Curriculum and Syllabus as per NEP-2020

Bachelor of Technology

In

Electronics and Communication Engineering

(Applicable for 2022-23 batch and onwards)

Department of Electronics and Communication Engineering
School of Engineering and Technology,
H. N. B. Garhwal (A Central) University,
Srinagar Garhwal, Uttarakhand- 246174

Curriculum

Mandatory Induction Program

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

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

1. **Code for Courses:**

Code for a course consists of two alphabets followed by three digits and an optional alphabet.

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

2. **Elective Course (Program Elective/Open Elective):**

Elective courses are provided in III, IV, 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. All the courses and course titles are subject to change at any stage as per directions of Authorities of the University.

3. **MOOC Courses:**

"MOOCs" means Massive Open Online Courses (MOOCs) are such online courses which are developed and made available on the SWAYAM platform of Government of India. MOOCs guidelines on online learning issued by the MHRD vide orders dated 11th March 2016 and subsequent addendums issued by the MHRD.
Any student can be permitted to opt for only up to 20% of the total courses being offered in a particular program in a semester through the online learning courses provided through SWAYAM platform. Any student can opt, with the permission of the department, the course of the SWAYAM platform, which is available/ offered in the same term (even or odd) with same credit and at least 80% syllabus should be match.

4. **Self & Social Development (SSD) Course registration: The undergraduate students of Electronics and Communication Engineering have to register for mandatory SSD course. Students may complete it at any time throughout the B. Tech degree course. Appendix –II sheet has attached for details.**

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

SEMESTER- WISE LIST SUBJECTS (AS PER NEP 2020)

SEMESTER I

(Click on subject for detail syllabus.)

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1.	Basic Science/ Multidisciplinary	SET/SH/BT/C101	Mathematics I	3	1	-	4	4
2.		SET/SH/BT/C102	Physics	3	1	-	4	4
3.	Core Basic Engineering Subjects	SET/EE/BT/C103	Basic Electrical Engineering	3	1	-	4	4
4.		SET/EC/BT/C104	Basic Electronics	3	1	-	4	4
5.		SET/IT/BT/C105	Fundamentals of Information Technology	3	1	-	4	4
6.	Core/ Basic Engineering Subjects Labs	SET/SH/BT/C107	Physics Lab	-		1	2	1
7.		SET/ME/BT/C108	Engineering Graphics and Workshop Practice	-	-	1	2	1
8.	Extracurricular Courses/ CC	VAC-1	*Understanding and Connecting with Environment	2	-	-	2	2
9.	Skill Course	SET/IE/BT/S106	Basic Electrical Engineering Lab	-	-	1	4	2
Total				17	5	3	30	26

*Common syllabus for all UG courses of the university.

SEMESTER II

(Click on subject for detail syllabus.)

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1.	Basic Science/ Multidisciplinary	SET/SH/BT/C201	Mathematics II	3	1	-	4	4
2.		SET/SH/BT/C203	Chemistry	3	1	-	4	4
3.	Core Basic Engineering Subjects	SET/ME/BT/C202	Basic Mechanical Engineering	3	1	-	4	4
4.		SET/ME/BT/C204	Engineering Mechanics	3	1	-	4	4
5.		SET/CS/BT/C205	C Programming	3	1	-	4	4
6.	Core/ Basic Engineering Subjects Labs	SET/SH/BT/C208	Chemistry Lab	-	-	1	2	1
7.		SET/CS/BT/C209	C Programming Lab	-	-	1	2	1
8.	Life Skills and Personality Development	VAC-2	*Life Skills and Personality Development	2	-	-	2	2
9.	Skill Course	SET/EC/BT/S206	Basic Electronics Lab	-	-	1	4	2
Total				**17**	**5**	**3**	**30**	**26**

*Common syllabus for all UG courses of the university.

SEMESTER III

(Click on subject for detail syllabus.)

S. No.	Category	Course Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1.	Basic Science/ Multidisciplinary	SET/SH/BT/C301	Mathematics III	3	1	-	4	4
2.	Core Subjects	SET/EC/BT/C302	Electronic Circuits	3	1	-	4	4
3.		SET/EC/BT/C303	Digital Electronics	3	1	-	4	4
4.			@Program Elective- I	3	1	-	4	4
5.	Interdisciplinary Subject	SET/IE/BT/C303	Signals and Systems	3	1	-	4	4
6.	Core Subjects Based Labs	SET/IE/BT/C305	Signals and Networks Lab	-	-	1	2	1
7.		SET/EC/BT/C306	Digital Electronics Lab	-	-	1	2	1
8.	Extra Curriculum	AMDSC-2	* Basic Yoga Practices	2	-	-	2	2
9.	Skill Course	SET/EC/BT/S307	Electronic Circuits Lab	-	-	1	4	2
TOTAL				**17**	**5**	**3**	**30**	**26**

*Common syllabus for all UG courses of the university.

@Course offered by the department from the Program Elective- I list as given below.

	S. No.	Code	Course Title
Program Elective- I	1.	SET/EC/BT/E308	Physics of Semiconductor Devices
	2.	SET/EC/BT/E309	Probability Theory and Stochastic Process
	3.	SET/EC/BT/E310	Data Structure and Algorithm

SEMESTER IV

(Click on subject for detail syllabus.)

S. No.	Category	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1.	Core Subjects	SET/EC/BT/C401	Analog Communication	3	1	-	4	4
2.		SET/EC/BT/C402	Analog Integrated Circuits	3	1	-	4	4
3.		SET/EC/BT/C403	Electromagnetic Field Theory	3	1	-	4	4
4.			@Program Elective-II	3	1	-	4	4
5.	Interdisciplinary Subject	SET/IE/BT/C402	Microprocessors and Interfacing	3	1	-	4	4
6.	Core Subjects Based Labs	SET/EC/BT/C405	Communication Lab-I	-	-	1	2	1
7.		SET/EC/BT/C406	Analog Integrated Circuits Lab	-	-	1	2	1
8.	Extra Curriculum	VAC-3	*Indian Knowledge System	2	-	-	2	2
9.	Skill Course	SET/IE/BT/S407	Microprocessors Lab and Mini Project	-	-	1	4	2
TOTAL				**17**	**5**	**3**	**30**	**26**

*Common syllabus for all UG courses of the university.

@Course offered by the department from the Program Elective- II list as given below.

	S. No.	Code	Course Title
Program Elective- II	1.	SET/EC/BT/E408	Circuit Theory
	2.	SET/EC/BT/E409	Engineering Materials
	3.	SET/EC/BT/E410	Numerical Techniques

SEMESTER V

(Click on subject for detail syllabus.)

S. No.	Category	S. No.	Course Title	L	T	P	Contact Hrs./Week	Credits
1.	Core Subjects	SET/EC/BT/C501	Digital Communication	3	1	-	4	4
2.		SET/EC/BT/C502	CMOS Digital VLSI Design	3	1	-	4	4
3.		SET/IE/BT/C502	Control Systems	3	1	-	4	4
4.			@Program Elective-III	3	1	-	4	4
5.	Open Elective / Inter-disciplinary Subject		#Open Elective- I	3	1	-	4	4
6.	Core Subjects Based Labs	SET/EC/BT/C503	Communication Lab-II	-	-	1	2	1
7.		SET/EC/BT/C504	CMOS Digital VLSI Design Lab		-	1	2	1
8.	Extracurricular/ Courses/ Compulsory course	VAC 4	* Culture, Traditions and Moral Values	-	-	1	4	2
9.	Skill Course	SET/EC/BT/S506	Micro Project	-	-	1	4	2
TOTAL				**15**	**5**	**4**	**32**	**26**

@Course offered by the department from the Program Elective- III list as given below.
#Courses offered by any department of School of Engineering and Technology.
* Courses offered by University.

	S. No.	Code	Course Title
Program Elective- III	4.	SET/EC/BT/E507	Antenna and Wave Propagation
	5.	SET/EC/BT/E508	Data Communication and Networking
	6.	SET/EC/BT/E509	Information Theory and Coding

SEMESTER VI

(Click on subject for detail syllabus.)

S. No.	Category	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1.	Core Subjects	SET/EC/BT/C601	Digital Signal Processing	3	1	-	4	4
2.		SET/EC/BT/C602	Computer Design using VHDL	3	1	-	4	4
3.		SET/EC/BT/C603	Microwave Theory and Techniques	3	1	-	4	4
4.			@Program Elective-IV	3	1	-	4	4
5.	Open Elective/ Inter-disciplinary Subject		#Open Elective- II	3	1		4	4
6.	Core Subjects Based Labs	SET/EC/BT/C604	Digital Signal Processing Lab	-	-	1	2	1
7.		SET/EC/BT/C605	FPGA Lab			1	2	1
8.	Communication skills/CC	SET/EC/BT/M606	* Communication Skills Course/ Technical Seminar	-	-	1	4	2
9.	Skill Course	SET/EC/BT/S607	Minor Project	-	-	1	4	2
TOTAL				**15**	**5**	**4**	**30**	**26**

@Course offered by the department from the Program Elective- IV list as given below.

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

*University will prepare communication course in Modern/Indian languages from which student will select one language course. The course will be more on applied side with giving students a chance to develop their soft skills. In case no syllabus is prepared by the university then Technical Seminar course will be offered to our students.

	S. No.	Code	Course Title
Program Elective- IV	1.	SET/EC/BT/E608	Microcontroller Programming and Interfacing
	2.	SET/EC/BT/E609	Introduction to Python Programming
	3.	SET/EC/BT/E610	Wireless Sensor Networks

SEMESTER VII

(Click on subject for detail syllabus.)

S. No.	Category	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1.	Core Subjects	SET/EC/BT/C701	Optical Fiber Communication	3	1	-	4	4
2.			@Program Elective- V	3	1	-	4	4
3.			@Program Elective- VI	3	1	-	4	4
4.	Core Subjects Based Labs	SET/EC/BT/C702	Advanced Communication Lab	-	-	1	2	1
5.		SET/EC/BT/C703	Industrial Training Seminar	-	-	1	2	1
6.	Life Skills and personality development	SET/SH/BT/L701	Essential Management Practices	2	-	-	2	2
7.	Skill Course	SET/EC/BT/S704	Major Project Preparation	-	-	1	8	4
TOTAL				**11**	**3**	**3**	**26**	**20**

@Course offered by the department from the Program Elective- V & VI list as given below.

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

	S. No.	Code	Course Title
Program Elective- V & VI	1.	SET/EC/BT/E705	CMOS Analog IC Design
	2.	SET/EC/BT/E706	RADAR Guidance and Navigation
	3.	SET/EC/BT/E707	Satellite Communication
	4.	SET/EC/BT/E708	Micro-sensors and Actuators
	5.	SET/EC/BT/E709	Internet of Things
	6.	SET/EC/BT/E710	Error Correcting Codes
	7.	SET/EC/BT/E711	Machine Learning
	8.	SET/EC/BT/E712	Cyber Security
	9.	SET/IE/BT/E701	Biomedical Instrumentation
	10.	SET/IE/BT/C701	Vacuum Instrumentation and Thin Film Deposition Techniques

SEMESTER VIII

(Click on subject for detail syllabus.)

S. No.	Category	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1.	Core Subjects	SET/EC/BT/C801	VLSI Technology	3	1	-	4	4
2.			@Program Elective- VII	3	1	-	4	4
3.	Open Elective /Inter-disciplinary Subject		#Open Elective-III	3	1	-	4	4
4.	Life Skills and personality development	SET/SH/BT/L801	Disaster Management	-	-	1	4	2
5.	Skill Course	SET/EC/BT/S802	Major Project	-	-	1	12	6
Total				**9**	**3**	**2**	**28**	**20**

@Course offered by the department from the Program Elective- VII list as given below.

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

	S. No.	Code	Course Title
Program Elective-VII	1.	SET/EC/BT/E803	Wireless and Mobile Communication
	2.	SET/EC/BT/E804	Mobile Ad hoc Networks
	3.	SET/EC/BT/E805	Digital Image and Video Processing
	4.	SET/EC/BT/E806	Mixed Signal Design
	5.	SET/EC/BT/E807	MOSFET Modeling
	6.	SET/EC/BT/E808	Integrated Circuits for Communication
	7.	SET/EC/BT/E809	High Speed Electronics
	8.	SET/EC/BT/E810	Nanoelectronics

DETAILED SYLLABI AS PER NEP-2020

SEMESTER I

(Click for Credit Distribution)

S. No.	Category	Course Code	Course Title	T.A	C.T	TOT	ESE	SUB. TOTAL
1.	Basic Science/ Multidisciplinary	SET/SH/BT/C101	Mathematics I	10	20	30	70	100
2.		SET/SH/BT/C102	Physics	10	20	30	70	100
3.	Core Basic Engineering Subjects	SET/EE/BT/C103	Basic Electrical Engineering	10	20	30	70	100
4.		SET/EC/BT/C104	Basic Electronics	10	20	30	70	100
5.		SET/IT/BT/C105	Fundamental of Information Technology	10	20	30	70	100
6.	Core/ Basic Engineering Subjects Labs	SET/SH/BT/C107	Physics Lab	30	-	30	70	100
7.		SET/ME/BT/C108	Engineering Graphics and Workshop Practice	30	-	30	70	100
8.	Extracurricular Courses/ CC	VAC-1	*Understanding and Connecting with Environment	10	20	30	70	100
9.	Skill Course	SET/IE/BT/S106	Basic Electrical Engineering Lab	30	-	30	70	100

*Common syllabus for all UG courses of the university.
T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

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

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

SET/EE/BT/C103. BASIC ELECTRICAL ENGINEERING		
Course Objective	1. To impart basic knowledge of electrical quantities and provide working knowledge for the analysis of DC and AC circuits. 2. To understand the construction and working principle of DC and AC machines. 3. To understand the construction and working principle of various instruments. 4. To understand the construction and working principle of 3- phase supply system.	
Course Outcomes	Student should be able to: 1. Understand the basic electric and magnetic circuits. 2. Analyze DC and AC circuits. 3. Interpret the construction and working of different types of electrical machines and instruments. 4. Analyze basic electrical components and circuits.	
Module Name	**Content**	**No. of Hrs.**
DC Networks	Concepts of linear, nonlinear, active, passive, unilateral and bilateral elements; Ideal and practical voltage & current sources, conversion from one from the other; Kirchhoff‟s laws, statements; Mesh Analysis; Nodal Analysis; Delta-Star & Star-Delta conversion; Superposition principle; Thevenin‟s theorem, statement, advantages in case of complex networks; explanation & illustration with examples; Norton‟s theorem, Maximum power transfer theorem, Reciprocity Theorem and its application.	**10**
Single Phase AC Circuits	Generation of single phase AC voltage and determination of average (mean) and RMS (effective) values of voltage and current with special reference to sinusoidal waveforms; Form factor and peak factor for various waves; Representation of sinusoidal time varying quantities as phasors; concepts of reactance, impedance and their representation in complex forms using j operator; Steady state analysis of series R-L-C circuit & its phasor diagram; Concept of power & power factor; Concept of admittance, susceptance in parallel circuits; Analysis of series parallel circuits & phasor diagrams; Resonance in series and parallel circuits.	**10**
Three Phase Circuits	Generation of 3-phase balanced sinusoidal voltage; star & delta connections; line & phase quantities (current & voltage); Solution of 3-phase star/delta circuits with balanced supply voltage and balanced load; phasor diagram; 3-phase, 4-wire circuits; Measurement of three phase power by two wattmeter method; phasor diagram with balanced load and determination of load power factor from wattmeter readings.	**6**
Transformers and Rotating Machines	Transformers: Constructional features and principle of operation, concept of ideal transformer under no load & loaded conditions and its equivalent circuit; Practical transformer rating & its equivalent circuit; Autotransformer – principle of operation & relative advantages & disadvantages; Rotating Machine: construction features (stator, rotor & air gap), conditions for production of steady electromagnetic torque; Three phase Induction motor: constructional features and operation; DC Machines: construction features, EMF and Torque expression, Classification of DC motors and generators; Stepper motor.	**12**
Measuring Instruments	DC PMMC instruments – constructional feature and principle of operation; Moving iron meters construction and principle of operation; Dynamometer type wattmeter; Induction type energy meter construction & principle of operation.	**6**
	Total No. of Hours	**44**
Textbooks	1. I. J. Nagrath, “Basic Electrical Engineering,” Tata Mc. Graw Hill.	
References	1. A. E. Fitgerald, D. E., Higginbotham and A. Grabel, “Basic Electrical Engineering”, Mc Graw Hill. 2. Rizzoni, "Principles and Applications of Electrical Engineering”, TMH. 3. V. Del Toro, “Principles of Electrical Engineering”, Prentice Hall. 4. W. H. Hayt & J. E. Kemmerly, “Engineering Circuit Analysis”, Mc Graw Hill. 5. H. Cotton, “Advanced Electrical Technology”, Wheeler Publishing.	

SET/EC/BT/C104. BASIC ELECTRONICS		
Course Objective	To familiarize the students with electronics field. To introduce semiconductor fundamentals, electronic devices, and elementary electronic circuits. To familiarize students with digital logics and gates.	
Course Outcomes	Student should be able to: 1. Understand the working and current voltage characteristics of semiconductor devices e.g., diodes and transistor. 2. Perform dc analysis of amplifier circuits. 3. Design basic OP AMP circuits. 4. Understand and use basic digital electronic concepts.	
Module Name	**Content**	**No. of Hrs.**
Semiconductor Diodes	Semiconductor materials- intrinsic and extrinsic types, Ideal Diode as a switch, Terminal characteristics, and equivalent circuit of PN diode: p-n junction under open circuit condition, p-n junction under forward bias and reverse bias conditions, p-n junction in breakdown region; Zener diode and basic voltage regulator using Zener diode; Rectifier Circuits, Clipping and Clamping circuits; LED, Photo Diode.	**10**
Bipolar Junction Transistors	Physical structure, physical operation and current-voltage characteristics of NPN transistor; Use of Voltage-dependent Current source as a Voltage amplifier; Transistor as an amplifier: Characteristics of CE amplifier; Active region operation of transistor; D.C. analysis of Common Emitter Amplifier: load line analysis; Transistor as a switch: cut-off and saturation modes.	**10**
Field Effect Transistor	Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics; MOSFET as a Switch, MOSFET as a Voltage-dependent Current source and Common Source Amplifier.	**8**
Operation Amplifier	Ideal Op-amp; Properties of the ideal Operational Amplifier; op-amp application circuits (assuming ideal op amp): inverting amplifier, non -inverting amplifier, weighted summer, Integrator and differentiator.	**6**
Digital Logic and Gates	Binary, octal, and hexadecimal number systems; Methods of base conversions; Binary, octal, and hexadecimal arithmetic; Representation of signed numbers; Basic logic operations and logic gates; MOSFET Switch Implementation of Logic Gates, e.g., Inverter, NAND, NOR. Basic postulates and fundamental theorems of Boolean algebra.	**8**
	Total No. of Hours	**42**
Textbooks	1. Agarwal Anant, Lang, Jeffrey H, "Foundations of Analog and Digital Electronic Circuits", Elsevier Science & Technology Books.	
References	1. V. Del Toro, "Principles of Electrical Engineering", PHI. 2. Rizzoni, "Principles and Applications of Electrical Engineering", TMH. 3. Malvino, Electronic Principles. 4. R. L. Boylestad & L. Nashelsky, "Electronics Devices & Circuit Theory", PHI. 5. Sedra, Smith, "Microelectronic Circuits", Oxford University Press.	

SET/IT/BT/C105. FUNDAMENTALS OF INFORMATION TECHNOLOGY		
Course Objective	1. Take on significant positions in various IT work. 2. Collaborate in diverse team environments. 3. Contributions in the field of IT. 4. Work effectively in the IT field to make a positive contribution to society.	
Course Outcomes	Student should be able to: 1. Develop information technology solutions by evaluating user requirements in the systems development environment. 2. Apply knowledge of IT requirements for technology solutions in cutting edges applications. 3. Analyze a problem and identify and define the computing requirements for the appropriate solutions. 4. Create, select and apply appropriate techniques, resources, and modern engineering and IT tools.	
Module Name	**Content**	**No. of Hrs.**
Introduction	Definition of Electronic Computer, Generations, Classification of Computers, Computer Hardware and Basic Computer Organization: CPU- ALU, CU; RAM/ROM, Various I/O devices, Peripherals, Storage Media.	**4**
Computer Languages	Binary, Hexadecimal Number System; Basic Binary Logic Operations; Binary Addition and Subtraction; Generation of Languages, Assembly Language, High level language; Translators, Interpreters, Compilers, Compilers; Flow Charts, Dataflow Diagram.	**6**
OS & Office	Software- System and Application Software; Elementary Concepts in Operating System; Textual Vs GUI, Introduction to DOS, MS Windows, UNIX/Linux.	**4**
Computer Networks	Elements of Communication system; Brief Introduction to Computer Networks- Introduction of LAN and WAN. Network Topologies, Client-server Architecture, IoT, Cloud Computing.	**6**
Internet	Internet & World Wide Web, Hypertext Markup Language, DHTML, Python, WWW, Gopher, FTP, Telnet, Web Browsers, Net Surfing, Search Engines, Email; Introduction to Web Development, Static and Dynamic Pages.	**6**
IT Application and Multi media	Basic Awareness of NICNET and ERNET; E Commerce, E governance; Brief Introduction to Different Formats of Image, Audio, Video.	**6**
Information Concepts & Processing	Definitions of Information, Need of information, quality of information, value of information, concept of information, Entropy category and Level of information in Business Organization, Data Concepts and Data Processing, Data Science, Data Representation, Application of IT to E-commerce, Electronic Governance, Multimedia, Entertainment, Introduction to Information System.	**8**
	Total No. of Hours	**40**
Textbooks	1. Sinha, Sinha, “Computer Fundamentals”. 2. Yadav R. P., “Information Technology”.	
References	1. D. S. Yadav, “Foundations of IT”, New Age, Delhi. 2. Rajaraman, “Introduction to Computers”, PHI. 3. Peter Nortans “Introduction to Computers”, TMH. 4. Patterson D. A. & Hennessy J. L., "Computer Organization and Design", Morgan Kaufmann Publishers.	

SET/SH/BT/C107. PHYSICS LAB		
Course Objective	To make students aware about experimental verification behind the theory, familiarize the student to the basic of spectroscopy, lasers, and semiconductor lab experiment and demonstrate their applications. Give the brief introduction about the Planck's constant, Hall Effect, Ohm's law, Thomson's experiment, conversion of Galvanometer to Voltmeter and Ammeter and unknown resistance using post office box.	
Course Outcomes	Student should be able to: 1. Perform the experiment and learn about the practical knowledge of various theory part. 2. Find the refractive index of material, wavelength of monochromatic source of light. 3. Find the efficiency of electric kettle, band gap of materials, behaviour of semiconductor, charge density and hysteresis curve in ferromagnetic materials.	
S. No.	**Experiments**	**No. of Hrs.**
1.	To determine refractive index of glass and liquid using spectrometer.	1x2
2.	To determine the wavelength of spectral lines using plane diffraction grating (Use Hg Source).	1x2
3.	To determine the wavelength of sodium light by Newton's Ring method.	1x2
4.	To measure an accessible (Horizontal and vertical) height using sextant.	1x2
5.	Determination of wavelength of He-Ne laser using single slit /N slit diffraction pattern.	1x2
6.	To study the photoelectric effect and determine the value of Planck's constant.	1x2
7.	To determine the heating efficiency of an electric kettle with varying voltage.	1x2
8.	To Determine the wavelength of the semiconductor diode laser.	1x2
9.	Measurement of forward/reverse saturation current in p-n-junction diode at various Temperatures and to find the approximate value of energy gap.	1x2
10.	To study the Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material.	1x2
11.	To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility.	1x2
12.	Measurement of e/m of electron e/m- Thomson's Experiment.	1x2
13.	To verify Ohm's law.	1x2
14.	Conversion of Galvanometer into Voltmeter and Ammeter.	1x2
15.	To determine the unknown resistance by a post office box.	1x2
	Total No. of Hours	**30**
References	1. Practical Physics, C. L. Arora, S. Chand & Co. 2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd. 3. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House. 4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers. 5. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.	

SET/ME/BT/C108. ENGINEERING GRAPHICS AND WORKSHOP PRACTICE		
Course Objective	The Engineering Graphics course aims at the following educational objectives: Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views (principal, auxiliary, sections). Dimension and annotate two- dimensional engineering drawings. The application of industry standards and best practices applied in engineering graphics. Emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.	
Course Outcomes	Student should be able to: 1. Sketch engineering objects, lettering and dimensioning by freehand. 2. Create geometric constructions; drawing parallel and perpendicular lines, and to construct circles, arcs, tangencies, and irregular curves. 3. Apply orthographic projection method to obtain: Multiview, auxiliary view and section view of an object.	
Module Name	**Content**	**No. of Hrs.**
Introduction to Engineering Graphics & Projection of Points	Drawing instruments and their use, Different types of lines, Lettering & dimensioning Familiarization with current Indian Standard Code of Practice for Engineering Drawing. Scales, Plain scales, Diagonal scales, Vernier scales. First angle and third angle projections Projection of points in different coordinates, Projections of lines inclined to one of the reference planes.	**08**
Projections of lines and planes	Projections of lines inclined to both the planes, True lengths of the lines and their angles of inclination with the reference planes, Traces of lines. Projection of plane lamina of geometric shapes inclined to one of the reference planes, inclined to both the planes, Traces of planes. Projections on auxiliary planes.	**08**
Projections of polyhedral and solids	Projections of polyhedral and solids of revolution, projection of solids with axis parallel to one of the planes and parallel or perpendicular to the other plane, Projections with the axis inclined to one of the planes.	**08**
Orthographic Projection	Concept of orthographic projection, Rules of Drawing orthographic projection, Conversion of pictorial views into orthographic projection, Drawing of orthographic projection of Machine components.	**08**
Carpentry, Fitting and Black smithy	Minimum two experiments from Carpentry, Fitting and Black smithy. And Development of jobs carried out and soldering, Black Smithy, House Wiring, Foundry (Molding only), Plumbing.	**08**
Welding & Machining	Practice of minimum two experiments of welding joints. Overview of Lathe, Shaper, Milling and Drilling machine. Perform one job on each machine.	**08**
	Total No. of Hours	**48**
Textbooks	1. Bhatt N. D, Elementary Engineering Drawing, Charotar Publishing House, Anand, 2002. 2. Elements of Workshop Technology Vol-1 by Hazra Chaudhary.	
References	1. Narayana K L & Kannaiah P, Engineering Graphics, Tata McGraw Hill, New Delhi, 1992. 2. Luzadder W J, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi, 2001. 3. Thomas E French & Charkes J V, Engineering Drawing & Graphing Technology, McGraw Hill Book Co, New York, 1993. 4. Venugopal K, Engineering Drawing & Graphics, New Age International Pvt. Ltd., New Delhi, 1994. 5. Workshop Technology, Raghubanshi.	

VAC-1. UNDERSTANDING AND CONNECTING WITH ENVIRONMENT		
Course Objective	1. To study an environment and ecosystem. 2. To study natural resources. 3. To study biodiversity and conservation. 4. To study environmental pollution, policies and practices. 5. To study human population and environmental ethics.	
Course Outcomes	1. Ability to demonstrate comprehensive understanding of the environment, environmental processes, theories and ethics. 2. Ability to describe the mechanisms of interactions between different spheres of environment. 3. Ability to recognize and describe how about resource management and sustainability.	
Module Name	**Content**	**No. of Hrs.**
Understanding of Environment	1. Definition, scope and importance of Environment, Multidisciplinary nature of Environmental Sciences. 2. Understanding of Ecology and Ecosystems, Ecological Succession and 3. Ecosystem Services. 4. Energy flow in an Ecosystem; Food Chain, Food Weband, Ecological Pyramids. 5. Human interaction with its Environment.	**7**
Natural Resources and Biodiversity Conservation	1. Basic concept, types and values of Natural Resources. 2. Resource Consumption, Restoration and Conservation Practices and Sustainable Development. 3. Concept, values and distribution of Biodiversity and its linkages with culture, health and people. 4. Threats to Biodiversity and Biodiversity conservation.	**7**
Global Environmental issues	1. Environmental Pollution and Waste Management. 2. Climate Change, Green House Effect and Global Warming. 3. Radiations, Nuclear and Technological Hazards. 4. Population Growth, Disaster, Pandemic and Human Health Risks.	**8**
Environment and Society	1. Origin and Evolution of Human; Social, Cultural and Religious Structure and values of Environment. 2. Traditional Wisdom, Indigenous/traditional Communities and Livelihood Security 4.3 Industrial Society, Modernization and Adaptations to Natural and Anthropogenic variations. 3. Environmental Movements, Environmental Ethics and Legislations. 4. Connecting human society with conservation and management of water, energy, biodiversity, culture and heritage and waste management.	**8**
	Total No. of Hours	**30**
Text Book/ References	1. WorldCommissiononEnvironmentandDevelopment.1987.*Our Common Future*. Oxford University Press. 2. Ramakrishnan, P.S., Purohit, A.N., Saxena, K.G., Rao, K.S., Maikhuri, R. K. 1996 *Conservation and Management of Biological Resources in Himalaya.* Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi. 3. Erach Bharucha, *Environmental Studies*. 2004, UGC and BVIEER Pune. 4. Khanduri, I., Pandey, M., Maikhuri, R. 2006. *Environment and Ecology*, Trans media Publication Srinagar Garhwal. 5. Pepper,I.L.,Gerba,C.P.&Brusseau,M.L.2011.EnvironmentalandPollutionScience.AcademicPress. 6. Paryavaran Mitra. Explore, Discover, Think, Act. 2011. Centre for Environmental Education. 7. P.D. Sharma, 2012 Ecology and Environment. Rastogi Publication. 8. Sodhi,N.S.,Gibson,L.&Raven,P.H.(eds).2013.*ConservationBiology*:*Voicesfromt heTropics*.JohnWiley&Sons. 9. Singh,J.S.,Singh,S.P.andGupta,S.R.2014.*Ecology,Environmental Science and recourse Conservation*.Anamaya Publishers. 10. Gopal. B., Bhardwaj, N. *Elements of Ecology*. Vikas Publication House New Delhi	

SET/IE/BT/S106. BASIC ELECTRICAL ENGINEERING LAB	
Content	**No. of Hrs.**
1. Study of multimeter, analog voltmeter and ammeter. 2. Study of CRO and function generator. 3. To understand the Line/circuit mechanism, phase and neutral points. 4. Familiarization of circuit breakers switches and loads. 5. Verification of KCL and KVL. 6. Verification of Thevenin and Norton theorem. 7. Verification of Superposition theorem. 8. Verification of Reciprocity theorems. 9. Verification of Maximum Power Transfer theorem. 10. Calibration of single phase AC energy meter. 11. Study of PMMC instrument. 12. Study of PMMI instrument. 13. Study of Electrodynamometer type instruments. 14. Study of regulated power supply. 15. Study of single phase AC transformer. 16. Transformer winding and load testing.	15x4
Total No. of Hours	**60**

SEMESTER II

(Click for Credit Distribution)

S. No.	Category	Course Code	Course Title	T.A	C.T	TOT	ESE	SUB. TOTAL
1.	Basic Science/ Multidisciplinary	SET/SH/BT/C201	Mathematics II	10	20	30	70	100
2.		SET/SH/BT/C203	Chemistry	10	20	30	70	100
3.	Core Basic Engineering Subjects	SET/ME/BT/C202	Basic Mechanical Engineering	10	20	30	70	100
4.		SET/ME/BT/C204	Engineering Mechanics	10	20	30	70	100
5.		SET/CS/BT/C205	C Programming	10	20	30	70	100
6.	Core/ Basic Engineering Subjects Labs	SET/SH/BT/C208	Chemistry Lab	30	-	30	70	100
7.		SET/CS/BT/C209	C Programming Lab	30	-	30	70	100
8.	Life Skills and Personality Development		*Life Skills and Personality Development	10	20	30	70	100
9.	Skill Course	SET/EC/BT/S206	Basic Electronics Lab	30	-	30	70	100

*Common syllabus for all UG courses of the university.
T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

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

SET/SH/BT/C203. CHEMISTRY		
Course Objective	1. Apply the electrochemical principles in batteries, understand the fundamentals of corrosion. 2. Analysis of water for its various parameters and its significance in industrial and domestic Applications. 3. Analyze microscopic chemistry in terms of atomic, molecular orbitals and Intermolecular forces. 4. Analysis of major chemical reactions that are used in the synthesis of molecules. 5. Understand the chemistry of various fuels and their combustion.	
Course Outcomes	Student should be able to: 1. Describe and understand the operation of electrochemical systems for the production of electric energy, i.e. batteries. 2. Explain the mode by which potable water is produced through the processes of screening, micro Straining, aeration, coagulation and flocculation, sedimentation, flotation, filtration and disinfection. 3. Recognize that molecular orbital theory is a method used by chemists to determine the energy of the electron in a molecule as well as its geometry. 4. Demonstrate an ability to design, implement, and evaluate the results of experimentation using standard scientific methodologies such as hypothesis formulation and testing. 5. Understand and analyze the combustion mechanisms of various fuels.	
Module Name	**Content**	**No. of Hrs.**
Advanced Theory of Chemical Bonding	Valence bond and molecular orbital theory. Structure of NH_3, H_2O, SO_3, PCl_5, XeO_2 molecules. Types of linkages, Hybridization, Hydrogen bonding, Metallic bonding.	**4**
Equilibrium on Reactivity	Bronsted and Lewis Acids, pH, pka, pkb scale, buffer solution.	**4**
Polymers	Structures of the following polymers, viz, Natural and synthetic rubbers, Polyamide and Polyester fibres, polymethylmethacrylate, poly acrylonitrile and polystyrene. A brief account of conducting polymers (polypyrrole & polytiphene) & their applications.	**3**
Complex Compounds	Introduction, Valence bond and crystal field theory.	**4**
Chemical Kinetics & Catalysis	Order of reactions, Parallel and reversible reactions, Catalysis- homogeneous and heterogeneous catalysis, Characteristics of catalytic reactions, catalytic promoters and poisons, auto catalysis and negative catalysis. Activation energy of catalysis, intermediate compound formation theory and adsorption theory.	**3**
Atmospheric Chemistry& Air Pollution	Environment and ecology, environmental segments, structure and composition of atmosphere, radiation balance of earth and Green House Effect, formation and depletion of Ozone layer, chemical and photochemical reactions of various species in atmosphere, air pollution-sources, reactions and sinks for pollutants, acid rains and smog formation. Pollution control methods.	**5**
Corrosion & Lubricants	Introduction, causes of corrosion, theories of corrosion- direct chemical attack, electrochemical theory of corrosion, factors influencing corrosion, corrosion inhibitors, passivity, types of corrosions, protection from corrosion and protective coatings. Theory, classification and mechanism of lubrication.	**5**
Water and Waste Water Chemistry	Introduction, hardness of water, characteristics imparted by impurities, analysis of contaminants, treatment of water by Zeolite, L-S process, boiler feed water, waste water treatment.	**6**
Fuels & Combustion	Classification of fuels, non-conventional energy, biogas, biomass and solar energy, calorific value – gross and net, characteristics of good fuel, determination of calorific value, solid fuels, analysis of coal, liquid fuels.	**5**
Stereochemistry of organic-compounds	Mechanism of chemical reaction, Beckman, Hoffman, Reimer Tiemann, Cunnizzaro, Diels-Alder and Skraup synthesis.	**3**
	Total No. of Hours	**42**
Textbooks	1. Jain, Jain, "Engineering Chemistry". 2. Sharma, Kumar, "Engineering Chemistry".	

References	1. R. T. Morrison and R N Boyd, "Organic Chemistry", 6th Edition, Prentice Hall, New Delhi. 2. J. D. Lee, "Concise Inorganic Chemistry", Chapman & Hall. 3. W. L. Jolly, "Modern Inorganic Chemistry", McGraw-Hill. 4. P. W. Atkins, "Physical Chemistry", 6th Edition, Oxford University Press. 5. Barrow, "Physical Chemistry". 6. Manahan, "Environmental Chemistry". 7. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R Vyvyan, I, "Spectroscopy", Cengage Learning India Pvt. Ltd, New Delhi, 2007. 8. R. M. Silverstein, F. X. Webster and D. J. Kiemle, "Spectrometric Identification of Organic Compounds", 7th edition, John-Wiley and Sons, New York, 2005. 9. William Kemp, "Organic Spectroscopy", 3rd edition, Palgrave, New York, 2005. 10. C.N. Banwell and E. M. McCash, "Fundamentals of Molecular Spectroscopy", McGraw- Hill, International, UK, 1995. 11. F. Carey, "Organic Chemistry", 5th Edition, McGraw Hill Publishers, Boston, 2003.

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

SET/ME/BT/C204. ENGINEERING MECHANICS		
Course Objective	1. To understand distributed force systems, centroid/ center of gravity and method of finding centroids of composite figures and bodies. 2. To understand the moment of inertia and method of finding moment of inertia of areas and bodies. 3. To understand types of frames and analyze for the forces in the members of the truss by method of joints and method of sections. 4. To understand dynamics of a particle. 5. To interpret the simple given dynamic problems and solve them for positions, velocities and accelerations, etc. 6. To understand the kinetics of the rigid bodies and solve simple problems using work-energy method. 7. To understand virtual work method and solve simple problems.	
Course Outcomes	Student should be able to: 1. Identify the significance of centroid/ center of gravity and find centroids of composite figures and bodies. 2. Understand the moment of inertia and method of finding moment of inertia of areas and bodies. 3. Identify the type of frame and analyze for the forces in the members of the truss (frame) by method of joints and method of sections. 4. Understand dynamics of a particle. 5. Interpret the simple given dynamic problems and solve them for positions, velocities and accelerations, etc., 6. Understand the kinetics of the rigid bodies and solve simple problems using work-energy method. 7. Understand virtual work method and solve simple problems.	
Module Name	**Content**	**No. of Hrs.**
Force System	Introduction: Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon‟s theorem, Lami‟s theorem, equilibrium of bodies under a force system, Problems.	**8**
Trusses And Frames	Truss and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, Analysis of perfect plane truss using method of joints and method of sections, Problems.	**8**
Centre Of Gravity And Moment Of Inertia	Centroid, Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems, Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects.	**10**
Friction and Virtual Work	Friction-characteristics of dry friction, problems involving friction of ladder, wedges and Connected bodies. Definition of virtual work, principle of virtual work for a system of connected bodies.	**7**
Kinematics And Dynamics	Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problems. Particle Dynamics: Energy methods and momentum methods, Newton‟s laws, work energy equation for a system of particles, linear and angular momentum equations, projectile motion, problem.	**12**
	Total No. of Hours	**45**
Textbooks	1. R S. Khurmi, “Engineering Mechanics”. 2. P. K. Nag “Engineering Thermodynamics”.	
References	1. Van Wylen G.J. & Sonnlog R.E.: Fundamentals of classical thermodynamics, John Wiley & Sons, Inc. NY. 2. Wark Kenneth: Thermodynamics (2nd edition), Mc Graw Hill book Co. NY. 3. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY. 4. Yadav R.: Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad. 5. Yadav R.: Steam & Gas Turbines. 6. Kshitish Chandra Pal: Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta. 7. S. Rao, B.B. Parulekar, „Energy Technology‟, Khanna Pub., New Delhi. 8. G. H. Ryder: "Strength of Materials". 9. F. L. Singer: "Strength of Materials". 10. Timoshenko: "Strength of Materials". 11. Beer, Johnson, Statics.	

SET/CS/BT/C205. C PROGRAMMING		
Course Objective	The course is designed to provide complete knowledge of programming in C language. Students will be able to develop logics, which will help them to create programs and applications in C. Also, by learning the basic programming concepts in C help them to learn any other programming language in future.	
Course Outcomes	Student should be able to: 1. Develop programs in C programming language. 2. Analyze the problem and find appropriate solution. 3. Evaluate the correctness of the developed solution. 4. Develop basic and advanced level applications using C programming language.	
Module Name	**Content**	**No. of Hrs.**
Introduction	Introduction, The C character set, Constants, Variables, Identifiers, Keywords, Data types, Declarations, The First C Program, Compilation and Execution.	**6**
Operators and Expressions	Arithmetic, Relational, Equality, Logical, Unary, Conditional, Bitwise, Assignment, Comma and Size of operator. Type Conversion and Typecasting.	**6**
Control Statements	If, if-else, while, do-while, for loop, nested loops, switch, break, continue and goto statements.	**5**
Functions & Pointers	Defining and accessing functions, Function prototype, Passing arguments, Recursion, Use of library functions. Introduction to pointers, Declarations, Passing to a function, Operations on pointers, Dynamic memory allocation, Array of pointers.	**11**
Arrays	Single and Multi-dimensional arrays, Row major and Column major form of an array, Character strings and arrays.	**4**
Storage classes	Automatic, Register, Static and External storage class.	**4**
Structures and Unions	Basics of structures, Structures and functions, Arrays of Structures, Pointers to structures, Self-referential structures, Unions.	**4**
File Input/output	Opening a File, Reading from a file, closing the file, Writing to a file.	**4**
	Total No. of Hours	**44**
Textbooks	1. E. Balagurusamy, "Programming in ANSI C".	
References	1. Byron S. Gottfried, "Programming With C". 2. Yashwant Kanitker, "LET US C". 3. B. W. Kernighan and D. M. Ritchie, "The C Programming Language". 4. B. W. Kernighan, "The Practice of Programming", Addison-Wesley, 1999. 5. C. L. Tondo and S. E. Gimpel, "The C Answer Book", (2/e), Prentice Hall, 1988.	

SET/SH/BT/C208. CHEMISTRY LAB	
Content	**No. of Hrs.**
1. To determine the percentage of available chlorine in the supplied sample of bleaching powder. 2. To determine the ferrous content in the supplied sample of iron ore by titrimetric analysis against standard K2Cr2O7 solution using K3Fe (CN)6 as external indicator. 3. To determine the chloride content in supplied water sample using Mohr"s method. 4. To determine the constituents and amount of alkalinity of the supplied water sample. 5. To determine the temporary and permanent hardness of water sample by complexometry. 6. To find chemical oxygen demand of a waste water sample using Potassium Dichromate. 7. To determine iron concentration in the sample of water by Spectrophotometric method. 8. To determine the molecular weight of a polystyrene sample by using viscometric method. 9. To determine pH of a solution by using digital pH meter and titration of such a solution pH metrically. 10. Analysis of a coal sample by proximate analysis method.	3x10
Total No. of Hours	**30**

SET/CS/BT/C209. C PROGRAMMING LAB	
Course Objective	1. To make the student learn a programming language. 2. To learn problem solving techniques. 3. To teach the student to write programs in C and to solve the problems.
Course Outcomes	course the student would be able to: 1. Read, understand and trace the execution of programs written in C language. 2. Write the C code for a given algorithm. 3. Implement Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor. 4. Write programs that perform operations using derived data types.

Content	**No. of Hrs.**
This lab shall have minimum 25 programs in C. There shall be minimum two programs per module as taught in theory. Programming shall follow logic/algorithm and flowchart wherever applicable. Exercises shall also enhance analytical and debugging abilities.	2x16
Total No. of Hours	**32**

VAC-2. LIFE SKILLS AND PERSONALITY DEVELOPMENT		
Course Objective	1. The course intends to develop talent, facilitate employability enabling the incumbent to excel and sustain in a highly competitive world of business. 2. The programme aims to bring about personality development with regard to the different behavioral dimensions that have far reaching significance in the direction of organizational effectiveness. 3. To make students know about self-awareness, life skills, soft skills, need for personal development etc.	
Course Outcomes	1. The student will be able to understand, analyze develop and exhibit accurate sense of self. 2. Think critically. 3. Demonstrate knowledge of personal beliefs and values and a commitment to continuing personal reflection and reassessment. 4. Learn to balance confidence with humility and overcome problems associated with personality	
Module Name	**Content**	**No. of Hrs.**
Career and Professional Skills	Career and Professional Skills: Listening Skills, Reading Skills, Writing Skills Effective Resume preparation, Interview Skills, Group Discussion Skills, Exploring Career Opportunities, Psychometric Analysis and Mock Interview Sessions Team Skills: Cognitive and Non-Cognitive Skills, Presentation Skills, Trust and Collaboration, Listening as a Team Skill, Brainstorming, Social and Cultural Etiquettes Digital Skills: Computer skills, Digital Literacy and Social Media, Digital Ethics and Cyber Security.	**06**
Attitude and Motivation	Attitude: Concept, Significance, Factors affecting attitudes, Positive attitude - Advantages, Negative attitude- Disadvantages, Ways to develop positive attitude, Difference between personalities having positive and negative attitude. Motivation: Concept, Significance, Internal and external motives - Importance of self motivation- Factors leading to de-motivation, Maslow's Need Hierarchy Theory of Motivation	**06**
Stress-management and Development of Capabilities	Development of will power, imagination through yogic lifestyle- Development of thinking, emotion control and discipline of mind through Pranayama- Improvement of memory through meditation-Stress: meaning, causes, and effects of stress in life. Management- Stress: psycho-physical mechanism, management of stress through Yoga.	**06**
Other Aspects of personality Development	Body language - Problem-solving - Conflict and Stress Management - Decision-making skills -Leadership and qualities of a successful leader - Character-building -Team-work - Time management -Work ethics – Good manners and etiquette.	**06**
Health and Hygiene	Health and Hygiene- Meaning and significance for Healthy Life- 3. Exercise And Nutrition and Immunity. Obesity- Meaning, Types and its Hazards. – Physical Fitness and Health Related Physical Fitness- Concept, Components and Tests- Adventure Sports.	**06**
	Total No. of Hours	**30**
Text Books/ References	1. Barun K. Mitra, "Personality Development & Soft Skills", Oxford Publishers, Third impression, 2017. 2. Ghosh, Shantikumar. 2004. Universal Values. Kolkata: The Ramakrishna Mission Larry James, "The First Book of Life Skills"; First Edition, Embassy Books, 2016. 3. **L.Chaito : Relaxation & Meditation Techniques,1983.** 4. Michael Aegyle : Bodily Communication, Methuen,1975. Mulligan J : The personal Management (handbook). 5. *M.L. Kamlesh (1998), "Psychology in Physical education and Sports" Metropolitan Book Company, New Delhi.* 6. Patra, Avinash. 2012. The Spiritual Life and Culture of India. London: Oxford University Press. 7. Postonjee D.M.: Stress and Coping,The Indian Experience,sage Publication,New Delhi. *8. R.D. Sharma (1979), "Health and Physical Education" Gupta Prakashan, New Delhi.* *9.* Shiv Khera, "You Can Win" , Macmillan Books, New York, 2003. 10. Acharya Maha Pragya- Shakti ki Sadhna (Hindi medium) Acharya Mahapragya- Naya manav, naya Vishwa, Adarsh Sahitya Sangh, Churu (Hindi medium). 11. Shiv Khera- Jeet Apki (Hindi medium)	

SET/EC/BT/S206. BASIC ELECTRONICS LAB		
Module Name	**Content**	**No. of Hrs.**
Experiments	1. Identification and IV characteristic of PN diode. 2. Half wave rectifier circuit. 3. Full wave rectifier circuit. 4. Bridge rectifier circuit. 5. Input characteristic of BJT in CE configuration. 6. Output characteristic of BJT in CE configuration. 7. Inverting Amplifier using 741 OP AMP. 8. Non-inverting Amplifier using 741 OP AMP 9. Verification of basic logic gates. 10. Hand-on exercise on soldering and assembly of circuits on PCB/ Breadboard. 11. Voltage regulator using Zener diode.	11x4
Simulations	1. IV characteristic of PN and Zener diodes. 2. Input and Output characteristic of BJT in CE configuration. 3. Simulating Inverting and Non-inverting amplifier using OP AMP. 4. Simulating weighted summer using SPICE. 5. Simulating basic logic gates using HDL simulator.	5x4
Total No. of Hours		**64**

SEMESTER III

(Click for Credit Distribution)

S. No.	Category	Course Code	Course Title	T.A	C.T	TOT	ESE	SUB. TOTAL
1.	Basic Science/ Multidisciplinary	SET/SH/BT/C301	Mathematics III	10	20	30	70	100
2.	Core Subjects	SET/EC/BT/C302	Electronic Circuits	10	20	30	70	100
3.		SET/EC/BT/C303	Digital Electronics	10	20	30	70	100
4.			@Program Elective- I	10	20	30	70	100
5.	Interdisciplinary Subject	SET/IE/BT/C303	Signals and Systems	10	20	30	70	100
6.	Core Subjects Based Labs	SET/IE/BT/C305	Signals and Networks Lab	30	-	30	70	100
7.		SET/EC/BT/C306	Digital Electronics Lab	30	-	30	70	100
8.	Extra Curriculum	AMDSC-2	*Basic Yoga Practices	10	20	30	70	100
9.	Skill Course	SET/EC/BT/S307	Electronic Circuits Lab	30	-	30	70	100

@Course offered by the department from the Program Elective- I list as given below.
*Common syllabus for all UG courses of the university.
T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Program Elective- I	1.	SET/EC/BT/E308	Physics of Semiconductor Devices
	2.	SET/EC/BT/E309	Probability Theory and Stochastic Process
	3.	SET/EC/BT/E310	Data Structure and Algorithm

SET/SH/BT/C301. MATHEMATICS-III		
Course Objective	To provide essential knowledge of methods to analytical and approximate solutions for different types of ordinary and partial differential equations which leads to complex variables.	
Course Outcomes	Solutions of different types of ordinary and partial differential applications leads to the analysis of complex problems in engineering such as hydraulic flow, heat transfer, level controller of a tank, vibration isolation, electrical circuits, etc.	
Module Name	**Content**	**No. of Hrs.**
Ordinary Differential Equations	Introduction to order, degree and arbitrary constants, linear differential equations of n^{th} order with constant coefficient, complimentary functions and particular integrals, Homogeneous differential equations, Cauchy's and Euler's equations, Method of variation of parameters, equations of the form y"" = f(y), applications to engineering problems.	**12**
Partial Differential Equations	Linear PDE with constant coefficients of 2nd order and their classifications, Initial and boundary value problems, PDE of parabolic, elliptic and hyperbolic type. Separation of variables method for solving PDE, heat equations, wave equations and Laplace equations.	**10**
Numerical Methods	Direct and iterative methods to solve of linear algebraic equations, numerical integration, integration by trapezoidal and Simpson"s rules.	**8**
Complex Variables	Analytic functions; Cauchy-Riemann equations; Harmonic functions, Cauchy"s integral Theorem and integral formula; sequences, series, convergence tests, Taylor and Laurent series, poles and singularity of zeros, residue theorem.	**12**
	Total No. of Hours	**42**
Textbooks/ References	1. R. K. Jain and S. R. K. Iyengar "Advanced Engineering Mathematics", Narosa Publications. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers. 3. H K Das, "Advanced Engineering Mathematics", S Chand. 4. Erwin Kreyszig, "Advanced Engineering Mathematics".	

SET/EC/BT/C302. ELECTRONIC CIRCUITS		
Course Objective	1. To understand the basic circuit operation of diode, BJT, MOSFET and amplifiers. 2. To understand the construction, operating principle of Feedback and Power amplifiers.	
Course Outcomes	Student should be able to: 1. Develop skills in the basics of the electronic devices and associated circuits. 2. Identify the components and design the circuits. 3. Incorporate the circuits with the software like PSPICE.	
Module Name	**Content**	**No. of Hrs.**
Review	Review of Diode, BJT, FET, Amplifier and its applications.	**4**
BJT and MOSFET Amplifiers	Small signal model of BJT; BJT Amplifiers: Operating point analysis: simple biasing, resistive divider biasing, biasing with emitter degeneration, self-bias; Small Signal Analysis of different topologies: CE, CE with emitter degeneration, CB, CC (Emitter follower); examples of amplifier design procedures, Multi-stage amplifier; basic BJT current mirror circuit, BJT differential amplifier; Small signal model of MOSFET, MOS Amplifier topologies and their comparison; Operating point and small signal analysis of CS, CS with current source load, CS with diode connected load, CS with source degeneration, CG, CD (source follower); basic MOS current mirror circuit, MOS differential amplifier.	**10**
Frequency Response	Frequency domain analysis: transfer function, poles and zeroes in circuits, Bode plot, miller‟s theorem, high-frequency models for BJT and MOSFET; transit or cut-off frequency of device; frequency response of CE and CS amplifier and calculation of their poles, zeroes; bandwidth, effect of frequency on I/O impedances.	**9**
Feedback Amplifiers	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	**7**
Oscillators	Barkhousen condition for Oscillations, Sinusoidal oscillators: RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.); non-sinusoidal oscillators.	**5**
Power Amplifiers	Distortion and efficiency; emitter follower as power amplifier; push-pull stage, high fidelity design using feedback; heat dissipation, thermal runaway; efficiency of emitter follower and push-pull stage; power amplifier classes; Tuned Amplifiers: basics, inductor losses, transformer coupled amplifiers, amplifier with multiple tuned circuits, class C tuned amplifier.	**10**
	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		
Course Objective	1. To revise and extend the basic knowledge of number system and logic gates. Simplification of the complex Boolean expression using K-map. 2. To understand the combinational and sequential logic circuits. 3. To get the basic knowledge of logic families and semiconductor memories.	
Course Outcomess	Student should be able to: 1. Describe and demonstrate the use of digital test equipments and its operating characteristics. 2. Identify and describe the combinational and sequential logic circuits. 3. Understand the different memory devices.	
Module Name	**Content**	**No. of Hrs.**
Introduction	Positional number system; Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers. Definition and specification of combination logic; Truth table; Basic logic operation and logic gates; Binary coded decimal codes; Gray codes.	**6**
Boolean Algebra and Switching Functions	Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map.	**4**
Logic Families	Diode, BJT and MOSFET as a switch. Introduction to different logic families; Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product; circuit description and operation; RTL; DTL, HTL, TTL and sub families, Brief idea of ECL, CMOS BI-CMOS.	**10**
Combinational Logic	Arithmetic modules: adders, subtractors and ALU; Design examples. Decoders, encoders, multiplexers and de-multiplexers; Parity circuits and comparators.	**6**
Sequential Logic	Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop and their inter-conversions; Timing hazards and races; Meta-stability; Analysis of state machines using D flip-flops and JK flip-flops; Definition of state machines, synchronous sequential logic, shift register, counters-ripple and mod counters.	**12**
Semiconductor Memories	RAM, ROM, Content Addressable Memory, Charge Coupled Device Memory. PLAs, PALs and their applications; Sequential PLDs and their applications.	**4**
	Total No. of Hours	**42**
Textbooks	1. M. Morris Mano, "Digital Design".	
References	1. Taub, Schilieng, "Digital Integrated Electronics". 2. Anad Kumar, "Digital principles and application". 3. John F Wakerly, "Digital Design: Principles and Practices", Prentice Hall. 4. Thomas L. Floyd, "Digital Fundamentals", Pearson/ Prentice Hall. 5. Ronald J. Tocci, "Digital Systems: Principles and Applications", Pearson/ Prentice Hall. 6. Charles Roth, "Fundamentals of Logic Design", Jaico Publishing House.	

SET/IE/BT/C303. SIGNALS AND SYSTEMS		
Course Objective	1. To provide the fundamental knowledge of different signals and systems. 2. To analyze the various systems using Fourier, Laplace and Z-transforms.	
Course Outcomes	Student should be able to: 1. Classify systems based on their properties and determine the response of LSI system using convolution. 2. Use the Laplace and Fourier transforms to analyze continuous and discrete time signal and system. 3. Apply the Z – transform to analyze the discrete – time signals and systems.	
Module Name	**Content**	**No. of 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/IE/BT/C305. SIGNALS AND NETWORKS LAB	
Content	**No. of Hrs.**
1. Programming using MATLAB.	10x2
2. Verification of principle of superposition with dc and ac sources. 3. Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits. 4. Verification of Tallegen‟s theorem for two networks of the same topology. 5. Determination of transient response of current in RL and RC circuits with step voltage input. 6. Determination of frequency response of current in RLC circuit with sinusoidal ac input.	5x2
Total No. of Hours	**30**

SET/EC/BT/C306. DIGITAL ELECTRONICS LAB		
Module Name	**Content**	**No. of Hrs.**
Experiments	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 subtractors. 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
Model Sim 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**

AMDSC-2. BASIC YOGA PRACTICES		
Course Objective	1. Understand about origin, history, meaning and types of Yoga. 2. Understand about the Asana, Pranayama and Meditation. 3. Experience the benefits of Asana, Pranayama and Meditationby self-practice.	
Course Outcomes	Yoga supports stress management, mental health, mindfulness, healthy eating, weight loss and quality sleep.	
Module Name	**Content**	**No. of Hrs.**
Fundamentals of Yoga	History and Development of Yoga, Meaning and Definition of Yoga, Aim and Objectives of Yoga, Misconceptions of Yoga; Brief knowledge about Streams of Yoga; Importance of Yoga.	**8**
SookshmaVyayma and Soorya Namaskar	Padanguli Naman & Goolf Naman, Goolf Chakra, Janu Naman, Poorna Titali Asana, Manibandha Naman, Kehuni Naman, Skandha Chakra, Greeva Sanchalana, Soorya Namaskar.	**8**
Asana	Tadasana, Vrikshasana, Utkatasana, ArdhChakrasana, Pashchimuttasana, Goumukhasana, Vakrasana,Vajrasana,Uttanpadasana, Nokasna,Halasana, Shavasana Bhujangasana, Shalabhasana, Dhanurasana, Makarasana.	**8**
Pranayama and Meditation	Nadishodhan, Bhastrika, Seetali, Bhramari, Ujjayi, Soham & Pranav Meditation, Yoga-Nidra.	**6**
	Total No. of Hours	**30**
Text Books/ References	1. Singh S. P: History of Yoga, PHISPC, Centre for Studies in Civilization Ist, 2010. 2. Singh S. P & Yogi Mukesh: Foundation of Yoga, Standard Publication, New Delhi, 2010. 3. Saraswati,SwamiSatyananda: SuryaNamaskar,YogaPublicationTrust,Munger,2004. 4. SwamiSatyanandaSaraswati: Asana Pranayama Mudra-Bandha, Bihar School of Yoga, Munger,2005. 5. Digambar, Swami (2012) Hathpradipika (Swatmaramkrit), Kaivalyadham Lonavala, Pune. 6. Swami, NiranjananandSaraswati (2013) Gherand Samhita, BiharSchoolofYoga, Munger.	

SET/EC/BT/S307. ELECTRONIC CIRCUITS LAB		
Module Name	**Content**	**No. of Hrs.**
Experiments and Simulations	Hands-on experiments and simulations related to the contents of Electronic Circuits and Digital Electronics courses.	14X4
	Total No. of Hours	**56**

SET/EC/BT/E308. PHYSICS OF SEMICONDUCTOR DEVICES		
Course Objective	1. To understand the concept of semiconductor device physics. 2. To analyze the different models of PN Junction Diode, BJT and MOSFET. 3. To Understand Miscellaneous Semiconductor Devices**.**	
Course Outcomes	Student should be able to: 1. Explain fundamental concepts related to semiconductor physics 2. Explain the working of miscellaneous semiconductor devices. 3. Understand the different models of BJT and MOSFET.	
Module Name	**Content**	**No. of Hrs.**
Introduction to Semiconductors	Evolution and trends of semiconductor devices and IC technology; Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier Statistics; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors; Comparison of different types of semiconductors.	**7**
Physics of PN Junctions	Carrier Statistics: Charge carriers in semiconductors, Fermi Dirac statistics, intrinsic and extrinsic semiconductors, carrier transport, mobility, conductivity, carrier life time, recombination, steady state carrier generation, quasi-Fermi levels, drift and diffusion of carriers, continuity equation PN Junction: PN junction at equilibrium, Forward and reverse bias junctions, steady state conditions, forward and reverse bias, breakdown of junctions, built-in potential, Metal Semiconductor contacts: Rectifying and Ohmic contacts, current voltage characteristics; switching behavior of PN junction, PN Junction capacitances; Avalanche breakdown, Zener diode, Schottky diode, Tunnel Diode.	**11**
Physics of Bipolar Junction Transistor	Bipolar Junction Transistor, npn transistor and its operations; ideal and typical I-V characteristics; Ebers-Moll Model, basic ac model; small-signal equivalent-circuit model.	**9**
Physics of MOSFET	MOS capacitor, C-V characteristics; Physics of MOSFET; ideal and typical I-V characteristics; second order effects; small signal model of MOS transistor; High frequency model.	**9**
Miscellaneous Semiconductor Devices	HEMT, MESFET, Multi-gate MOSFETs, Thyristor, Varactor diode, p-i-n diode, IMPATT Diode, GUN Diode, Schottky diode, Solar cell, Light Emitting Diodes, Photodiode.	**9**
	Total No. of Hours	**45**
Textbooks	1. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education. 2. S. M. Sze and K. N. Kwok, ―Physics of Semiconductor Devices,‖ 3rd edition, John Wiley &Sons, 2006. 3. Sima Dimitrijev, "Principles of Semiconductor Devices", Oxford University Press.	
References	1. Millman, Halkias, "Electronic Devices and Circuits". 2. B. G. Streetman, "Solid state Devices", Pearson. 3. Y. Tsividis and M. Colin, ―Operation and Modeling of the MOS Transistor, Oxford Univ. Press, 2011. 4. Yuan Taur and Tak H. Ning, "Fundamentals of Modern VLSI Devices", Cambridge Uni. Press.	

SET/EC/BT/E309: PROBABILITY THEORY AND STOCHASTIC PROCESSES		
Course Objective	To gain the knowledge of the basic probability concepts and acquire skills in handling situations involving more than one random variable and functions of random variables. To understand the principles of random signals and random processes.	
Course Outcomes	Student should be able to: 1. Develop understanding of basics of probability theory. 2. Identify different distribution functions and their relevance. 3. Apply the concepts of probability theory to different problems. 4. Extract parameters of a stochastic process and use them for process characterization.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.	**6**
Module 2	Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions;	**8**
Module 3	Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds;	**10**
Module 4	Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.	**10**
Module 5	Random process. Stationary processes. Mean and covariance functions, Ergodicity, Transmission of random process through LTI. Power spectral density.	**8**
	Total No. of Hours	**42**
Text/Reference Books	1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education 2. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill. 3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International 4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers, 5. 5. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.	

SET/EC/BT/E310: DATA STRUCTURE AND ALGORITHM		
Course Objective	1. To impart the basic concepts of data structures and algorithms. 2. To understand concepts about searching and sorting techniques. 3. To understand basic concepts about stacks, queues, lists trees and graphs. 4. To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.	
Course Outcomes	Student should be able to: 1. Understand the different types of data structure to be implemented using any programming language. 2. Choose the data structures that effectively model the information in a problem and analyses the efficiency trade-offs (run time and memory usage) among alternative data structure implementations or combinations. 3. Design, implement, test, and debug programs using a variety of data structures including stacks, queues, hash tables, binary and general tree structures, search trees, and graphs. 4. Apply efficient data structure (linked lists, stacks and queues) to solve a particular problem.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Introduction and Elementary Data Structures Introduction: Introduction to Data Structures and data types, Efficient use of memory, Recursion, time and space complexity of algorithms, Big O Notation and theta notations. Elementary Data Structures: Stacks, queues, Infix, Postfix & Prefix conversions, evaluations of expressions, multiple, stacks and queues, priority queues as heaps, double ended queue, implementation of stacks and queues.	**9**
Module 2	Linked Lists Singly linked lists, linked stacks and queues, polynomial addition, sparse matrices, doubly linked lists and dynamic storage management, circular linked list, Applications of Stacks, Queues and Linked lists, Garbage collection, Josephus Problem	**11**
Module 3	Trees Basic terminology, binary trees, binary tree traversal, representations of binary tree, application of trees, decision tree, game trees, Threaded Trees, Binary Search Tree, AVL tree, B-tree.	**10**
Module 4	Graph Theory Graph representations, Graph Traversals, Dijkstra's algorithm for shortest path, Prim's and Kruskal's Algorithm for Minimal Spanning tree Module 5: Sorting and Searching Searching: Linear search, binary search and hash search. Sorting: Insertion sort, selection sort, bubble sort, quick sort, merge sort, heap sort, and Bucket sort	**12**
	Total No. of Hours	**42**
Text/Reference Books	1. Data Structures, R.S. Salaria, Khanna Book Publishing, 2019. 2. Data Structures and Program Design in C By Robert L. Kruse,C.L. Tondo, Bruce Leung, Pearson Education, 2007. 3. Expert Data Structures with C/ 3rd Edition, R.B. Patel, Khanna Book Publishing, 2020. 4. Expert Data Structures with C++/ 2nd Edition, R.B. Patel, Khanna Book Publishing, 2020. 5. Data Structures Using C & C++, By Langsam, Augenstein, Tanenbaum, Pearson Education, 1989. 6. Fundamentals of Data Structures, By Ellis Horowitz and Sartaj Sahni, Computer Science Press, 2011. 7. An introduction to data structures with applications, By J.P. Trembley & P.G. Sorensen, TMH, 2004.	

SEMESTER IV

(Click for Credit Distribution)

S. No.	Category	Code	Course Title	T.A	C.T	TOT	ESE	SUB. TOTAL
1.	Core Subjects	SET/EC/BT/C401	Analog Communication	10	20	30	70	100
2.		SET/EC/BT/C402	Analog Integrated Circuits	10	20	30	70	100
3.		SET/EC/BT/C403	Electromagnetic Field Theory	10	20	30	70	100
4.			@Program Elective- II	10	20	30	70	100
5.	Interdisciplinary Subject	SET/IE/BT/C402	Microprocessors and Interfacing	10	20	30	70	100
6.	Core Subjects Based Labs	SET/EC/BT/C405	Communication Lab-I	30	-	30	70	100
7.		SET/EC/BT/C406	Analog Integrated Circuits Lab	30	-	30	70	100
8.	Extra Curriculum	VAC-2	*Indian Knowledge System	10	20	30	70	100
9.	Skill Course	SET/IE/BT/S407	Microprocessors Lab and Mini Project	30	-	30	70	100

@Course offered by the department from the Program Elective- II list as given below.
*Common syllabus for all UG courses of the university.
T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Program Elective- II	1.	SET/EC/BT/E408	Circuit Theory
	2.	SET/EC/BT/E409	Engineering Materials
	3.	SET/EC/BT/E410	Numerical Techniques

SET/EC/BT/C401. ANALOG COMMUNICATION		
Course Objective	1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth. 2. Analyze and compare the performances of AM and FM receiver. 3. Random variable, random process and their application for Noise analysis. 4. Analyze the behavior of a communication system in presence of noise.	
Course Outcomes	Student should be able to: 1. Understand different modulation schemes used in analog communication. . 2. Understand issue of noise in communication systems. 3. Understand signal generation/ detection techniques used in different modulation schemes. 4. Understand working different transmitter and receiver circuits.	
Module Name	**Content**	**No. of Hrs.**
Introduction	An overview of electronic communication system-signals and information, system block Diagram, performance metrics and data rate limits; Signal and Spectra; Orthogonal representation of signals; Random variables and processes: probability, random	**8**
Amplitude Modulation systems	Need for frequency translation, DSB-SC, SSB, VSB, QAM, FDM, AM and linearity, Radio Transmitter and Receiver; Superheterodyne radio receiver.	**12**
Angle Modulation	Angle Modulation, phase modulation and frequency modulation, tone modulated FM signal, arbitrary modulated FM signal, FM modulators and demodulators, approximately compatible SSB systems, PLL and applications.	**14**
Noise in Communication	Mathematical representation of Noise: sources of noise, frequency domain representation of noise, superposition of noises, linear filtering of noises, quadrature components of noise, representation of noise using orthogonal coordinates; Noise performance of AM/FM/PM	**8**
	Total No. of Hours	**42**
Textbooks	1. Taub,Schilling, Goutam, Saha,"Prinicples of communication systems",3rdEdition,TMH. 2. Singh &Sapre,"Communication System: Analog & Digital", 2nd Edition, TMH.	
References	1. S. Haykin,Communication systems, John Wiley, 2001. 2. B.P. Lathi, Analog and Digital Communication system	

SET/EC/BT/C402. ANALOG INTEGRATED CIRCUITS		
Course Objective	1. To study the operation of operational amplifier and its various applications in different electronic circuits. 2. To obtain the basic knowledge of PLL and its applications. 3. To study the different power supply regulator circuits, and DACs and ADCs	
Course Outcomes	Student should be able to: 1. Understand the operation of op-amp and its various applications, e.g., Instrumentation amplifiers, active filters, multivibrators and pulse shaping circuits. 2. Explain the concepts of PLL and its applications. 3. Design the different power supply regulator circuits, and different ADCs and DACs.	
Module Name	**Content**	**No. of Hrs.**
Introduction	Operational Amplifiers, DC and AC characteristics; Applications of Op-amp: Precision rectifiers, Log and antilog amplifiers, four quadrant multipliers. Instrumentation amplifier, Sample and Hold Circuits.	**12**
Active filters	Introduction to filters. Butterworth, Chebyshev & Bessel filter; LC ladder filter – prototype & synthesis; Frequency transformation of low pass filter. Impedance converters; Gm-C filters, Active-RC Filters; Switched capacitor filter.	**9**
Multivibrators and Pulse shaping circuits	Multivibrators using op amps; 555 timer; Triggering circuits for bistable and monostable multivibrators; Programmable timer; Pulse shaping circuits.	**6**
PLL	Analog multiplexer, PLL and its applications, Frequency synthesizers, Coherent synthesizers using PLL, Direct digital synthesis, Phase noise in oscillators.	**6**
Power supply Regulators and DACs and ADCs	Voltage regulators, Regulators using op amps, IC regulators, Protection circuits, Foldback current limiting, current boosting of IC regulators, switching regulators. D/A Converter – General considerations, Static non-idealities and Dynamic non-idealities; Current-steering DAC – Binary weighted DAC, Design issues, Effect of Mismatches. A/D converter – General considerations, static and dynamic non-idealities; Flash ADC – Basic architecture, Design issues, Comparator and Latch, Effect of non-idealities, Interpolative and folding architectures. Successive Approximation ADC; Pipeline ADC.	**12**
	Total No. of Hours	**45**
Textbooks	1. S.Franco, Design with Operational Amplifiers and Analog Integrated Circuits (3/e) TMH. 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. 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/EC/BT/C403. ELECTROMAGNETIC FIELD THEORY		
Course Objective	1. Being familiar with the concepts of gradient, divergence, and curl in vector algebra. 2. Examining the magnetic and electric fields for different structures. 3. Evaluation of E-M wave parameter in different medium. 4. Applying the boundary concept for wave guide structure. 5. Modeling of Transmission line and it's various parameter.	
Course Outcomes	Student should be able to: 1. Understand and analyze behavior of static electric or magnetic field. 2. Understand and solve Maxwell's equations. 3. Understand electromagnetic field and related material properties in electronic systems. 4. Understand electromagnetic wave propagation and power flow in a medium.	
Module Name	**Content**	**No. of Hrs.**
Review of Vector Calculus	Orthogonal coordinate systems, Coordinate transformation, Gradient of scalar fields, Divergence and Curl of vector fields.	**5**
Static fields	Static Electric Field: Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density. Static Magnetic Fields: Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.	**8**
Transmission Lines	Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.	**8**
Maxwell's Equations	Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface, Solution of maxwell's equations.	**6**
Uniform Plane Wave	Uniform plane wave, Propagation of wave, Wave polarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor	**8**
Plane Waves at a Media Interface	Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.	**7**
	Total No. of Hours	**42**
Textbooks	1. Hayt W H, "Electromagnetics"	
References	1. David J Griffiths: Introduction to Electrodynamics, Third edition,PHI,1999 2. David Cheng: Field and Wave Electromagnetics, Second edition, Pearson Education Asia, 2001 3. Nannapaneni Narayana Rao: Elements of Engineering Electromagnetics, Fifth edition, PHI 4. Matthew N.O.Sadiku: Elements of Electromagnetics, Fourth Edition, Oxford University Press 5. J D Krauss: Electromagnetics,Fourth edition, MGH, 1992	

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

SET/EC/BT/C405. COMMUNICATION LAB-I		
Module Name	**Content**	**No. of Hrs.**
Experiments	1. Verification of DSB-SC and calculate its modulation index. 2. To study generation of DSB-SC amplitude modulation using balanced modulator. 3. Study and verification of DSB-SC Demodulation. 4. Verification of SSB-SC and calculate its modulation index. 5. Study and verification of SSB-SC Demodulation. 6. Verification of AM and calculate its modulation index. 7. Study and verification of AM Demodulation. 8. Verification of FM and calculate its modulation index. 9. To study the Sensitivity, Selectivity, and Fidelity characteristics of AM receiver 10. Study of Superheterodyne radio receiver. 11. Study of PLL and applications. 12. Study of Propagation Constant, Characteristic impedance and reflection coefficient. 13. Study of Smith chart and it's applications for unknown impedance measurement. 14. Calculation of impedance, VSWR and reflection coefficient from the load using smith chart. 15. Design a matched network using Lumped elements (LCR) with the help smith chart.	14x2
	Total No. of Hours	**28**

SET/EC/BT/C406. ANALOG INTEGRATED CIRCUITS LAB		
Module Name	**Content**	**No. of Hrs.**
Experiments	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.	14x2
	Total No. of Hours	**28**

VAC-3. INDIAN KNOWLEDGE SYSTEM		
Course Objective	1. Indian Knowledge Systems: Origin, Evolution and Ontological Approach 2. Sanskrit Language and Literature 3. Indian Knowledge Approaches- Time, Language, Environment, Management 4. Sciences of Life and Mind 5. Self Exploration and Self Knowledge for Personal Effectiveness 6. Indian Knowledge System Torchbearers – Ancient and Modern	
Course Outcomes	**Students should be able to:** 1. Understand and appreciate the rich heritage that resides in our traditions. 2. Inculcate an understanding of the mind/voice dynamic and its function in Indian knowledge systems. 3. Learn to appreciate the need and importance of Sanskrit in getting to the roots of the philosophical concepts. 4. Prepare one for the inner-journey to discover the Self.	
Module Name	**Content**	**No. of Hrs.**
Introduction to Indian Knowledge System (IKS), Definition, Concept and Scope of IKS	1. Definition, Concept and Scope of IKS. 2. IKS based approaches on Knowledge Paradigms. 3. IKS in ancient India and in modern India	**4**
IKS and Indian Scholars, Indian Literature	1. Philosophy and Literature (Maharishi Vyas, Manu, Kanad, Pingala, Parasar, Banabhatta, Nagarjuna and Panini). 2. Mathematics and Astronomy (Aryabhatta, Mahaviracharya, Bodhayan, Bhashkaracharya, Varahamihira and Brahmgupta). 3. Medicine and Yoga (Charak, Susruta, Maharishi Patanjali and Dhanwantri). 4. Sahitya (Vedas, Upvedas, Upavedas (Ayurveda, Dhanurveda, Gandharvaveda) 5. Puran and Upnishad) and shad darshan (Vedanta, Nyaya.Vaisheshik, Sankhya, Mimamsa, Yoga, Adhyatma and Meditation). 6. Shastra (Nyaya, vyakarana, Krishi, Shilp, Vastu, Natya and Sangeet).	**8**
Indian Traditional/tribal/ethnic communities, their livelihood and local wisdom	1. Geophysical aspects, Resources and Vulnerability. 2. Resource availability, utilization pattern and limitations. 3. Socio-Cultural linkages with Traditional Knowledge System. 4. Tangible and intangible cultural heritage.	**6**
Unique Traditional Practices and Applied Traditional Knowledge	1. Myths, Rituals, Spirituals, Taboos and Belief System, Folk Stories, Songs, Proverbs, Dance, Play, Acts and Traditional Narratives. 2. Agriculture, animal husbandry, Forest, Sacred Groves, Water Mills, Sacred Water Bodies, Land, water and Soil Conservation and management Practices. 3. Indigenous Bio-resource Conservation, Utilization Practices and Food Preservation Methods, Handicrafts, Wood Processing and Carving, -Fiber Extraction and Costumes. 4. Vaidya (traditional health care system), Tantra-Mantra, Amchi Medicine System. 5. Knowledge of dyeing, chemistry of dyes, pigments and chemicals.	**8**
Protection, preservation, conservation and Management of Indian Knowledge System.	1. Documentation and Preservation of IKS. 2. Approaches for conservation and Management of nature and bio-resources. 3. Approaches and strategies to protection and conservation of IKS.	**4**
Total No. of Hours		**30**

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

SET/EC/BT/E408. CIRCUIT THEORY		
Course Objective	1. To make capable to the learner to solve any electrical network using network theorems, transient, and s-domain analyses. 2. To synthesize/realize any electrical network using Cauer and Foster methods.	
Course Outcomes	Student should be able to: 1. Apply transformation of a network to analyze in time domain and s-domain. 2. Apply various network theorems and transient analysis to determine the circuit response/behavior. 3. Analyze the RC, RL and RLC networks with the help of Positive Real Function, Foster form, and Cauer form.	
Module Name	**Content**	**No. of Hrs.**
Networks and Transients	Basic elements of electrical network: Resistor, capacitor, inductor, voltage and current sources; Review of KVL, KCL, and network theorems: Thevenin's & Norton's theorem, superposition theorem, maximum power transfer theorem, reciprocity theorem, Tellegen‟s theorem, Millman‟s theorem, Star-Delta and Delta-Star Transformation; Transients in linear circuits: Initial conditions, complete response, analysis of RC and RL circuits with impressed DC voltage, RC network as differentiator and integrator, DC transients in RLC circuits; Introduction to network topology: Definition of basic terms, graph, oriented graph, tree and co-tree of the graph, tie-sets, cut-sets, and matrices, incidence and reduced incidence matrix.	**14**
S-Domain Analysis and Network Functions	S-domain analysis of circuits: Review of Laplace transform, transformation of a circuit into S- domain, transformed equivalent of inductance, capacitance and mutual inductance, impedance and admittance in the transformed domain; Network functions: Driving point and transfer functions, poles and zeros, restriction of pole and zero locations of network functions.	**8**
Two Port Networks	Characterization in terms of impedance, admittance, hybrid and transmission parameters, Inter relationships among parameter sets, Interconnection of two port networks: Series, parallel and cascade, Symmetrical two port networks: T and π Equivalent of a two port network; Symmetrical two port reactive filters: Filter fundamentals, constant-k low pass and high pass filters, band pass and band elimination filters, m-derived T and π sections and their applications for infinite attenuation and filter terminations.	**10**
Network Synthesis	Driving point functions, Hurwitz polynomials and its properties, Positive real function and its features, Testing of driving point functions, Driving point Synthesis of RC, RL and LC networks, Realization of networks using Foster and Cauer forms.	**10**
	Total No. of Hours	**42**
Textbooks/ References	1. D. Roy Choudhary, “Network and Systems”, Wiley Eastern. 2. Abhijit Chakrabarti, “Circuit Theory: Analysis and Synthesis”, Dhanpat Rai & Co. 3. Van Valkenburg M. E., “Network Analysis”, 3rd Edition, Prentice Hall. 4. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013. 5. Franklin F. Kuo, “Network Analysis and Synthesis”, John Wiley & sons.	

SET/EC/ BT/E409. ENGINEERING MATERIALS		
Course Objective	To familiarize student with concepts of material science and useful materials' properties for engineering applications.	
Course Outcomes	Student should be able to: 1. Describe different types of crystal structures and defects. 2. Explain electrical and thermal conduction properties of different type of materials. 3. Explain magnetic behavior of materials and related temperature effects. 4. Explain optical properties of materials.	
Module Name	**Content**	**No. of Hrs.**
Crystal Structure	Introduction to crystal structure of materials, density computations, polymorphism and allotropy, Miller indices for crystallographic planes and directions, isotropy and anisotropy with respect to material properties. X-ray diffraction for determination of crystal structure. Defects in solids: point, line and planar defects and their effect on properties of materials. Phase diagrams, mono component and binary systems, Interpretation of phase diagrams, the Gibbs phase rule.	**8**
Band Theory of Solids	Band theory of solids, conductors, semi-conductors and insulators, metals – Drude model and conductivity, electron wave functions in crystal lattices, E-k diagrams, band gaps, effective mass, semiconductors, Fermi energy, doping of semiconductor, conductivity and mobility of electrons, Hall effect, Fundamentals of mesoscopic physics and nano technology: size effects, interference effect, quantum confinement and Coulomb blockade. Quantum wells, wires, dots, nanotubes.	**9**
Mechanical and Electrical properties of materials	Development of micro structure – equilibrium and non equilibrium cooling. Time-temperature-transformation curves and their applications. Mechanical properties of materials, inelasticity, elastic and plastic behavior, stress-strain relationship, fatigue and creep, strengthening mechanisms and fracture. Thermal properties, heat capacity, thermal expansion, thermal conductivity and thermal stresses. Electrical properties of materials: conduction in terms of band and atomic bonding models; the temperature variation of conductivity and carrier concentration; Electrical properties of polymers. Dielectric behavior, Ferro electricity and Piezoelectricity; Superconductivity in materials.	**10**
Magnetic properties of Materials	Magnetic properties, diamagnetic, paramagnetic, Ferro magnetic, anti-ferromagnetic, ferromagnetic materials and their applications. Influence of temperature on magnetic characteristics of materials.	**9**
Optical Properties of Materials	Optical properties of materials: Absorption, transmission, refraction, reflection; opacity and translucency in materials. Mechanism of photon absorption.	**9**
	Total No. of Hours	**45**
Textbooks	1. Callister W.D., "Materials Science and Engineering: An introduction", 6th Edition, John Wiley and Sons Inc., New York 2002 2. Van Vlack, LH, " Elements of Materials Science and Engineering". 6th Edition, Addison – Wesley Singapore, 1989	
References	1. Askeland D.R. " The Science and Engineering of Materials", 2nd Edition, Chapman and Hall, London, 1989 2. W.F.Smith and J.Hashemi. "Foundations of Materials Science and Engineering", 4th Edition, Mc Graw Hill, United States, 2005. 3. Raghavan V. " Materials Science and Engineering – A first course" 5th Edition, Prentice Hall, New Delhi, 1998 4. B. G. Streetman, Solid state Devices, 5th Ed., Pearson (2006) 5. Dekker, "Electrical Engineering Materials", PHI	

SET/EC/BT/E410: NUMERICAL TECHNIQUES		
Course Objective	To provide a way to solve problems related to polynomials, non linear equations, numerical solutions of ordinary differential equations and integration quickly and easily.	
Course Outcomes	Student should be able to: 1. Understand different numerical integration techniques, and numerically solve differential equations. 2. Perform various matrix computations and solve simultaneous linear equations. 3. Find roots of a transcendental equation using different methods. 4. Implement different interpolation schemes.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Interpolation by polynomials, error of the interpolating polynomial, piecewise linear and cubic spline interpolation. Numerical integration, Simpson rule, composite rules, error formulae, Gauss quadrature.	**8**
Module 2	Solution of a system of linear equations, implementation of Gaussian elimination and Gauss-Seidel methods, partial pivoting, row echelon form, LU factorization, Cholesky's method, ill-conditioning, norms.	**9**
Module 3	Solution of a nonlinear equation, bisection and secant methods. Newton-Raphson method, rate of convergence, solution of a system of nonlinear equations.	**8**
Module 4	Numerical solution of ordinary differential equations, Euler and Runge-Kutta methods, multistep methods, predictor-corrector methods, order of convergence, finite difference methods, numerical solutions of elliptic, parabolic, and hyperbolic partial differential equations.	**9**
Module 5	Eigenvalue problem, power method, QR method, Gershgorin's theorem. Exposure to software packages like MATLAB.	**8**
	Total No. of Hours	**42**
Text/Reference Books:	1. S. D. Conte and Carl de Boor, Elementary Numerical Analysis- An Algorithmic Approach (3rd Edition), McGraw-Hill, 1980. 2. C. E. Froberg, Introduction to Numerical Analysis (2nd Edition), Addison-Wesley, 1981. 3. E. Kreyszig, Advanced engineering mathematics (8th Edition), John Wiley (1999). 4. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing (2022). 5. K. E. Atkinson, An Introduction to Numerical Analysis (2nd edition), Wiley-India, 1989 6. R. Agor, Elements of Mathematical Analysis, Khanna Publishing House, 2015.	

SEMESTER V

(Click for Credit Distribution)

S. No.	Category	S. No.	Course Title	T.A	C.T	TOT	ESE	SUB. TOTAL
1.	Core Subjects	SET/EC/BT/C501	Digital Communication	10	20	30	70	100
2.		SET/EC/BT/C502	CMOS Digital VLSI Design	10	20	30	70	100
3.		SET/IE/BT/C502	Control Systems	10	20	30	70	100
4.			@Program Elective-III	10	20	30	70	100
5.	Open Elective / Inter-disciplinary Subject		#Open Elective-I	10	20	30	70	100
6.	Core Subjects Based Labs	SET/EC/BT/C503	Communication Lab- II	30	-	30	70	100
7.		SET/EC/BT/C504	CMOS Digital VLSI Design Lab	30	-	30	70	100
8.	Extracurricular/ Courses/ Compulsory course	VAC 4	*Culture, traditions and moral values	10	20	30	70	100
9.	Skill Course	SET/EC/BT/S506	Micro Project	30	-	30	70	100

@Course offered by the department from the Program Elective- III list as given below.
#Courses offered by any department of School of Engineering and Technology.
* Course offered by University.
T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Program Elective- III	1.	SET/EC/BT/E507	Antenna and wave Propagation
	2.	SET/EC/BT/E508	Data Communication and Networking
	3.	SET/EC/BT/E509	Information Theory and Coding

SET/EC/BT/C501. DIGITAL COMMUNICATION		
Course Objective	1. To understand the functional block diagram of digital communication system. 2. Knowledge of digital base band signal transmission and analogue to digital conversion. 3. Examine how ISI are mitigated and what effect they have. 4. Development of the best receiver for the AWGN channel. 5. Examine several digital modulation techniques and determine their bit error performances. 6. Knowledge of measurement of information and source coding methodologies. 7. To understand the need for source and channel coding. 8. To understand the digital modulation and demodulation techniques.	
Course Outcomes	Student should be able to: 1. Describe basic components of digital communication systems. 2. Compare different error detecting and error correction codes. 3. Understand the basics of information theory, source coding techniques and calculate Entropy of source. 4. Describe and determine the performance of line codes and methods to mitigate inter symbol Interference. 5. Learn the generation and detection of base band system. 6. Understand the generation, detection signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of different band pass modulation techniques. 7. Describe and determine the performance of different error control coding schemes for the reliable transmission of digital representation of signals and information over the channel.	
Module Name	**Content**	**No. of Hrs.**
Elements of Digital Communication and information Theory	Model of a digital communication system, logarithmic measure of information rate, conditional entropy and redundancy, source coding, fixed and variable length codewords, source coding theorem, prefix doing and Kraft inequality, Shannon-Fano and Hauffman coding for 1st, 2nd and 3rd order extensions, maximum entropy of a continuous source(with Gaussian distribution), entropy of band limited white Gaussian noise, mutual information and channel capacity of discrete memory less channel, Hartley-Shannon law.	**8**
Pulse Modulation and Waveform Coding Techniques	Sampling and its classification, Sampling theorem, Pulse Modulation, types of analog pulse modulation, method of generation and detection of PAM, PWM and PPM, Discretization in time and amplitude, Linear quantizer, Quantization noise power calculation, signal to quantization noise ratio, non- uniform quantizer, A-law and μ-law companding, encoding and Pulse code modulation, bandwidth of PCM, differential pulse code modulation, Delta modulation, Granular noise and slope overload, Adaptive delta modulation, Adaptive DPCM, comparison of PCM and DM, MPEG audio coding standard, Digital Multiplexing.	**9**
Digital Baseband Transmission	Line coding and its properties, NRZ and RZ types, Signaling format for unipolar, polar, bipolar(AMI) and Manchester coding and their power spectra(no derivation), HDB and B8ZS signaling, ISI, Nyquist criterion for zero ISI and raised cosine spectrum; Matched filter receiver, derivation of its impulse response and peak pulse signal to noise ratio, correlation detector decision threshold and error probability for binary unipolar (on-off) signaling.	**8**
Digital Modulation Techniques	Types of Digital modulation, waveform of amplitude modulation, frequency and phase shift keying, method of generation and detection of coherent and non-coherent binary ASK, FSK and PSK, differential phase shift keying, quadrature modulation techniques, (QPSK and MSK), probability of error and comparison of various digital modulation techniques.	**8**
Error Control Coding	Error free communication over a noisy channel, Hamming sphere, Hamming distance and bound, relation b/w minimum distance and error detecting and correcting capability, linear block codes, encoding and syndrome decoding, cyclic codes, encoder and decoder for symmetric cyclic codes, convolutional codes, code tree and Treelis diagram, Viterbi and sequential decoding, burst error correction, comparison of performance	**9**
	Total No. of Hours	**42**
Textbooks	1. Taub, Schilling, Goutam Saha,"Principles of communication systems",3rd Edition,TMH.	
References	1. B.P.Lathi,"Modern analog and digital communication",OxfordUniversityPress 2. ProakisJ.J."Digital Communication" 3. SimonHaykin,"Digital Communication",JohnWiley. 4. Analog And Digital Communication, Sudakshina Kundu, Pearson. 5. Digital Communication, Sklar & Ray, Pearson. 6. Digital Communication, Ian Glover, Pearson. 7. Modern Digital and Analog Communication Systems, Lathi, Oxford. 8. Digital Communications, Simon Haykin, Wiley. 9. Digital and Analog Communication Systems, K.Sam Shanmugam, Wiley. 10. Principle of Digital Communication, J. Das, New Age. 11. Digital Communication, Barry John, Le, Edward, David. G, Springer.	

SET/EC/BT/C502. CMOS DIGITAL VLSI DESIGN		
Course Objective	1. Knowledge of trends in IC industry. 2. Understanding of digital CMOS IC design. 3. Recognize the characteristics and features of the MOS transistor and logics. 4. Designing and analyzing inverter circuits for noise margin and switching characteristics. 5. Stick diagram and layout implementation for CMOS logic gates and arithmetic circuits. 6. Comprehend the operation of various CMOS sequential circuits and Memories.	
Course Outcomes	Student should be able to: 1. Understand working of static and dynamic CMOS logic circuits. 2. Design a CMOS circuit of given functionality and requirements. 3. Understand timing and power dissipation issues in digital circuits. 4. Understand and design Data-path subsystems. 5. Understand and design different type of digital memory.	
Module Name	**Content**	**No. of Hrs.**
Introduction to CMOS and CMOS Inverter	Historical perspective and Moore's law; CMOS logic; CMOS fabrication: n-Well process; twin well process; CMOS layout: CMOS inverter layout, layout design rules-well rule, transistor rule, contact rule; Design partitioning; Logic, Circuit and Physical design; Design verification; Manufacturing issues; Design Methodology and tools: structured design strategies, design methods, design flows, design economics, data sheets and documentation; Static and Dynamic behavior of CMOS inverter; Estimating delay for CMOS gates and interconnect, Logical Effort method; Concept of Static and Dynamic power consumption and their estimation;	**9**
Combinational Circuits and Interconnects	Static CMOS, ratioed circuits, dynamic circuits: domino logic, pass transistor circuits: CMOS with transmission gates; low power CMOS circuits; Low power design techniques; Speed Power product; Energy delay optimization; Wire geometry and inter metal stacks, Interconnect parameters and models: ideal wire, resistance , capacitance, inductance, skin effect, temperature dependence, delay, energy, crosstalk, inductive effects, lumped model, Lumped RC model, distributed RC model, transmission line model; Elmore method;	**10**
Sequential circuits	Timing Constraints: max-delay constraint, min-delay constraint, meta-stability; clock skew; conventional CMOS latches and flip-flops, resettable latches and flip-flops, enabled latches and flip-flops;	**8**
Memories	Performance metrics of memories; classification of memories and their comparison, Organization of memory and working; Operation of 6T SRAM cell read-write operation: access time, noise margins, tradeoffs; DRAM cell; ROM: NOR ROM, NAND ROM,	**9**
Data path Subsystem and Miscellaneous topics	Different types of Adders and their working: ripple carry, look ahead carry, carry skip, carry save, Manchester carry chain; CMOS circuits for Subtraction, Comparators, Counters; Shifter; Multiplier architectures, unsigned array multiplier, 2's complement array multiplication, booth encoding; Power distribution in IC: PDN, IR drops, L di/dt noise, bypass capacitance, power filtering;	**9**
	Total No. of Hours	**45**
Textbooks	1. Neil H. Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design, a circuits and systems perspective", Pearson, 4th edition. 2. John P Uyemura, "Introduction to VLSI Systems" Wiley. 3. S. M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits", Mc Graw Hill.	
References	1. Pucknell, "Basic VLSI Design" PHI. 2. Jan M. Rabaey, A. Chandrakasan, and B.Nikolic, "Digital Integrated Circuits: A design Perspective", Pearson Education. 3. Michal John Sebastian smith, "Application-Specific Integrated Circuits", Pearson. 4. Wayne Wolf, "Modern VLSI Design: IP based design", Prentice Hall.	

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

SET/EC/BT/C503. COMMUNICATION LAB-II		
Module Name	**Content**	**No. of Hrs.**
Experiments	1. To Study and verify of Pulse amplitude modulation and demodulation. 2. To Study and verify of Pulse width modulation and demodulation. 3. To Study and verify of Pulse position modulation and demodulation. 4. To Study and verify of TDM-PAM modulation and demodulation. 5. To Study and verify of Quadrature amplitude modulation and demodulation. 6. To Study Pulse code modulation and demodulation. 7. To Study Delta modulation and demodulation. 8. To Study Amplitude shift keying modulator and demodulator. 9. To Study Frequency shift keying modulator and demodulator. 10. To Study Phase shift keying modulator and demodulator.	28
	Total No. of Hours	**28**

SET/EC/BT/C504. CMOS DIGITAL VLSI DESIGN LAB		
Module	**Content**	**No. of Hrs.**
Module 1	Related Experiments in LT Spice and Electric VLSI.	14x2
	Total No. of Hours	**28**

VAC-4. CULTURE, TRADITIONS AND MORAL VALUES		
Course Objective	1. To give the overview about the basics of culture, traditions and moral values. 2. To understand thebasics of the social welfare.	
Course Outcome	After Completion of this course the student would be able to 1. To understand the basics of social awareness.	
Module Name	**Content**	**No. of Teaching Hrs.**
Indian Culture	(a) Four Purusharthas (b) Chaturvarn System (c) Ashram System (d) GurukulParampara: Education System	**6**
Vaidik Literature	(a) Samhitas (b) Upnishads (c)Vedangas: Shiksha (Education), Nirukta, Vyakarana (Grammar), Kalpa, Jyotish (Astrology), ChhandShastra (Metres)	**8**
Exponents of Indian Ayurveda	(a) Charaka (b) Susruta (c) Vagbhatta	**8**
Aarsha Literature	(a) Shrimadbhagvadgeeta (b) Bhartrihari'sNitishtakam	**8**
	Total No. of Teaching Hours	**30**
Textbooks	1 Pandey, PanditOmprakash: History of VaidikSahitya	
References	1. Scientific Authenticity of Samskaras: Uttar Pradesh Sanskrit Akademi, Lucknow 2. Sharma, Vishnu: Panchtantra, Hitopdesh, Mitralabh 3. Bhartrihari: Neetishatakam 4. GairolaVachaspati: History of VaidikSahitya, Delhi Sahitya Academy 5. PandeySangamLal: History of Indian Philosophy 6. KALYAN's special issue on Ayurveda, Gita Press Gorakhpur 7. Shreemadbhagvadgeeta: Gita Press Gorakhpur 8. Vatsyayan, Kapila: Traditional Indian Theatre	

SET/EC/BT/S506. MICRO PROJECT		
Module	**Content**	**No. of Hrs.**
	The micro-project is a team activity having 3-4 students in a team. This is electronic circuit building and testing for developing real life small electronic applications. The micro-project may be a complete hardware or hardware with small programming aspect. It should encompass electronics components, devices, analog or digital ICs, micro controller etc. Micro- Project should cater to a small system required in laboratory or real-life application. Based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of Micro-project. Micro Project shall be a printed board implementation of circuit/system involving dc power supply design, discrete components, analog ICs, digital ICs, op amps, relays etc. Project must be based on electronics, signal conditioning, communication, Microprocessor and Microcontroller. Alternately, students can also work on simulation based project on topic related to electronics and communication engineering. Evaluation is based on work done, quality of report, performance in viva-voce, Presentation etc.	28
	Total No. of Hours	**28**

SET/EC/BT/E507. ANTENNA AND WAVE PROPAGATION		
Course Objective	1. Being aware of the idea of radiation. 2. A comparison of various antenna features and basic antenna parameters. 3. Analysis of uniform and non-uniform antenna array. 4. Being familiar with the construction and operation of various types of antenna, such as loop and slot antennas, microstrip patch antennas, reflector antennas, etc. 5. Comprehending the idea of wave propagation in free space.	
Course Outcomes	Student should be able to: 1. Develop an understanding of the design features of various Antenna Types and their families. 2. Understand the fundamentals and modes of wave propagation. 3. Differentiate and deploy Broadband and Narrowband Antennas with characteristic radiation patterns. 4. Use mathematical analysis and tools to simulate Antenna signals for transmission and reception. 5. Quantify the fields radiated by various types of antenna. 6. Plot the characteristics of wire and aperture antennas.	
Module Name	**Content**	**No. of Hrs.**
Introduction and Antennas Basics	Basic Antenna Parameters, Patterns, Beam Area (or Beam Solid Angle), Radiation Intensity, Beam Efficiency, Directivity, Gain, Resolution, Antenna Apertures, Effective Height, The radio Communication link, Fields from Oscillating Dipole, Single-to-Noise Ratio(SNR), Antenna Temperature, Antenna Impedance. Retarded Potential, Far Field due to an alternating current element Power radiated by a current element Field variation due to sinusoidal current distribution.	**9**
Point Sources and Their Arrays	Introduction, Point Source, Power Theorem and its Application to an Isotropic Source, Radiation Intensity, Arrays of Two Isotropic Point Sources, Non-isotropic but similar point sources and the principle of Pattern Multiplication, Pattern Synthesis by Pattern Multiplication. Linear Arrays of n Isotropic Point Sources of Equal Amplitude and Spacing, Linear Broadside Arrays with Non-uniform Amplitude Distributions. General Considerations.	**8**
Electric Dipoles, Thin Liner Antennas and Arrays of Dipoles and Apertures	Short Electric Dipole, Fields of a Short Dipole, Radiation Resistance of Short Electric Dipole, Thin Linear Antenna, Radiation Resistance of $\lambda/2$ Antenna, Array of Two Driven $\lambda/2$ Elements: Broadside Case and End-Fire Case. Yagi-Uda Antenna Design, Long-Wire Antennas, folded Dipole Antennas.	**8**
Loop antennas and Slot antennas	Loop Antenna. Design and its Characteristic Properties, Application of Loop Antennas, Far Field Patterns of Circular Loop Antennas with Uniform Current. Introduction: Slot Antennas, Horn Antennas, Helical Antennas, Log-Periodic Antenna, Micro-strip Antennas.	**7**
Reflector Antennas	Flat Sheet Reflectors, Corner Reflectors, The Parabola-General Properties, A comparison Between Parabolic and Corner Reflectors, The Paraboloidal Reflector, Reflector Types, Feed Methods for Parabolic Reflectors.	**5**
Wave Propagation	Plane Earth Reflection, Space Wave and Surface Wave; Space Wave Propagation: Field Strength Relation, Effects of Imperfect Earth, Effects of Curvature of Earth; Sky wave Propagation: structural details of the ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and SkipDistance, Relation Between MUF and the Skip Distance, Multi-Hop Propagation, Wave Characteristics.	**8**
	Total No. of Hours	**45**
Text Books:	1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and WavePropagation",Fourth Edition,Tata McGraw Hill,2010 Special Indian	
Reference Books:	2. K. D. Prasad, "Antennas and wave propagation" 3. A.R.Harish, M.Sachidananda, "Antennas and Wave Propagation", Oxford University Press. 2009.	

SET/EC/BT/E508. DATA COMMUNICATION AND NETWORKING		
Course Objective	1. A working knowledge of the OSI and TCP/IP network concepts, as well as physical layer architecture. 2. Recognizing the roles played by the data link layer and associated protocols. 3. Recognizing IEEE LAN and MAN protocols and channel access strategies. 4. Examining the effectiveness of routing protocols and comprehending congestion control techniques, IPV4, TCP. 5. Being aware of how the presentation, session, and application layers work.	
Course Outcomes	Student should be able to: 1. Explain the functions of the different layer of the OSI Protocol. 2. Draw the functional block diagram of wide-area networks (WANs), local area. 3. Networks (LANs) and Wireless LANs (WLANs) describe the function of each block. 4. For a given requirement (small scale) of wide-area networks (WANs), local area. 5. networks (LANs) and Wireless LANs (WLANs) design it based on the market available component 6. For a given problem related TCP/IP protocol developed the network programming. 7. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.	
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, Pearson Education. 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/EC/BT/E509. INFORMATION THEORY AND CODING		
Course Objective	1. To define and apply the basic concepts of information theory (entropy, channel capacity etc. 2. To learn the principles and applications of information theory in communication systems. 3. To study various data compression methods and describe the most common such methods. 4. To understand the theoretical framework upon which error-control codes are built**.**	
Course Outcomes	Student should be able to: 1. Understand the concept of information and entropy. 2. Understand Shannon's theorem for coding. 3. Calculation of channel capacity. 4. Apply coding techniques.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Entropy and Loss-less Source Coding : Entropy, Entropy of discrete random variables- Joint, conditional and relative entropy- Chain rule for entropy, Mutual information and conditional mutual information, Relative entropy and mutual Information; Lossless source coding- Discrete Memory-less sources, Uniquely decodable codes- Instantaneous codes- Kraft's inequality – Average codeword length, Optimal codes- Huffman coding, Arithmetic Coding, Lemplel-Ziv Coding, Shannon's Source Coding Theorem.	**10**
Module 2	Channel Capacity and Coding Theorem: Channel Capacity- Discrete memory-less channels (DMC) and channel transition probabilities, Capacity computation for simple channels- Shannon's Channel Coding Theorem for DMC (proof is optional), Converse of Channel Coding Theorem Continuous Sources and Channels: Differential Entropy- Mutual information- Waveform channels- Gaussian channels- Shannon-Harley Theorem, Shannon limit, efficiency of digital modulation schemes-power limited and bandwidth limited systems.	**11**
Module 3	Channel Coding- Part-I: Introduction- Error detection and correction, Review of Vector Space, properties, Linear block codes- Construction and decoding, Standard Array decoding, Distance properties. Characteristics of Finite fields- Construction and basic properties of Finite Fields- Computations using Galois Field arithmetic- Extension Fields. Cyclic codes – Non-systematic and systematic codes-Construction and Decoding- Minimal Polynomials, Conjugates and Conjugacy classes, BCH codes – Construction and decoding - Reed Solomon codes, Introduction to low density parity check codes.	**11**
Module 4	Channel Coding- Part-II: Convolutional codes – Encoder representations and Types- Maximum likelihood decoding - Viterbi decoding, Hard decision and Soft decision decoding, Transfer function of convolutional codes, Interleaving, Concatenated codes, Introduction to Turbo codes.	**8**
	Total No. of Hours	**40**
Textbooks / References	1. Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory", John Wiley & Sons, 2. Shu Lin and Daniel. J. Costello Jr., "Error Control Coding: Fundamentals and applications", 2nd Ed., Prentice Hall Inc, 2004. 3. John G. Proakis and M. Salehi, "Digital Communication", 5th Ed., MGH, 2008 4. David J. C. MacKay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2003 5. Robert Gallager, "Information Theory and Reliable Communication", John Wiley & Sons, 1968. 6. R. E. Blahut, "Theory and Practice of Error Control Codes", Addison-Wesley, 1983.	

SEMESTER VI

(Click for Credit Distribution)

S. No.	Category	Code	Course Title	T.A	C.T	TOT	ESE	SUB. TOTAL
1.	Core Subjects	SET/EC/BT/C601	Digital Signal Processing	10	20	30	70	100
2.		SET/EC/BT/C602	Computer Design using VHDL	10	20	30	70	100
3.		SET/EC/BT/C603	Microwave Theory and Techniques	10	20	30	70	100
4.			@Program Elective-IV	10	20	30	70	100
5.	Open Elective/ Inter-disciplinary Subject		#Open Elective-2	10	20	30	70	100
6.	Core Subjects Based Labs	SET/EC/BT/C604	Digital Signal Processing Lab	30	-	30	70	100
7.		SET/EC/BT/C605	FPGA Lab	30	-	30	70	100
8.	Communication skills/CC	SET/EC/BT/M606	* Communication Skills Course/ Technical Seminar	10	20	30	70	100
9.	Skill Course	SET/EC/BT/S607	Minor Project	30	-	30	70	100

@Course offered by the department from the Program Elective- IV list as given below.
#Courses offered by any department of School of Engineering and Technology.
*University will prepare communication course in Modern/Indian languages from which student will select one language course. The course will be more on applied side with giving students a chance to develop their soft skills. In case no syllabus is prepared by the university then Technical Seminar course will be offered to our Students.
T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Program Elective- IV	1.	SET/EC/BT/E608	Microcontroller Programming and Interfacing
	2.	SET/EC/BT/E609	Introduction to Python Programming
	3.	SET/EC/BT/E610	Wireless Sensor Networks

SET/EC/BT/C601. DIGITAL SIGNAL PROCESSING		
Course Objective	1. To understand basic concept of DTFT and Z-transform. 2. To learn DFT, FFT and its algorithm. 3. To understand the various filter structure and its designing concept.	
Course Outcomes	Student should be able to: 1. Analyze the different properties of DTFT, Z-transform and DFT. 2. Analyze the discrete Fourier transform with the help of FFT algorithm. 3. Construct and design the different digital filters (IIR and FIR).	
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; Low pass, Band pass, Band stop and High pass filters, properties of linear-phase FIR filters, window design techniques, Park-McClellan's method.	**12**
	Total No. of Hours	**42**
Text Book/ 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/EC/BT/C602. COMPUTER DESIGN USING VHDL		
Course Objective	1. Learn the working of digital computer, basic computer organization and architecture,. 2. To learn about different types of addressing modes, programmable logics and HDLs. 3. To learn the memories and it's design using VHDL.	
Course Outcomes	Student should be able to: 1. Compare performance of different computing architectures. 2. Specify and design a basic computer. 3. Write programs for computers with different type of architectures. 4. Use VHDL to implement different building blocks of a computer.	
Module Name	**Content**	**No. of Hrs.**
Introduction to Computers	Basic computer organization and architecture, working of digital computer, register transfer notation, programmer's register model, CPU organization, instruction set architecture, data types, floating point number system; Measurement of computer performance.	**7**
Selected topics of Computer Architecture	Addressing modes, instruction format, instruction sequencing, stacks. zero, one, two and three address machine, assembly language, assembly language programming; Pipelined processing;	**8**
Introduction to programmable logics and HDLs	Introduction to PROM, PLAs, PALs, CPLDs and FPGAs; Introduction to VHDL; VHDL programs for combinational circuits: logic gates, adders, decoder, encoder, multiplexer, de-multiplexer; VHDL programs for sequential circuits: flip flops, up down counter, universal shift register; FSM design: Melay and Moore type FSM, sequence detector using VHDL;	**10**
Central Processing Units	Computer arithmetic, fixed and floating points arithmetic, logical operations; design of fast adders, multiplication and division circuits; Control Unit: types, working and design. Design of Instruction Decoder, ALU, CU and CPU using HDL and implementation using FPGA.	**10**
Memory and I/O	Memory hierarchy, system balance consideration, Speed, size and cost; RAM, ROM Cache, Cache and mapping procedures; Virtual memory; Memory design using VHDL; I/O processing, data transfer methods; Using HDL to communicate with peripherals; Examples of interfacing 7-segment display.	**10**
	Total no. of Hours	**45**
Text Book	1. Sandige and Sandige, "Fundamentals of Digital and Computer Design using VHDL", McGrawHill, Indian Edition, 2014 2. Harris and Harris, "Digital Design and Computer Architecture", Morgan Kauffmann	
Reference Books:	1. Kevin Skahill, "VHDL for programmable logics", Pearson. 2. Volnei A. Pedroni, "Circuit Design and Simulation with VHDL", PHI 3. Charles H. Roth Jr. and Lixy Kurian John, "Digital System Design using VHDL" Cengage Learning 4. Stephan Brown and Zvonko Vranesic "Fundamentals of Digital Logic with VHDL", McGrawHill 5. M. Morris Mano, "Computer System Architecture", Pearson.	

SET/EC/BT/C603. MICROWAVE THEORY AND TECHNIQUES		
Course Objective	1. Study Microwave Communication System. 2. To learn the propagation of microwave through different types of Waveguides and resonators. 3. To gather knowledge about microwave components, microwave tubes and different types of microwave semiconductor devices. 4. To study the techniques of microwave measurements.	
Course Outcomes	Student should be able to: 1. Understand the working of basic microwave components 2. Understand the theory of microwave amplifiers and oscillators 3. Design waveguides and resonators 4. Understand the basic working principle of ferrites in microwave devices 5. Proficient in analysis and characterization of microwave networks. 6. Understand the use of microwave devices in real time scenarios.	
Module Name	**Content**	**No. of Hrs.**
Propagation through Waveguide and cavity resonator	Rectangular waveguide, solutions of wave equation in rectangular co-ordinates, derivation of field equations for TE and TM modes degenerate and dominant mode, power transmission and power loss, Excitation of waveguides, nonexistence of TEM mode in waveguide, introduction to circular waveguides, strip line and micro-strip line. Rectangular and cylindrical cavities. Quality factor, excitation of cavities.	**12**
Microwave components	Waveguide coupling, bends and twists, transitions, directional couplers, matched road, attenuators and phase shifters, E-plane, H-plane, and hybrid Tee, hybrid ring, wave guide discontinuities, windows, irises and tuning screws, detectors, wave meters, isolators and circulators, Scattering matrix.	**8**
Microwave measurements	Measurements of frequency, wave length, VSWR, impedance, attenuation, low and high power; Limitations of measurements using conventional active devices at microwave frequency.	**8**
Microwave tubes	Klystron, reflex klystron, magnetron, TWT, BWO: their schematic, principle of operation, performance characteristics and application.	**7**
Microwave semiconductor devices	PIN, tunnel diode, Gunn diode, IMPATT and TRAPATT, their principle of operation characteristics and application.	**7**
	Total No. of Hours	**42**
Text Book/ References	1. Liao S. Y. , “Microwave devices and circuits”. 2. Pozar, “Microwaves”. 3. Collin R.E., “Foundations of Microwave engineering”.	

SET/EC/BT/C604. DIGITAL SIGNAL PROCESSING LAB		
Module Name	**Content**	**No. of Hrs.**
Simulations	MATLAB simulation for DTFT, DFT, Z-Transform and digital filters	28
	Total no. of Hours	**28**

SET/EC/BT/C605. FPGA LAB		
Module Name	**Content**	**No. of Hrs.**
Simulations	Laboratory experiments related to course "Computer Design using VHDL".	**28**
	Total No. of Hours	**28**

SET/EC/BT/M606. COMMUNICATION SKILLS COURSE/ TECHNICAL SEMINAR		
Module Name	**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 Electronics And Communication engineering. Students should search for the related literature and prepare a presentation. . Select a topic relevant to ECE domain and suitable for UG level presentation. For the selection topics refer to internationally reputed journals. The primary reference should be published during the last two or three years. Evaluation shall be based on content, presentation and active participation.	56
	Total No. of Hours	**56**
References	1. Internet and Journals/Magazines	

SET/EC/BT/S607. MINOR PROJECT		
Module	**Content**	**No. of Hrs.**
	The minor project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design. The minor project may be a complete hardware or a combination of hardware and software. Minor Project should cater to a small system required in laboratory or real life. It should encompass components, devices, analog or digital ICs, micro controllers with which functional familiarity is introduced. Based on comprehensive literature survey/ Industry requirements analysis, the student shall identify the title and define the aim and objectives of the minor project. Students are expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within the first week of the semester. The student is expected to exert on design, development, and testing of the proposed work as per the schedule. Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirements of the system, mechanical aspects for enclosure and control panel design. Completed minor project and documentation in the form of project report is to be submitted at the end of semester. Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.	24x2
	Total No. of Hours	**48**

SET/EC/BT/E608. MICROCONTROLLER PROGRAMMING AND INTERFACING		
Course Objectives	1. To analyze the basic concepts and programming of 8051 microcontroller 2. To understand the interfacing circuits for various peripherals of 8051 microcontroller. 3. To understand the programming of 8051 Microcontroller and interface 8051 with different peripherals.	
Course Outcomes	Student should be able to: 1. Understand and describe features of Microcontroller. 2. Compare different microcontrollers and choose one for his/her requirements. 3. Write program for microcontroller for different computing/ control applications. 4. Interface and write program for various peripherals with microcontroller.	
Module Name	**Content**	**No. of Hrs.**
Introduction	Fundamental differences of microprocessors and microcontrollers; 8-bit, 16-bit, 32-bit microcontroller examples and comparison; Introduction to 8051 μC.	**5**
Architecture and instruction set.	Introduction of Architecture and instruction set; Addressing modes and data transfer; Special Function Registers (SFR), I/O ports;. 8051 operational code mnemonics: Introduction, 8051 instruction hexadecimal codes, internal RAM and SFR addresses.	**12**
Counters and timers in 8051	Introduction, Applications and Programming of Counters and Timers; Programming examples for 8051.	**8**
Interfacing	Circuit connections for interfacing of switches, LED, seven segment display, DAC and ADC to microcontroller, LCD interfacing, RTC interfacing, keyboard interfacing.	**10**
Programming 8051	Programming examples for 8051, Programs to interface 8051 with different peripherals.	**10**
	Total No. of Hours	**45**
Textbooks	1. Kenneth J. Ayala, "The 8051 Microcontroller", Penram International 2. Muhammad Ali Mazidi and Jenice G. Mazidi "The 8051 Microcontroller and Embedded Systems", Pearson.	
References	1. J.W. Valvano, Embedded Microcomputer System: Real Time Interfacing, Brooks/Cole, 2000. 2. Shibu K.V.: Introduction to Embedded Systems, Tata McGraw Hill, 2009 3. Raj Kamal, Embedded Systems. Architecture, Programming and Design. Tata McGraw Hill. 4. G.H. Miller, Microcomputer Engineering, 3d edition, Pearson Education.	

SET/EC/BT/E609: INTRODUCTION TO PYTHON PROGRAMMING		
Course Objective	1. Learn the syntax and semantics of Python Programming Language. 2. Write Python functions to facilitate code reuse and manipulate strings. 3. Illustrate the process of structuring the data using lists, tuples and dictionaries. 4. Demonstrate the use of built-in functions to navigate the file system. 5. Appraise the need for working on web scraping.	
Course Outcomes	Student should be able to: 1. Demonstrate the concepts of control structures in Python. 2. Implement Python programs using functions and strings. 3. Implement methods to create and manipulate lists, tuples and dictionaries. 4. Apply the concepts of file handling and regexusing packages. 5. Illustrate the working of scraping websites with CSV.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Introduction, Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, your First Program, Dissecting Your Program. Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit().	**9**
Module 2	Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling. 08 L1, L2, L3 Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods.	**8**
Module 3	Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things. Manipulating Strings - Working with Strings, Useful String Methods.	**8**
Module 4	Pattern Matching with Regular Expressions: Finding Patterns of Text without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and Nongreedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re.IGNORECASE, re .DOTALL, and re .VERBOSE. Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint.pformat() Function. Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module.	**9**
Module 5	Web Scraping: Project: MAPIT.PY with the web browser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML. Working with Excel Spreadsheets: Excel Documents, Installing the openpyxl Module, Reading Excel Documents, Project: Reading Data from a Spreadsheet, Writing Excel Documents, Project: Updating a Spreadsheet, Setting the Font Style of Cells, Font Objects, Formulas, Adjusting Rows and Columns, Charts.	**8**
	Total No. of Hours	**42**
Text/Reference Books:	1. Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015, ISBN: 978-1593275990. 2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755. 3. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014. 4. Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365. 5. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithms in Python”, 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176. 6. ReemaThareja, “Python Programming using problem solving approach”, Oxford University press, 2017. ISBN-13: 978-0199480173 7. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1 st Edition, Shroff Publishers, 2017. ISBN: 978-9352136278.	

SET/EC/BT/E610. WIRELESS SENSOR NETWORKS		
Course Objective	1. Recognizing the fundamental ideas and uses of wireless sensor networks (WSN). 2. Learning technologies for WSN. 3. Examining various WSN routing protocols. 4. Examining WSN's dissemination protocols. 5. Analyzing and comprehending wireless sensor network design principles.	
Course Outcomes	Student should be able to: 1. Design wireless sensor networks for a given application. 2. Understand emerging research areas in the field of sensor networks. 3. Understand MAC protocols used for different communication standards used in WSN. 4. Explore new protocols for WSN.	
Module Name	**Content**	**No. of Hrs.**
Introduction	Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks	**8**
Mobile Ad-hoc Networks	Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks, Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.	**10**
Dissemination protocol	Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.	**8**
Design Principles	Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.	**8**
Single-node architecture	Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.	**8**
	Total No. of Hours	**42**
Text/References	1. Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011. 2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009 3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications,2004 4. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science	

SEMESTER VII

(Click for Credit Distribution)

S. No.	Category	Code	Course Title	T.A	C.T	TOT	ESE	SUB. TOTAL
1.	Core Subjects	SET/EC/BT/C701	Optical Fiber Communication	10	20	30	70	100
2.			@Program Elective-V	10	20	30	70	100
3.			@Program Elective- VI	10	20	30	70	100
4.	Core Subjects	SET/EC/BT/C702	Advanced Communication Lab	30	-	30	70	100
5.	Based Labs	SET/EC/BT/C703	Industrial Training Seminar	30	-	30	70	100
6.	Life Skills and personality development	SET/SH/BT/L701	*Essential Management Practices	10	20	30	70	100
7.	Skill Course	SET/EC/BT/S704	Major Project Preparation	30	-	30	70	100

@Course offered by the department from the Program Elective- V & VI list as given below.
#Courses offered by any department of School of Engineering and Technology.
T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Program Elective- V & VI	1.	SET/EC/BT/E705	CMOS Analog IC Design
	2.	SET/IE/BT/E706	RADAR Guidance and Navigation
	3.	SET/EC/BT/E707	Satellite Communication
	4.	SET/EC/BT/E708	Micro-sensors and Actuators
	5.	SET/EC/BT/E709	Internet of Things
	6.	SET/EC/BT/E710	Error Correcting Codes
	7.	SET/EC/BT/E711	Machine Learning
	8.	SET/EC/BT/E712	Cyber Security
	9.	SET/IE/BT/E701	Biomedical Instrumentation
	10.	SET/IE/BT/C701	Vacuum Instrumentation and Thin Film Deposition Techniques

SET/EC/BT/C701. OPTICAL FIBER COMMUNICATION		
Course Objective	1. To understand the concept and significance of optical fiber communication system. 2. To understand the transmission characteristics of optical fiber communication system. 3. To identify and understand the operation of optical sources and detectors. 4. To understand the design of optical systems and WDM.	
Course Outcomes	Student should be able to: 1. Distinguish Step Index, Graded index fibers and compute mode volume. 2. Explain the Transmission Characteristics of fiber and Manufacturing techniques of fiber/cable. 3. Classify the construction and characteristics of optical sources and detectors. 4. Discuss splicing techniques, passive optical components and explain noise in optical system. 5. Design short haul and long haul Analog/ Digital optical communication systems. 6. Design the optical fiber communication system. 7. Estimate the losses due to attenuation, absorption, scattering and fiber bending.	
Module Name	**Content**	**No. of Hrs.**
Introduction	Block diagram of optical fiber communication system, Advantages of optical fiber communication, Optical fiber waveguides: structure of optical wave guide, light propagation in optical fiber using ray theory, acceptance angle, numerical aperture, skew rays, wave theory for optical propagation, modes in a planar and cylindrical guide, mode volume, single mode fibers, cutoff wavelength, mode field diameter, effective refractive index and group and mode delay factor for single mode fiber.	**8**
Transmission Characteristics of Optical fiber	Attenuation in optical fibers, intrinsic and extrinsic absorption, linear and nonlinear scattering losses, fiber bends losses. Dispersion and pulse broadening, intramodal and intermodal dispersion for step and graded index fibers, modal noise, over all fiber dispersion for multimode and monomode fiber, dispersion shifted fibers, modal birefringence and polarization maintaining fibers.	**8**
Optical Sources	Basic concepts, Einstein relations and population inversion, optical feedback and threshold conditions, direct and indirect band gap semiconductors, spontaneous and stimulated emission in p-n junction, threshold current density, Hetero junction & DH structure, semiconductor injection lasers structure & Characteristics of injection laser. Drawback and advantages of LED and LASER, LED structures and Characteristics.	**8**
Optical detectors	Requirement for photo detections, p-n photodiode, characteristics of photo detections, p-i-n and avalanche photodiodes, phototransistors & photoconductors, receiver performance considerations Noise sources in optical fiber communication, noise in p-n, p-i-n and APD receivers, Receiver structures.	**8**
Optical fiber communication systems	Principal components of an optical fiber communication system, optical transmitter circuits, LED and laser drive circuits, optical receiver block diagram, simple circuits for pre-amplifier, automatic gain control and equalization, Regenerative repeater, BER of optical receiver, channel losses, ISI penalty and optical power budgeting for digital optical fiber system, line coding, Direct intercity and sub carrier intensity modulation using AM, FM and PM. Block diagram and detection principle of coherent optical fiber system,WDM.	**10**
	Total No. of Hours	**42**
Books/ References	1. John.M.Senior, "Optical Fiber Communication" 2. G.E. Keiser, "Optical Fiber Communication"	

SET/EC/BT/C702. ADVANCED COMMUNICATION LAB		
Module Name	**Content**	**No. of Hrs.**
	Related Experiments of Optical Communication, Satellite Communication, Radar Guidance and Navigation, Microwave, Antenna and Telecommunication Switching.	14x2
	Total No. of Hours	**28**

SET/EC/BT/C703. INDUSTRIAL TRAINING SEMINAR		
Module Name	**Content**	**No. of Hrs.**
	Student shall prepare a detailed report on her/his industrial training and deliver a seminar of 30 minutes.	2x14
	Total No. of Hours	**28**

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

SET/EC/BT/S704. MAJOR PROJECT PREPARATION		
Module Name	**Content**	**No. of Hrs.**
	Project Preparation includes following assignments: 1. Survey and study of published literature on the assigned topic. 2. Working out a preliminary approach to the Problem relating to the assigned topic. 3. Conducting Preliminary Analysis/ Modelling/ Experiment/Simulation/ Experiment/ Design/ Feasibility. 4. Preparing a Written Report on the Study conducted for presentation to the Department. 5. Final Seminar, as oral Presentation before a Departmental Committee.	84
	Total No. of Hours	**84**

SET/EC/BT/E705. CMOS ANALOG IC DESIGN		
Course Objective	1. To familiarize students with CMOS analog IC design and important building blocks of CMOS analog ICs. 2. To familiarize students with different circuit choices and the tradeoffs involved in design of analog CMOS ICs. 3. To familiarize students with: specific design issues related to single and multistage voltage, and differential amplifiers; issues about their I/O impedance, bandwidth; use of feedback, and concept of stability. 4. To understand the design of differential amplifiers, and OP AMPs.	
Course Outcomes	Student should be able to: 1. Analyze and Design basic building blocks of CMOS analog ICs. 2. Carry out the design of single and two stage operational amplifiers and voltage references. 3. Determine the device dimensions of each MOSFETs involved.	
Module Name	**Content**	**No. of Hrs.**
Introduction and review	Comparison of MOS and Bipolar Transistors, square-law ,regions – cutoff , triode, saturation, biasing , body effect, channel length modulation, mobility degradation and velocity saturation, threshold voltage effects, temperature and geometry dependence, parasitic and equivalent circuits, short and long channel approximations, types and modelling of noise sources in electronic circuits ; Analog Circuit performance metrics and tradeoffs;	9
Building blocks	Design and Analysis of MOS amplifiers,: CS with different types of loads, CG, source followers, cascodes, folded cascade, current mirrors: simple, cascode current mirror, wide swing cascode current mirror. differential amplifier;	9
Frequency response and Feedback	Frequency analysis of amplifiers;, Different types of Feedback in amplifiers and Analog design; Feedback voltage and transconductance amplifiers, feedback trans-impedance amplifiers and current amplifiers; Stability in Op Amps and compensation;	9
OP AMP Design	OP AMP specifications, Design topologies and their comparison; Tradeoffs in OP AMP Design; Systematic design procedure for one-stage and two-stage OP AMP design.	9
Voltage and Current references	Voltage and current reference circuits: need, , sensitivity issues; Analysis and design of references; Bandgap Reference: Principles, CMOS Bandgap Circuits , Start-Up Circuits;	9
	Total No. of Hours	**45**
TextBooks	1. Wiley Sansen: Analog Design Essesntials, Springer 2006 2. Jacob Baker "CMOS Design Layout and Simulation", Wiley 3. Behzad Razavi "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001	
References	1. Philip E Allen, D R Holberg, "CMOS Analog IC Design", Oxford University Press, 2004 2. Gray, May, "Analysis and Design of Analog Integrated Circuits", Wiley.	

SET/EC/BT/E706. RADAR GUIDANCE AND NAVIGATION		
Course Objective	1. Main objective of this course is to make the students understand the basic concept in the field of Radar and Navigational aids. Students are taught about different types of Radar Systems. 2. To become familiar with basics of Radar. 3. To get complete knowledge about the different types of Radar and their operation. 4. To become familiar with signal detection techniques. 5. To understand the concepts of Radio Navigation techniques	
Course Outcomes	Student should be able to: 1. Explain the principles, concepts and operation of satellite communication. 2. Explain the concepts and operation of telemetry and command control for satellite communication. 3. Describe the concepts of signal propagation affects, link design, rain fading and link availability and perform interference calculations. 4. Understand different multiple access techniques.	
Module Name	**Content**	**No. of Hrs.**
General Management	Block diagram, range equation, performance factors, pulse and CW radar, moving target indicator, pulse, Doppler radar, delay line cancellers, tracking and scanning radar.	**10**
Radar transmitter and receiver	Different types of radar modulators, receivers block diagram and operations, low noise front ends, receiver protector, radar displays, A-scope and PPI, ends, mixer, duplexer.	**10**
Navigation Aids	Radio direction finding, loop antenna goniometer, Adcock, error in direction finders, radar bacons, VHF and UHF radio range, LF/MF radio range, VOR, DME, hyperbolic navigation systems, loran-decca-tacan landing systems, GCAs, ILS, MLS, global positioning systems.	**12**
Guidance	Basic guidance, block diagram, internal guidance, Gyroscopes,Servo accelerators, basic application of server system components.	**12**
	Total No. of Hours	**44**
References	1. Merril I. Skolnik, “Introduction to Radar Systems” 2. N. S. Nagraja, “Elements of Electronic navigation” 3. R. S. Berkowiz, “Modern Radar”	

SET/EC/BT/E707. SATELLITE COMMUNICATION		
Course Objective	Students will study the basic satellite system, Geostationary satellite, satellite link budget, Multiple accesses, and satellite Earth station etc. This subject will be helpful to EC students for understanding wireless communication.	
Course Outcomes	Student should be able to: 1. Explain the principles, concepts and operation of satellite communication. 2. Explain the concepts and operation of telemetry and command control for satellite communication. 3. Describe the concepts of signal propagation affects, link design, rain fading and link availability and perform interference calculations. 4. Understand different multiple access techniques.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Introduction: origin and brief history of satellite communication, elements of satellite communication link, current status of satellite communication.	**5**
Module 2	Orbital mechanism and launching of satellite: equation of orbital, locating the satellite in the orbit, orbital elements, elevation and azimuth calculation, geostationary,geosyncronous and other orbits, mechanics of launching satellite.	**7**
Module 3	Space craft: satellite subsystems, telemetry, tracking and command (TT and C), communication subsystem, transponders, spacecraft antennas.	**7**
Module 4	Satellite channel and link design: G/T ratio of earth stations, design of down links and uplinks, FM improvement factor	**7**
Module 5	Earth station technology: earth station design, earth station, tracking, low noise amplifiers.	**7**
Module 6	Multiple access techniques: frequency division multiple access (FDMA), FDM/FM/FMFDMA, time division multiple access, frame structure and synchronization, code division multiple access, random access.	**9**
	Total No. of Hours	**42**
Textbooks	1. Pratt, “Satellite Communication”	

SET /EC/BT /E708. MICRO- SENSORS AND ACTUATORS		
Course Objective	To understand the concepts of working of Micro-sensors and actuators, to enable selection, design and configuration of Micro-sensors and actuators.	
Course Outcome	On successful completion of this course, students will be able to understand the basic concept of micro-sensors and actuators. Students will be able to utilize these devices for various applications.	
Module Name	**Content**	**No. of Hrs.**
Introduction to Micro Fabrication	Integrated circuit process, Bulk micromachining, Isotropic etching and anisotropic etching, Wafer bonding, LIGA process, Micro system packaging, Considerations packaging – levels of micro system packaging die level, device level and system level.	**8**
Micro-Sensors	Classification of physical sensors, Integrated, Smart sensors, Sensors principles, Electrical sensors, Thermal sensors, Mechanical sensors, Chemical and Biosensors.	**8**
Micro-Actuators	Electromagnetic and thermal micro actuation, Mechanical design of micro actuators, Micro actuator examples, microvalves, micropumps, micromotors, Micro actuator systems, Ink-Jet printer heads, Micro-mirror TV Projector.	**8**
Surface Micromachining	One or two sacrificial layer process, Surface micromachining requirement, Polysilicon surface micromachining, other compatible materials, Silicon dioxide, Silicon nitride, piezoelectric materials, Surface micromachined systems.	**9**
Application Areas	3D electromagnetic sensors and actuators, RF/ Electronic devices, Optical/Photonic devices, Bio-medical devices, MEMS for RF applications: Need of RF MEMS components in communication, space and defence application.	**9**
	Total No. of Hours	**42**
TextBooks	1. J. W. Gardner, "Microsensors, MEMS and Smart Devices", Wiley, 2002. 2. Chang Liu, "Foundations of MEMS", Pearson, 2012. 3. P. Rai Choudhary, "MEMS and MOEMS Technology and Applications", PHI, 2009.	
References	1. J. W.Gardner, "Micro-sensors, Principles and Applications", John Wiley, 2008). 2. T. Korvacs Gregory, Micromachined Transducer sourcebook, McGraw Hill, 1998). 3. A.P.F. Turner, and G.S.Wilson , Biosensors Fundamentals and applications, Oxford UniversityPress (2005). 4. William T., Micromechanics and MEMS, IEEE Press (1997).	

SET/EC/BT/E709. INTERNET OF THINGS		
Course Objective	1. Students will study the basic of IoT Introduction and Fundamentals. 2. To understand the concept Signals, Sensors, Actuators, Interfaces using IoT. 3. To understand the concept Communication and Networking in IoT and Cloud Computing. 4. To get the knowledge of Data Analytics and security for IoT.	
Course Outcomes	Student should be able to: 1. Illustrate the fundamentals of IoT. 2. Identify suitable hardware and interfaces for IoT deployments. 3. Develop cloud computing model and service options. 4. Illustrate data analytics and security for IoT.	
Module Name	**Content**	**No. of Hrs.**
IoT Introduction and Fundamentals	Deciphering the term IoT Applications where IoT can be deployed Benefits/Challenges of deploying an IoT, IoT components: Digital Signal Processing, Data transmission, Choice of channel (wired/wireless), back-end data analysis. Understanding packaging and power constraints for IoT implementation.	**7**
Signals, Sensors, Actuators, Interfaces	Introduction to sensors & transducers, Introduction to electrodes & biosensors, Static and dynamic characteristics of sensors, Different types of sensors, Selection criteria's for sensors / transducers, Signal conditioning modules of IoT system , Energy and power considerations, Introduction to actuators, Different types of actuators, Interfacing challenges, Modules of data acquisition system, Wireless sensor node structure, positioning topologies for IoT infrastructure.	**9**
Communication and Networking in IoT	Review of Communication Networks, Challenges in Networking of IoT Nodes, range, bandwidth Machine-to-Machine (M2M) and IoT Technology Fundamentals, Medium Access Control (MAC) Protocols for M2M Communications Standards for the IoT Basics of 5G Cellular Networks and 5G IoT Communications, Low-Power Wide Area networks (LPWAN)Wireless communication for IoT: channel models, power budgets, data rates. Networking and communication aspects: IPv6, 6LoWPAN, COAP, MQTT, Operating Systems need and requirements for IoT.	**9**
Modern networking: Cloud computing	Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud, Hypervisors, Comparison of Cloud providers, Cloud and Fog Ecosystem for IoT Review of architecture	**7**
IoT Data analytics and Security	OLAP and OLTP, NoSQL databases, Row and column Oriented databases, Introduction to Columnar DBMS CStore , Run :Length and Bit vector Encoding, IoT Data Analytics. Cryptographic algorithms, Analysis of Light weight Cryptographic solutions IoT security, Key exchange using Elliptical Curve Cryptography, Comparative analysis of Cryptographic Library for IoT.	**7**
IoT Applications	IoT applications like Home Automation, Precision Agriculture, Smart vehicles, Smart Grid, Industry 5.0.	**3**
	Total No. of Hours	**42**
Text/ References	1. Arshdeep Bahga and Vijay Madisetti , "Internet of Things, a hands on approach" , Universities Press (India) Pvt. Ltd. 2017. 2. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms"Copyright © 2016 Elsevier Inc. 3. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" Publisher: Addison-Wesley 2015.	

SET/EC/BT/E710. ERROR CORRECTING CODES		
Course Objective	1. Understand Block Codes and Maximum Likelihood Decoding. 2. Understand Decoding Tables, Hamming Weight and Distance and Error Correction v/s Detection. 3. Understand Generator Matrix, Parity-Check Matrix and Error-Correcting Capability of a Linear Code. 4. Design an error detecting and correcting system for semiconductor memory system to meet given system specification. 5. Understand Binary Cyclic Codes, encoding with (n-k)-Stage Shift Register and Syndrome Calculations and Error Detection. 6. Design an error detecting and correcting system for magnetic storage device to meet given system specification. 7. Understand Error Trapping Decoding for Cyclic Codes. 8. Understand BCH Codes and the encoding and decoding techniques.	
Course Outcomes	Student should be able to: 1. Understand the error sources. 2. Understand error control coding applied in digital communication. 3. Understand and compare different algorithms used in error control. 4. Implement different algorithms used in error control.	
Module Name	**Content**	**No. of Hrs.**
Linear block codes	Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels.	**10**
Hamming codes	Weight enumerators and the McWilliams identities; Perfect codes, Introduction to finite fields and finite rings; factorization of (X^n-1) over a finite field; Cyclic Codes.	**10**
BCH codes	Idempotents and Mattson-Solomon polynomials; Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa and generalized BCH codes; Spectral properties of cyclic codes. ;Decoding of BCH codes	**10**
Berlekamp's decoding	Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. A fast Berlekamp - Massey algorithm. Convolution codes; Wozencraft's sequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm.	**12**
	Total No. of Hours	**42**
Text/References	1. F.J. McWilliams and N.J.A. Slone, The theory of error correcting codes, 1977. 2. R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.	

SET/EC/BT/E711. MACHINE LEARNING		
Course Objective	1. To understand the basic theory underlying machine learning. 2. To be able to formulate machine learning problems corresponding to different applications. 3. To understand a range of machine learning algorithms along with their strengths and weaknesses. 4. To be able to apply machine learning algorithms to solve problems of moderate complexity. 5. To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	
Course Outcomes	Student should be able to: 1. Grasp and develop algorithms for linear, logistic, and multivariate regression. 2. Design and implement linear and nonlinear classifiers based on SVM, Neural networks and Decision trees. 3. Identify and implement clustering techniques for moderate to large size data. 4. Evaluate and interpret the results of the machine learning algorithms.	
Module Name	**Content**	**No. of Hrs.**
Introduction to probability and linear algebra	Review of Probability Theory and Linear algebra, Convex Optimization, relationship between AI, ML, and DL.	**6**
Introduction to Statistical Decision Theory, Regression	Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Logistic Regression, Partial Least Squares Classification: Linear Classification, LDA.	**8**
Introduction to Perceptron and SVM, Neural Networks	Introduction, Early Models, Perceptron Learning, Back-propagation, Initialization of neural network, Training and Validation, Parameter Estimation.	**8**
Bayesian Learning	Introduction to Bayesian Learning, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naive Bayes classifier.	**9**
Classification Families and Learning Alogrithms	Decision Trees - Stopping Criterion and Pruning, Loss function, Categorical Attributes, Multiway Splits, Missing values, Instability, Regression Trees. Bootstrapping and Cross Validation, Class Evaluation, Measures, ROC curve, MDL, Ensemble methods, Committee Machines and Stacking. Partitional clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density- Based Clustering, Gaussian Mixture Models, Expectation Maximization, Learning Theory, Re-enforcement Learning.	**11**
	Total No. of Hours	**42**
Text/References	1. Rajiv Chopra, Machine Learning, Khanna Book Publishing Company, 2023. 2. Hastie, T. R. Tibshirani, and J. G. Friedman, "The Elements of Statistical Learning: Data Mining, Inference and Prediction", New York, NY: Springer. 3. EthemAlpaydin, "Introduction to Machine Learning", PHI, 2005. 4. Bishop Christopher, "Neural Networks for Pattern Recognition", New York, NY: Oxford University Press 5. Mitchell Tom, "Machine learning", New York, NY: McGraw-Hill 6. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani "Introduction to Statistical Learning", Springer, 2013.	

SET/EC/BT/E712. CYBER SECURITY		
Course Objective	Demonstrate data analysis as it pertains to identifying and responding to cyber-attacks. Effectively apply knowledge in simulated real-world conditions to protect and defend complex networks and infrastructures, including in the cloud. Implement incident response and digital forensics techniques.	
Course Outcomes	Student should be able to: 1. Understand the basic concept of cyber security and its importance. 2. Analyze and distinguish various security threats and attacks that are prevalent now. 3. Find different ways for safety of assets and systems by increasing the strength of security parameters. 4. Perform simple simulations of cyber security attacks and ways to mitigate those.	
Module Name	**Content**	**No. of Hrs.**
Cyber Security Concepts	Cyber Risks, Breaches, attacks, Exploits, Social Engineering, Foot Printing, Scanning, etc.	**4**
Cryptography and Cryptanalysis	Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security.	**6**
Infrastructure and Network Security	Introduction to System Security, Server Security, OS Security, Physical Security, Introduction to Networks, Network packet Sniffing, Network Design Simulation. DOS/ DDOS attacks. Asset Management and Audits, Vulnerabilities and Attacks. Introduction to Intrusion detection and Prevention Techniques, Host based Intrusion prevention Systems, Security Information Management.	**8**
Cyber Security Vulnerabilities & Safe Guards	Internet Security, Cloud Computing & Security, Social Network sites security, Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness.	**8**
Malware	Explanation of Malware, Types of Malware: Virus, Worms, Trojans, Rootkits, Robots, Adware's, Spywares, Ransom wares, Zombies etc., OS Hardening (Process Management, Memory Management, Task Management, Windows Registry/ services another configuration), Malware Analysis. Open Source/ Free/ Trial Tools: Antivirus Protection, Anti Spywares, System tuning tools, Anti Phishing.	**9**
Security in Evolving Technology	Biometrics, Mobile Computing and Hardening on android and ios, IOT Security, Web server configuration and Security. Basic security for HTTP Applications and Services, Basic Security for Web Services like SOAP, REST etc., Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.	**7**
	Total No. of Hours	**42**
Text/References	1. Jeeva Jose & Vijo Mathew, Introduction to Security of Cyber-Physical Systems, Khanna Book Publishing Company, 2023. 2. William Stallings, "Cryptography and Network Security", Pearson Education/PHI, 2006. 3. V.K. Jain, "Cryptography and Network Security", Khanna Publishing House. 4. Gupta Sarika, "Information and Cyber Security", Khanna Publishing House, Delhi. 5. Atul Kahate, "Cryptography and Network Security", McGraw Hill. 6. V.K. Pachghare, "Cryptography and Information Security", PHI Learning.	

SET/IE/BT/E701. BIOMEDICAL INSTRUMENTATION		
Course Objective	1. To study about the different bioelectric potential, and electrodes. 2. To understand the working of various instruments like ECG, EEG, EMG, X -Ray imaging and ultrasound imaging used in medical diagnosis.	
Course Outcomes	Student should be able to: 1. Explain the bioelectric potentials and how they can be picked up. 2. Understand and explain the main biological organs of humans and their structure. 3. Use the ECG, EEG, EMG, X -Ray imaging and ultrasound imaging.	
Module Name	**Content**	**No. of 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/IE/BT/C701. VACUUM INSTRUMENTATION AND THIN FILM DEPOSITION TECHNIQUES		
Course Objective	1. To understand the basic theory of different gaseous flow. 2. To study the various vacuum pumps and vacuum gauges to create and measure the vacuum pressure in a working chamber, respectively. 3. To learn about different leak detection techniques. 4. To know the physical and chemical methods for thin film deposition, and different methods for the measurement of film thickness.	
Course Outcomes	Student should be able to: 1. Understand the general terminology used in the vacuum system, i.e., throughput, mean free path, out gassing, vapor pressure, gettering, etc. 2. Understand the theory of gaseous flow (turbulent, viscous and molecular), and the effect of physical variable on the flow. 3. Understand the working, construction, characteristics curve and applications of various vacuum pumps. 4. Measure the vacuum pressure with the help of different vacuum gauges. 5. Understand the properties of materials used in the vacuum systems, and basic idea of designing the vacuum system. 6. Detect the leak in the vacuum systems. 7. Learn about the physical and chemical methods of thin film deposition, and the measurement of thickness of thin film.	
Module Name	**Content**	**No. of Hrs.**
Definitions and Gas laws	Pressure units, gas laws, throughput and speed, kinetic theory of gases, gas pressure, mean free path, partial pressures of gases, viscosity of gases, thermal conductivity, vapour pressure, ionization, sorption and desorption, out gassing, gettering.	**4**
Theory of Gaseous Flow	Impedance, conductance, effect on pumping speed due to a component, effect of speed in a vessel due to several pumps, mechanism of gas flow, turbulent flow, viscous flow, molecular flow, transitional flow, effect of temperature and nature of gas; conductance of the components, like, orifice, straight pipe of finite length, annular orifice, concentric cylinders, rectangular dent, right angled bends.	**4**
Vacuum Pumps	Rotary pump: Working and characteristics, ultimate pressure, removal of vapours: chemical, physical and gas ballasting techniques. Roots pump: Working and characteristics; Diffusion pump: Working and characteristics, multistage pumps and jet design, pump fluid, self fractionalization of the pump fluid, cooling, backing and roughening requirements, speed characteristics and ultimate pressure. Sorption pumps, cryogenic pumps, ion pumps, getter pumps, sputter-ion pumps, turbo-molecular pumps-their characteristics, merits and limitations.	**8**
Measurement of Vacuum	McLeod gauge, thermo conductivity gauges: Pirani, thermocouple. Ionization gauges; Penning gauge, hot cathode ionization gauge, Bayard Alpert gauge; capacitance gauges. Calibration of gauges.	**5**
Vacuum Materials	Properties of vacuum materials; vapour pressure, out gassing, permeability, mechanical strength. Seals: demountable, permanent, elastomers, metal gaskets, glass to metal seals, ceramic to metal seals. Vacuum grease, oils, cement and waxes. Idea of designing of a vacuum system.	**5**
Leak Detection	Bubble, soap solution, spark coil, discharge tube, ultrasonic, dye penetration, thermal Conductivity and mass spectrometer methods.	**3**
Physical Methods of Thin Film Deposition	Basic idea of evaporation method: source materials, resistive evaporation, electron beam evaporation, flash evaporation, laser ablation, reactive evaporation. Sputtering: DC, bias, triode, 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.	

SEMESTER VIII

(Click for Credit Distribution)

S. No.	Category	Code	Course Title	T.A	C.T	TOT	ESE	SUB. TOTAL
1.	Core Subjects	SET/EC/BT/C801	VLSI Technology	10	20	30	70	100
2.			@Program Elective- VII	10	20	30	70	100
3.	Open Elective /Inter-disciplinary Subject		#Open Elective- III	10	20	30	70	100
4.	Life Skills and personality development	SET/SH/BT/L801	Disaster Management	10	20	30	70	100
5.	Skill Course	SET/EC/BT/S802	Major Project	30	-	30	70	100

@Course offered by the department from the Program Elective- V list as given below.
#Courses offered by any department of School of Engineering and Technology.
T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Program Elective-VII	1.	SET/EC/BT/E803	Wireless and Mobile Communication
	2.	SET/EC/BT/E804	Mobile Ad hoc Networks
	3.	SET/EC/BT/E805	Digital Image and Video Processing
	4.	SET/EC/BT/E806	Mixed Signal Design
	5.	SET/EC/BT/E807	MOSFET Modeling
	6.	SET/EC/BT/E808	Integrated Circuits for Communication
	7.	SET/EC/BT/E809	High Speed Electronics
	8.	SET/EC/BT/E810	Nanoelectronics

SET/EC/BT/C801: VLSI TECHNOLOGY		
Course Objective	To familiarize students with the methods and technologies used for the fabrication of Integrated Circuits.	
Course Outcomes	Student should be able to: 1. Understand process of fabrication of MOSFET and other IC components. 2. Explain different steps/ techniques used in the IC fabrication. 3. Understand the working and specifications of different equipments used in fabrication of ICs. 4. Understand different issues faced by modern IC technologies.	
Module Name	**Content**	**No. of Hrs.**
Introduction and Crystal Growth	Overview of IC technology- CMOS, BIPOLAR, BI-CMOS, SOI; IC design flow; Basic fabrication steps and their significance; Crystal structure, lattice, basis, planes, directions, angle between different planes; Crystal growth; Crystal defects; Epitaxial, Clean room; conductivity, resistivity, sheet resistance.	**9**
Oxidation and Thin Film Deposition	Wet and Dry oxidation; Setups for Oxidation; Various deposition techniques CVD, PVD, evaporation, sputtering, spin coating, LPCVD, Epitaxial, MBE, and APCVD.	**9**
Doping Methods	Diffusion and Ion Implantation: Diffusion process, Solid state diffusion modeling, various doping techniques, Ion implantation, modeling of Ion implantation, statistics of ion implantation, damage annealing, thermal budget, rapid thermal annealing.	**9**
Lithography and Etching	Photolithography; Positive photo resist, negative photo resist, comparison of photo resists, components of a resist, light sources, exposure, Resolution, Depth of Focus, Numerical Aperture (NA), sensitivity, contrast, need for different light sources, masks, Contact, proximity and projection lithography, EUV lithography, X-ray lithography, e-beam lithography, ion lithography, SCALPEL; Wet etch, Dry etch, Plasma etching, RIE etching, etch selectivity/selective etch, etch directionality;	**9**
Metallization and Process Integration	Planarization Techniques: Need for planarization, Chemical Mechanical Polishing; Metallization and Interconnects: Copper damascene process, Metal interconnects; Multi-level metallization schemes; MOS process, CMOS:N-well process, Twin well process, CMOS inverter fabrication and masks; Bipolar process.	**9**
	Total No. of Hours	**45**
Textbooks	1. Gray S. May and S. M. Sze, "Fundamentals of Semiconductor Fabrication", Wiley	
References	1. Stephan A. Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford University Press 2. S.K. Gandhi, " VLSI Fabrication Principles", John Willey & Sons 3. Botkar, " Integrated Circuits", Khanna Publishers	

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

SET/EC/BT/S802 MAJOR PROJECT	
Course Outcomes	1. Identify a problem statement from a rigorous literature survey or the industry requirements analysis. 2. Simulate and design a solution for the identified problem by applying acquired technical knowledge. 3. Develop and test the prototype/algorithm to solve the complex engineering problem. 4. Accomplish all objectives of the project in an allocated period with efficient teamwork. 5. Present project work orally and through a comprehensive report.
Content	
After interactions with project guides/industry experts, based on a comprehensive literature survey/ Industry requirements analysis, the student shall identify the title and define the aim and objectives of a project. The student is expected to work on details specifications, methodology, resources required, critical issues in design and implementation, and submit the project proposal within the first two weeks of semester. The student is expected to work on the design, development, and testing of the proposed project work as per the schedule. The project report is to be submitted at the end of the semester. This report includes a summary of the literature survey, detailed objectives, project specifications, design, proof of concept, developed system/Algorithm, results, contributions, and innovations in project work. The Major Project 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/EC/BT/E803. WIRELESS AND MOBILE COMMUNICATION		
Course Objective	1. To understand the basic concepts of RF propagation, circuits and systems. 2. To understand the various modulation/demodulation techniques and multiple access techniques. 3. To study about mobile communication standards and applications.	
Course Outcomes	Student should be able to: 1. Understand the concepts of RF propagation circuits and systems. 2. Explain multiple access techniques-FDMA, TDMA, CDMA, etc. 3. Analyze wireless data communication systems, wireless multimedia, and GSM systems.	
Module Name	**Content**	**No. of Hrs.**
Module-1	Introduction to RF propagation, multi-path fading, mobile channel description and analysis, RF circuits and systems.	**8**
Module-2	Mobile communication concepts, cellular engineering, cellular concepts, frequency allocation, spectrum efficiency, speech coding, modulation/demodulation techniques, multiple access techniques-FDMA, TDMA, CDMA, Spread Spectrum Techniques.	**11**
Module-3	Error control coding for mobile channel, communication applications, capacity of cellular communication networks, mobile communication standards.	**10**
Module-4	Wireless data communication systems, wireless multimedia, ATM and IP, paging, wireless local loops, Mobile satellite communication, third generation cellular systems, GSM systems, 4G, 5G, universal mobile telecommunication systems.	**13**
	Total No. of Hours	**42**
Textbooks	1. Rappaport, "Wireless Communication".	
References	1. William Stalling, "Wireless Communication and Networks". 2. D. R. Kamilo Fehar, "Wireless Digital Communication". 3. Haykin S & Moher M., "Modern Wireless Communication", Pearson.	

SET/EC/BT/E804. MOBILE AD HOC NETWORKS		
Course Objective	1. To understand the concept of ad hoc wireless networking,802.11(Wi-Fi), 802.16 (Wi-Max) Bluetooth, IrDA, RF home , design and operation of ad hoc network, their design issues and available solution. 2. To understand MAC layer protocols and design issues of MAC protocols. 3. To analyze the energy management in ad hoc network. 4. To analyze the security attacks and QoS provisioning in ad hoc network.	
Course Outcome	Student should be able to be familiar with infrastructure less network, design and, implementation, MAC protocols, routing protocols, energy management, security attacks and QoS in ad hoc network.	
Module Name	**Content**	**No. of Hrs.**
Introduction	Ad hoc Networking: An Introduction. Model of operation, Symmetric links, Fundamental of wireless networks, Bluetooth, IrDA, Comparison of Bluetooth and IrDA, Home RF, 802.11(Wi-Fi), 802.16(Wi-Max), Hotspot, Difference between cellular and ad hoc networks, Technical and research challenges, DoD perspective.	**6**
MAC Layer Protocols for Ad hoc wireless Networks	Need for Medium Access Control(MAC) Protocols, Issues and design goals of MAC protocols, Classification of MAC protocols: Contention Based Mac protocols, Contention Based Mac protocols with reservation mechanism, Multiple Access Collision Avoidance (MACA), Media Access Protocol for wireless (MACAW), Floor Acquisition Multiple Access Protocols (FAMA), Busy Tone Multiple Access Protocols (BTMA), Multiple Access Collision Avoidance – by Invitation(MACA-BI), Dual Busy Tone Multiple Access Protocols (DBTMA), Multichannel Carrier sense Multiple access (CSMA) MAC Protocol.	**10**
Routing Protocols	Design Issues of Routing Protocols, Ideal characteristics of Routing, Classification of Routing Protocols: Proactive, Reactive, Hybrid. Overview of DSDV (Destination Sequenced Distance Vector) Routing protocol, Link state, Distance vector, DSDV Properties and its Merits demerits, Damping Fluctuations. Clustering, Hierarchical Routing. Overview of DSR (Dynamic Source Routing) Protocols: DSR Properties, Additional Route Discovery and Maintenance Features. Overview of AODV (Ad Hoc On Demand Distance vector) Protocols, Unicasting, Multicasting, Unicast Route Establishment, Multicasting Route Establishment, Expanding Ring Search. Overview of ZRP (Zone Routing Protocol), Reconfigurable Wireless Networks, Intrazone, Interzone Routing Protocols. Overview of OLSR (Optimized Link State Routing) Protocol, Multipoint Relays (MPRs), Protocol Functioning, Core Functioning.	**12**
Energy management	Energy management System in Ad Hoc networks, Power Issues, Smart Batteries, and Associatively based Routing, Effects of Beaconing of Battery Life, Maximum life Time Routing.	**6**
Network Security Attacks and Quality of Service	Security in Ad Hoc wireless networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks. QoS in Ad Hoc wireless networks, Issues and Challenges, Classification of QoS solutions. Wireless Sensor Networks, Issues and Challenges, Sensor Network Architecture, Flooding Gossiping, Rumor Routing, Quality of Sensor Networks, Evolving Standards.	**8**
	Total No. of Hours	**42**
Textbooks	1. Perkins, C., 'Ad Hoc Networking', Addison Wesley, 2000. 2. Murthy, C. Siva Ram, and Manoj, B. S., 'Ad Hoc Wireless Networks Architecture and Protocols', Pearson Education 2nd Edition, 2004.	
References	1. Basagni, S. And Conti M., '*Mobile Ad Hoc Networking*', Wiley, 2004.	

SET/EC/BT/E805. DIGITAL IMAGE AND VIDEO PROCESSING		
Course Objective	1. To study the image fundamentals and mathematical transforms necessary for image processing. 2. To study the image enhancement techniques. 3. To study image restoration procedures. 4. To study the image compression procedures.	
Course Outcomes	Student should be able to: 1. Mathematically represent the various types of images and analyze them. 2. Process these images for the enhancement of certain properties or for resource optimization. . 3. Understand algorithms for image compression and coding. 4. Understand video coding and different video codec standards.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Digital image representation: Basic ideas in digital image processing: problems and applications - Image representation and modeling Sampling and quantization - Basic relationships between pixels - Two dimensional systems - shift in variant linear systems - Separable functions; 2-D convolution; 2-D correlation. Image perception - light, luminance, brightness and contrast - MTF of the visual system - visibility function - monochrome vision models - image fidelity criteria - colour representation - colour matching and reproduction - colour co-ordinate systems - colour difference measures - colour vision models.	**8**
Module 2	Image transforms: 2-D Discrete Fourier transform - properties; Walsh Hadamard, Discrete Cosine, Haar and Slant transforms; The Hotelling transform. Matrix theory - block matrices and Kronecker products - Circulant matrix formulation for complexity reduction; Algebraic methods - random fields - spectral density function.	**8**
Module 3	Image enhancement & Restoration: Image enhancement: Basic gray level transformations – Histogram processing: histogram equalization and modification - Spatial operations - Transforms operations - Multispectral image enhancement - Colour image enhancement, Image restoration: Degradation model; Restoration in presence of noise only – Estimating the degradation function - Inverse _filtering - Wiener _filtering – Constrained Least Squares filtering.	**8**
Module 4	Image compression: Fundamental concepts of image compression - Compression models - Information theoretic perspective - Fundamental coding theorem – Lossless Compression: Huffman Coding- Arithmetic coding – Bit plane coding – Run length coding - Lossy compression: Transform coding – Image compression standards.	**8**
Module 5	Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X,.Video Segmentation- Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.	**10**
	Total No. of Hours	**42**
References	1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education. II Ed.,2002 2. Jain A.K., "Fundamentals of Digital Image Processing," Prentice-Hall, 1989. 3. Jae S. Lim, Two Dimensional Signal And Image Processing, Prentice-Hall, Inc, 1990. 4. Pratt W.K., "Digital Image Processing", John Wiley, 1991. 5. K. R. Castleman, .Digital image processing., Prentice Hall, 1995. 6. Netravalli A.N. &Hasbell B.G., "Digital Pictures-Representation Compression and Standards", Plenum Press, New York, 1988. 7. Rosenfeld &Kak A.C., "Digital Picture Processing", Vol.1&2, Academic Press, 1982.	

SET/EC/BT/E806. MIXED SIGNAL DESIGN		
Course Objective	1. To familiarize students with different filters. 2. To familiarize students with implementation of ADC /DAC and PLL for mixed signal processing. 3. To familiarize students with current mode and voltage mode operation.	
Course Outcomes	Student should be able to: 1. Understand the practical issues of mixed signal processing. 2. Analyze and handle the inter-conversions between signals. 3. Understand operation and design procedure for Filter circuits, DACs, ADCs and PLL etc. 4. Understand and use different signaling and layout techniques used for mixed signal systems.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous time filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.	**8**
Module 2	Switched-capacitor filters- Non idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.	**8**
Module 3	Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.	**12**
Module 4	Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission. Introduction to frequency synthesizers and synchronization; Basics of PLL, Analog PLLs; Digital PLLs; DLLs.	**14**
	Total No. of Hours	**42**
Text/References	1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008 2. Behzad Razavi, Design of analog CMOS integrated circuits, McGraw-Hill, 2003. 3. R. Jacob Baker, CMOS circuit design, layout and simulation, Revised second edition, IEEE press, 2008. 4. Rudy V. dePlassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005. 5. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.	

SET/EC/BT/E807. MOSFET MODELING		
Course Objective	To provide students with an understanding of the essential physics of nanoscale transistors and their modeling.	
Course Outcomes	Student should be able to: 1. Explain MOSFET and different types of models. 2. Explain physics of nanoscale MOSFETs, different non-idealities and, accordingly, modify the MOSFET model.	
Module Name	**Content**	**No. of Hrs.**
MOS Modelling	Modeling MOS capacitor: C-V characteristics, effect of metal work function, oxide and interface trapped charges, threshold voltage, tunneling current; Modeling MOSFET: threshold based models of static I-V characteristics, channel length modulation, field-dependent mobility, short channel and narrow width effects, sub threshold current, quantum mechanical effects, capacitances, concept of non-reciprocal capacitances, dynamic behavior under small and large signals, surface potential and charge based models, model parameters and their extraction.	**42**
	Total No. of Hours	**42**
Textbooks	1. Schroder D. K., "Semiconductor Material and Device Characterisation", John Wiley & Sons. 2. Taur Y and Ning T. H., "Fundamentals of Modern VLSI devices", Cambridge (2013).	
References	1. Arora N., "MOSFET modeling for VLSI Simulation: Theory and Practice", World Scientific. 2. Y. Tsividis, "THE MOS TRANSISTOR", Oxford University Press.	

SET/EC/BT/E808. INTEGRATED CIRCUITS FOR COMMUNICATION		
Course Objective	To familiarize students with the working and design of analog and RF circuits for communication applications.	
Course Outcomes	Student should be able to: 1. Explain different device/ circuit level specifications and performance parameters of RF circuits. 2. Explain working of different building blocks RF transceivers. 3. Design an amplifier for RF applications.	
Module Name	**Content**	**No. of Hrs.**
Module 1	Analysis and design of electronic circuits for communication systems, with an emphasis on integrated circuits for wireless communication systems. Analysis of distortion in amplifiers with application to radio receiver design. Power amplifier design with application to wireless radio transmitters. Class A, Class B, and Class C power amplifiers. Radio-frequency mixers, oscillators, phase- locked loops, modulators, and demodulators. System integration in single chip/multichip module, system partitioning, high throughput and low latency design requirement for real-time communication, critical path analysis for high speed VLSI design, design of analog front ends, impedance matching with bonding pads, Si-Ge devices for RF circuits, interface for optical fibres.	**42**
	Total No. of Hours	**42**
Textbooks	1. Thomas H. Lee, "The design of CMOS radio-frequency integrated circuits", Cambridge University Press, 1998. 2. Behzaad Razavi, "RF microelectronics", Pearson. 3. B. Razavi, "Design of Integrated Circuits for Optical Communications", *McGraw-Hill, 2003*	
References	1. E. Säckinger, "Broadband Circuits for Optical Fiber Communication", *Wiley, 2005* 2. Donald O. Pederson and Kartikeya Mayaram, "Analog Integrated Circuits for Communication Principles, Simulation and Design", Springer.	

SET/EC/BT/E809. HIGH SPEED ELECTRONICS		
Course Objective	1. To familiarize students with design, challenges and techniques related to high speed Printed Circuit Boards. 2. To familiarize students with RF amplifier design.	
Course Outcomes	Student should be able to: 1. Understand significance and the areas of application of high-speed electronics circuits. 2. Understand the properties of various components used in high speed electronics. 3. Design High-speed electronic system using appropriate components. 4. Use PCB techniques for high speed PCBs and circuits.	
Module Name	**Content**	**No. of Hrs.**
Transmission line theory	Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise.	**8**
Noise Analysis	Sources, Noise Figure, Gain compression, Harmonic distortion, Inter modulation, Cross-modulation, Dynamic range.	**7**
Devices	Passive and active, Lumped passive devices (models), Active (models, low v/s high frequency).	**8**
RF Amplifier Design	Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D, E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages, Mixers –Up conversion, Down conversion, Conversion gain and spurious response, Oscillators Principles, PLL Transceiver architectures.	**10**
Printed Circuit Board Anatomy	CAD tools for PCB design, Standard fabrication, Micro via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.	**9**
	Total No. of Hours	**42**
Text/References	1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press. 2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2004, ISBN 0521835399. 3. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.	

SET/EC/BT/E810. NANO ELECTRONICS		
Course Objectives	1. To introduce the students to nanoelectronics, nanodevices, spintronics and molecular electronics. 2. To identify quantum mechanics behind nanoelectronics. 3. To describe the principle and the operation of nanoelectronic devices. 4. To explain the principle and application of spintronic devices.	
Course Outcomes	Student should be able to: 1. Understand various aspects of nano-technology and the processes involved in making nano Components and material. 2. Leverage advantages of the nano-materials and appropriate use in solving practical problems. 3. Understand various aspects of nano-technology and the processes involved in making nano Components and material. 4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.	
Module Name	**Content**	**No. of Hrs.**
Module1	Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy, Band Theory of Solids, Kronig-Penny Model. Brillouin Zones.	**10**
Module2	Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)	**10**
Module3	Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics.	**11**
Module4	Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation.	**11**
	Total No of Hours.	**42**
Text/ References	1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009 2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003 3. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998 4. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003	

APPENDIX-I

Mandatory Induction Program for Electronics and Communication 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 every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

1.3 Universal Human Values:

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, 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.

Appendix-II

Mandatory SSD Program for Electronics and Communication Engineering Branch

About the Course

"The graduates should be able to demonstrate the capability to participate in community-engaged services/ activities for promoting the well-being of society."

"The curricular component of 'community engagement and service'will involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems."

This course will enable students to learn about challenges faced by vulnerable households and develop an understanding of local wisdom and lifestyle respectfully. This well-designed community engagement course provides opportunities for immersion in rural realities. The student will appreciate rural lifestyles, understand their livelihoods, observe local institutions and governance, and conduct research-based activities. They will participate in social activities.

Credit

A credit is a unit by which the course work is measured. It determines the number of hours of instruction required per week over the duration of a semester.

For all students, this course is of 2credits, 60hours (theoretical and field-based activities).

A). Objectives

1. To promote awareness and appreciation of Uttarakhand's rich cultural heritage, including traditional arts, languages, and festivals, while integrating modern social values, rural culture, lifestyle and wisdom amongst students.
2. To apply classroom knowledge to field realities and thereby improving the quality of learning.
3. To engage students in community-based initiatives such as education, healthcare, and social welfare, addressing the specific needs of Uttarakhand's rural and hilly regions.
4. To equip students with skills necessary for sustainable livelihoods, such as eco-friendly agriculture, forest management, and tourism, aligned with Uttarakhand's environmental and economic landscape.
5. To foster environmental responsibility among students, encouraging them to contribute to the conservation of Uttarakhand's biodiversity, forests, and water resources.
6. To develop leadership skills in students, empowering them to take active roles in governance, policy-making, and regional development efforts in Uttarakhand.
7. To encourage practices that enhance physical fitness and mental health, emphasizing the connection between personal well-being and social development, especially in Uttarakhand's challenging terrain.
8. To inspire students to become entrepreneurs, particularly in areas like tourism, organic farming, and handicrafts, to boost the local economy while contributing to sustainable development in Uttarakhand.

B). Learning Outcomes

- After completing this course, students will be able to
- Gain an understanding of rural life, Indian culture and ethos and social realities
- Develop a sense of empathy and bonds of mutuality with the local community
- Appreciate significant contributions of local communities to Indian society and economy
- Learn to value the local knowledge and wisdom of the community

- Identify opportunities for contributing to community's socio-economic improvements
- Participate in social, local, state, and national activities.

C). Contents

The course is divided into two parts, A & B, with mandatory field immersion. The content, learning process and assessment criteria are presented below.

Part-A: Connect to Community

The students will visit a village of their convenience and perform the following activities.

S. No.	Course Content	Teaching-Learning Methods	Credits	Assessment
1.	Appreciation and understanding of Rural Society, local economy And livelihoods.	Classroom discussion and field visit	8 Hours	Map submission and Geo tagged Picture- based report.
2.	Functioning of Rural and Local Institutions	Classroom discussion and field visit	7 Hours	Written or audio-visual report with Geo-tagged photos.
3.	Evaluation of Rural and National Development Programmes	Classroom discussion and field visit. It can be conducted with the help of NGOs (registered).	15 Hours	Research-based written Report with Geo- tagged photos.

Part-B: Community Sensitization and Services

The students will participate in various activities organised by the department or intercollegiate/state- level, or national-level.

S. No.	Course Content	Teaching-Learning Methods	Credits	Assessment
1.	Social awareness activities organised under Swakchh Bharat, Ek Bharat Shrestha Bharat, Namami Gange etc.	Field-based	10 Hours	Suggestive report
2.	Participation in activities organized at the university inter collegiate, state.	Field-based	10 Hours	Participation certificate
3.	Participation in local issues and delivering valuable inputs for the welfare of society (heath-related, SDG, Environment related, yoga camp, Digital Literacy and Social Media awareness camp, Cyber Security, etc.).	Field-based	10 Hours	Suggestive report/ Participation certificate

A). Teaching and Learning Methods

A variety of methods of teaching should be deployed. Awareness in the classrooms, E-learning, and OER, self-paced learning by the students, which can be supplemented through discussions in the classroom and guided for assignment and report preparation. Proposed hours to be completed should be ensured.

B). Assessment

Reflections from field visits should be maintained by each student in a Field Diary. To award credits, the respective coordinators will assess assignments/reports submitted by the students. All students will be registered by the concerned department. The department will evaluate and verify that the students have completed the required hours to earn credits and share the details with the school coordinator for recording and issuing the certificate. The coordinators will inform the examination cell for the award of the degree