols, Network Architectures, Network Components: Bridges, Routers, Switches, Distributed Embedded Architectures, Elements of Protocol Design, High Level Protocol Design Languages, Network Based Design, Internet-Enabled Systems, Protocols for industrial and control applications, Internetworking Protocols, Wireless Applications, Blue-tooth	4
Embedded Control Applications	Introduction, Open-loop and Closed Loop Control Systems, Examples: Speed Control, PID Controllers, Software Coding of a PID Controller.	3
Embedded System Development	Design Methodologies, UML as Design tool, UML notation, Requirement Analysis and Use case, Modeling, Static Modeling, Object and Class Structuring, Dynamic Modeling, Architectural Design, Hardware-Software Partitioning, Hardware-Software Integration, Design Examples, Inkjet Printer, Set-top Box.	3
	Total No. of Hours	**44**
Textbooks	1. John B. Peatman : Design with Microcontrollers, TMH.	
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. 5. Intel : 8 Bit Embedded Controller Hand Book. 6. Intel : 16 Bit Embedded Controller Hand Book. 7. Web : http://nptel.ac.in/courses/108102045/	

SET/EI/BT/E704 (ii). FUZZY LOGIC & NEURAL NETWORK SET/EI/BT/E705 (ii). FUZZY LOGIC & NEURAL NETWORK		
Module Name	**Content**	**No. of Hrs.**
Introduction	History of development in neural networks, neural network characteristics, Artificial neural network technology, Model of a neuron, topology, learning, types of learning, supervised, unsupervised and reinforcement learning.	6
Supervised Learning	Basic hop field model, the perceptron, linear reparability, Basic learning laws, Hebb's rule, Delta rule, Widroff and Huff LMS learning rule, correlation learning rule, In star and out star learning rules. Unsupervised learning, competitive learning, K mean clustering algorithm, Kolwner's feature maps.	8
Training Algorithms	Single layer perceptron and Multilayer feedforward networks, Back propagation training for multi layer feedforward networks , Basic learning laws in RBF network, recurrent networks, recurrent back propagation, Real time recurrent learning algorithm.	5
Counter Propagation Networks	Introduction to counter propagation networks, CMAC networks, ART networks, Application of neural networks, pattern recognition, optimization, associative memory networks, vector quantization, control.	6
Fuzzy Logic	Basic concepts of fuzzy logic, Fuzzy logic crisp set, Linguistic variable, Membership functions, fuzzy set theory and their Operation including addition, subtraction, multiplication and division, Fuzzy IF THEN rules, fuzzy relations, Variable inference techniques, Defuzzification techniques, Basic fuzzy inference algorithm, Application of fuzzy logic, Fuzzy system design, Implementation of fuzzy system, Useful tools supporting design.	10
Neural and Fuzzy Control	Fuzzy controller design, Classification of Control Systems, Neural Networks in direct and indirect control.	8
	Total No. of Hours	**43**
Textbooks	1. Riza Berkin and Trubatch, "Fuzzy System Design Principles", PHI (2000). 2. Yegna Narayenan, "Artificial Neural Networks", MGH (1999). 3. Bart Kosko, "Nueral Networks and Fuzzy Logic", PHI, New Delhi (1998).	
References	1. Simon Haykin, "Neural Networks", Pearson Education (2002). 2. Anderson J A "An Introduction to Neural Networks", PHI, New Delhi (1998).	

SET/EI/BT/E704 (iii). INTRODUCTION TO ROBOTICS SET/EI/BT/E705 (iii). INTRODUCTION TO ROBOTICS		
Module Name	**Content**	**No. of Hrs.**
Module 1	History, Robots, Industrial robots and their applications: robot subsystems, classification of robots, industrial applications.	8
Module 2	Actuators and Grippers: Electric actuators, Hydraulic actuators, Pneumatic actuators, Selection of motors, grippers, Sensor classification, Internal and External sensors,	10
Module 3	Transformations: robot architecture, pose of a rigid body, Coordinate transformation, forward and inverse position analysis.	8
Module 4	Statics and Manipulator Design: Forces and moments balance, Role of Jacobian in statics, manipulator design.	8
Module 5	Inertia properties, Eular-Lagrange Formulation, Newton-Eular Formulation, Dynamic modeling. Control Techniques, Nonlinear and force control.	9
	Total No. of Hours	**43**
Textbooks	1. Introduction to robotics, S. K. Saha, Tata McGraw-Hill Education 2. Fundamentals of mechanics of robotic manipulation, Marco Ceccarelli, Springer Science.	
References	3. Elements of robotics, Mordechai Ben-Ari, Francesco Mondada, Springer.	

SET/EI/BT/E704 (iv). COMPUTER ARCHITECTURE SET/EI/BT/E705 (iv). COMPUTER ARCHITECTURE		
Module Name	**Content**	**No. of Hrs.**
Introduction	Introduction and overview of computer architecture, basic computer organization, register transfer notation. General aspects of processor design, CPU organization, instruction set architecture, data types, addressing modes, program sequencing.	5
Instructions and Assembly language Programming	Direct, indirect, indexed, relative and immediate addressing mode. Pre and post indexing, instruction formats, zero, one, two and three address machine, different types of instructions – memory and non memory reference instructions; Assembly language – Basic I/O operations – Stacks and Queues; Assembler, Compiler, Linker.	6
Arithmetic	Basic structure functional blocks, register involved, fetch and execution cycle, instruction sequencing; ALU design: computer arithmetic, fixed and floating points arithmetic, logical operations; design of fast adders, multiplication and division circuits.	6
Control unit	Control unit concepts, execution of complete instructions, and sequencing of control signals, hardware control unit, general micro-programming concepts, micro-programmed control unit, micro-instructions and their encoding.	6
Pipelined processing	Pipelining, Basic Concepts, Data hazards, Instruction hazards, Influence on Instruction sets; Data path and control consideration – Superscalar operation.	5
Memory System Design	Memory hierarchy, system balance consideration, Speed, size and cost; memory I/O design, cache, ROM, Performance consideration, Virtual memory, Memory management requirements, Secondary storage.	6
Input-Output Organization	Addressing I/O devises, data transfer synchronization, interrupt handling, I/O channels, computer peripherals and interfacing, I/O interfaces I/O devices, terminals, card readers, and I/O processors, Standard I/O Interfaces (PCI, SCSI, and USB).	5
Programmable Logics and HDL	Introduction to CPLDs and FPGAs; Introduction to VHDL and different styles of modeling; VHDL programs for adders, decoder, encoder, 7-segment display decoder, multiplexer, de-multiplexer, up down counter, universal shift register, ALU, Melay and Moore type FSM sequence detector;	6
	Total No. of Hours	**45**
Textbooks	1. Moris M Mano, "Computer System Architecture", PHI. 2. Roth, "Digital Design using VHDL"	
References	1. Hennesy, Patterson, "Computer Organization and Design: the hardware/ software interface", Morgan Kauffman. 2. Hamacher, C., Vranesic, Z. and Zaky, S., "Computer Organization" McGraw Hill.	

SET/EI/BT/C706. 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/EI/BT/C707. 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/EI/BT/C708. PROJECT PREPARATION	
Content	**No. of Hrs.**
Project Preparation 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.	24x2
Total No. of Hours	**48**

SET/EI/BT/C709. INDUSTRIAL TRAINING SEMINAR	
Content	**No. of Hrs.**
Student shall prepare a detailed report on her/his industrial training and deliver a seminar of 30 minutes.	24x2
Total No. of Hours	**48**

SET/HS/BT/H710. PRINCIPLES OF MANAGEMENT		
Module Name	**Content**	**No. of Hrs.**
General Management	Nature, scope and significance of management. Process and functions of management. Overview of the functional areas of the general management.	6
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.	6
Marketing Management	Nature, concept, scope and significance of marketing management, functions of marketing management, marketing planning and marketing mix.	6
Product Development	Concept, nature, significance of product management, product value, types of products, new product development, product life cycle, functions of product managers.	6
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.	6
Operations Management	Concept of operations management, tools and techniques: PERT, CEPM, JIT, KANBAN, Inventory management, six sigma, TQM, SCM;	6
Production Management	Concept, nature and significance of production management, functions of production managers.	6
	Total No. of Hours	**42**
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.	

.SEMESTER VIII

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1		PE-04	3	1	-	10	20	30	70	100	3
2		OE-04	3	1	-	10	20	30	70	100	3
3		OE-05	3	1	-	10	20	30	70	100	3
4	SET/EI/BT/C804	Major Project	-	-	16	-	-	-	-	100	8
										Total	17

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Professional Elective 04 (PE-04)	1	SET/EI/BT/E801 (i)	Renewable Energy Engineering
	2	SET/EI/BT/E801 (ii)	Electrical Distribution System
	3	SET/EI/BT/E801 (iii)	Control Systems Design
	4	SET/EI/BT/E801 (iv)	Switchgear and Protection

	S. No.	Code	Course Title
Open Elective 04 and 05 (OE-04, OE-05)	1	SET/EI/BT/E802 (i)	Data Communication and Networking
		SET/EI/BT/E803 (i)	
	2	SET/EI/BT/E802 (ii)	Virtual Instrumentation
		SET/EI/BT/E803 (ii)	
	3	SET/EI/BT/E802 (iii)	Smart Grid Technology
		SET/EI/BT/E803 (iii)	
	4	SET/EI/BT/E802 (iv)	Mobile Communication and Networks
		SET/EI/BT/E803 (iv)	

***** 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.

SET/EI/BT/E801 (i). RENEWABLE ENERGY ENGINEERING		
Module Name	**Content**	**No. of Hrs.**
Introduction	Energy sources and their availability- conventional and renewable energy sources, prospects of renewable energy. Energy conservation and energy audit.	4
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- in agriculture, distillation, pumping cooking, green houses, hydrogen production, etc. Solar 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, basic components of wind energy conversion system, types of wind machines- horizontal axial and vertical axial machines, aerodynamic forces acting on blades, scheme of electricity generation, generator control, load control, energy storage, applications of wind energy.	8
Energy from Biomass	Biomass conversion technologies- wet and dry processes, photosynthesis, biogas plants, fuel properties of biogas, thermal gasification of biomass.	4
Geothermal energy	Nature of geothermal fields, geothermal sources, energy estimation, application of geothermal energy, materials selection for geothermal power plants.	4
Ocean energy	Ocean thermal energy conversion (OTEC)- open cycle and close cycle OTEC, site selection, energy utilization, energy from tides, components of tidal power plants, Ocean wave energy- Energy conversion devices.	4
Mini and micro hydro	Components, turbine and generators for small scale hydro, protection, control and management of equipments.	4
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, hydrogen as an alternative fuel, safety and management.	6
	Total No. of 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/EI/BT/E801 (ii). ELECTRICAL DISTRIBUTION SYSTEM		
Module Name	**Content**	**No. of Hrs.**
General concepts	Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, Contribution factor loss factor-relationship between the load factor and loss factor. Classification of loads (Residential, Commercial, Agricultural and industrial) and their characteristics.	5
Distribution feeders	Design consideration of distribution feeders: Radial and loop types of primary feeders, Voltage levels, Feeder loading; Basic design practice of the secondary distribution system. Substations: location of substation, Rating of distribution substation, Service area within primary feeders. Benefits derived through optimal location of substations.	6
Underground Cables	Introduction, Insulation, Sheath, Armour and Covering, Classification of Cables, Pressurized Cables, Effective Conductor Resistance, Conductor Inductive Reactance, Parameters of Single Core Cables, Grading of Cables, Capacitance of Three Core Belted Cable, Breakdown of Cables, Cable Installation, Current Rating of Cables, System Operating Problems with Underground Cables, HVDC Cables.	14
System Analysis	Voltage drop and power-loss calculations, Derivation for voltage drop and power loss in lines, Manual methods of solution for radial networks, Three phase balanced primary lines.	4
Protection	Objectives of distribution system protection, Types of common faults and procedure for fault calculations. Protective devices: Principle of operation off uses, Circuit re-closures, Line sectionalizes, and Circuit breakers.	5
Coordination	Coordination of protective devices: General coordination procedure. Compensation for power factor improvement, Capacitive compensation for power-factor control. Different types of power capacitors, Shunt and series capacitors, Effect of shunt capacitors (fixed and switched), Power factor correction, Capacitor allocation-economic justification, Procedure to determine the best capacitor location.	8
	Total No. of Hours	**42**
Textbooks	1. Gonen, T., Electric Power Distribution System Engineering, 3rd edition CRC Press 2014. 2. Pabla, A.S., Electric Power Distribution, 6th ed., Tata McGraw Hill, 2012.	
References	1. Sivanagaraju, S. and Sankar, V., Electrical Power Distribution and Automation, Dhanpat Rai & Co, 2006. 2. Kamaraju, V., Electrical Power Distribution Systems, Tata McGraw Hill Education, New Delhi, 2011.	

SET/EI/BT/E801 (iii). CONTROL SYSTEMS DESIGN		
Module Name	**Content**	**No. of Hrs.**
Design Specifications	Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.	10
Design of Classical Control System in the time domain	Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.	6
Design of Classical Control System in frequency domain	Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.	6
Design of PID controllers	Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.	6
Control System Design in state space	Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle.	10
Nonlinearities and its effect on system performance	Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.	4
	Total No. of Hours	**42**
Textbooks	1. N. Nise, "Control system Engineering", John Wiley, 2000.	
References	2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley, 2000. 3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988. 4. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010. 5. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995. 6. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995. 7. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.	

SET/EI/BT/E801 (iv). SWITCHGEAR AND PROTECTION		
Module Name	**Content**	**No. of Hrs.**
Faults in Power Supply System	Symmetrical component transformation. Three phase power in unbalanced circuit in terms of symmetrical component. Sequence impedance of generator. Transformer transmission line & passive loads. Phase shift in Y/delta three phase transformers (Yd1, Yd11 connection). Symmetrical fault analysis without & with pre-fault load currents. Selection of circuit breakers ratings, current limiting reactors.	10
Unsymmetrical fault analysis	L-G, L-L-G-, L-L, open conductors fault using symmetrical components.	4
General philosophy of protective relaying	Protective zones. Primary protection, back up protection, remote and local back up, selectivity. Medium voltage line protection: over current relaying directional over current relays.	6
High voltage line protection	Distance relays, carrier distance schemes. Unit carrier schemes.	2
Equipment protection	Principles of differential relaying, protection of generator, transformers and busbars by differential relaying and other relays. Protection of induction motor‘s against overload, short-circuits, thermal release, miniature circuit breaker.	6
Introduction to numerical relays	Comparison of static and electro-mechanical relays, two input amplitude and phase comparators and their duality. Generation of various distance relay characteristics using above comparators. Switchgear: circuit breakers, arc interruption theory, recovery.	8
Switchgear	circuit breakers, arc interruption theory, recovery and restriking voltages, RRRV, breaking of inductive and capacitive current, C.B. ratio, different media of arc interruption, SF6 and vacuum breakers.	6
	Total No. of Hours	**42**
Textbooks	1. Ram, B. and Vishwakarma, D.N. Power System Protection & Switchgear,2nd ed., Tata McGraw Hill, 2013. 2. Paithankar, Y.G. and Bhide, S.R., Fundamentals of Power System Protection, 2nd ed., PHI Learning, 2013	
References	1. Elmore, W.A, Protective Relaying Theory and Applications, 2nd ed., MarcelDekker, New York, 2004. 2. Mason, C.R., Art and Science of Protective Relaying, Wiley, New York, 1968. 3. Warrington, A.R.V., Protective Relays: Their Theory and Practice (Vol. I & Vol. II), 3rd ed., Chapman and Hall, London, 1978.	

SET/EI/BT/E802 (i). DATA COMMUNICATION AND NETWORKING SET/EI/BT/E803 (i). DATA COMMUNICATION AND NETWORKING		
Module Name	**Content**	**No. of Hrs.**
Introduction to networks	Networks: Components and Categories, Types of Connections,Topologies, Transmission Media, Coaxial Cable, Fiber Optics, ISO/OSI Model.	8
Data link layer	Error- Detection and correction, Parity, LRC, CRC, Hamming code, Low Control and Error control, Stop and wait, ARQ, Sliding window, HDLC, LAN, IEEE 802 Standards, Wireless LAN, Bridges.	8
Network layer	Inter-networks, Packet Switching and Datagram approach, IP addressing methods, Sub-netting, Routing, Distance Vector Routing, Link State Routing, Routers.	8
Transport layer	Duties of transport layer, Multiplexing, De-multiplexing, Sockets, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion Control, Quality of Services (QOS)	8
Application layer	Domain Name Space (DNS), SMTP, FTP, HTTP –WWW, Network Security.	4
Industrial Data Networks	RS – 232 AND RS – 485, 20ma current loop – Serial interface converters; MODBUS protocol, Data highway (plus) protocol; HART Protocol; Introduction to AS–interface and Device-Net; Introduction to Profibus; Foundation field bus versus Profibus; 10Mbps Ethernet; 100Mbps;	6
	Total No. of Hours	**42**
Textbooks	1. Behrouz A. Forouzan, “Data communication and Networking”. Tata McGrawHill, 2004 2. Mackay, S., Wrijut, E., Reynders, D. and Park, J., “Practical Industrial DataNetworks Design, Installation and Troubleshooting”, Newnes Publication,Elsevier, 1st Edition, 2004.	
References	1. Andrew S. Tanenbaum, “Computer Networks”. PHI, Fourth Edition, 2003. 2. William Stallings, “ Data and Computer Communication”, Sixth Edition, PearsonEducation 3. Leon-Garcia, Widjaja: Communication Networks, TMH. 4. Buchanan, W., “Computer Busses”, CRC Press, 2000 5. Stallings, W., “Wireless Communication and Networks”, 2nd Edition, PrenticeHall of India.	

SET/EI/BT/E802 (ii). VIRTUAL INSTRUMENTATION SET/EI/BT/E803 (ii). VIRTUAL INSTRUMENTATION		
Module Name	**Content**	**No. of 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 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/EI/BT/E802 (iii). SMART GRID TECHNOLOGY SET/EI/BT/E803 (iii). SMART GRID TECHNOLOGY		
Module Name	**Content**	**No. of Hrs.**
Module 1	Review of basic elements of electrical power systems, Desirable traits of a modern grid, Principal characteristics of the smart grid, Key technology areas; Smart grid communication: Two way digital communication paradigm, network architectures, IP-based systems, Power line communications, Advanced metering infrastructure; Renewable generation: Renewable resources: Wind and solar, Microgrid architecture, Tackling intermittency, Distributed storage and reserves; Wide area measurement: Sensor networks, Phasor measurement units, Communications infrastructure, Fault detection and Self-healing systems, Application and challenges; Security and privacy: Cyber security challenges in smart grid, Defense mechanism, Privacy challenges.	43
	Total No. of Hours	**43**
Textbooks	1. J. Momoh , Smart Grid: Fundamentals of Design and Analysis‘ Wiley-IEEE Press, 2012.	
References	1. P. F. Schewe, The Grid: A Journey through the Heart of our Electrified World‘Joseph Henry Press, 2006. 2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama _Smart Grid: Technology and Applications‘Wiley press, 2012. 3. Ali Keyhani, Design of smart power grid Renewable Energy Systems‘2nd Edition Wiley-IEEE Press, 2011.	

SET/EI/BT/E802 (iv). MOBILE COMMUNICATION AND NETWORKS SET/EI/BT/E803 (iv). MOBILE COMMUNICATION AND NETWORKS		
Module Name	**Content**	**No. of 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.	12
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, universal mobile telecommunication systems.	14
	Total No. of Hours	**44**
Textbooks	1. Rappa port, "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/EI/BT/C804. MAJOR PROJECT	
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.	16 x 2 = 32

Appendix-I

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.