Tripura University

(A Central University)

Curriculum Structure For

B.Tech in Electronics and Communication Engineering

(3rd to 8thSemester)

2021

Curriculum Structure (Total Credit: 162)

COMMON SYLLABUS- FIRST SEMESTER

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Basic Science - 1	BS 101	Mathematics - I	3	1	0	4	4	100
2.	Basic Science - 2	BS 102	Physics	3	1	0	4	4	100
3.	Engineering Science - 1	ES 103	Basic Electrical Engineering	3	1	0	4	4	100
4.	Engineering Science - 2	ES 104	Engineering Graphics and Design	1	0	0	1	1	100
5.	Basic Science - 3	BS 105	Physics Laboratory	0	0	3	3	1.5	100
6.	Engineering Science - 3	ES 106	Engineering Graphics Practice	0	0	4	4	2	100
7.	Engineering Science - 4	ES 107	Basic Electrical Engineering Laboratory	0	0	2	2	1	100
8.	Mandatory Course - 1	MC 108	Induction Program	3 weeks in the beginning of the semester				0	100
			Total :	**10**	**3**	**9**	**22**	**17.5**	**800**

COMMON SYLLABUS- SECOND SEMESTER

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 1	HS 201	English	2	0	0	2	2	100
2.	Basic Science - 4	BS 202	Mathematics-II	3	1	0	4	4	100
3.	Basic Science - 5	BS 203	Chemistry	3	1	0	4	4	100
4.	Engineering Science - 5	ES 204	Programming for Problem Solving	3	0	0	3	3	100
5.	Engineering Science - 6	ES 205	Manufacturing Practices	1	0	0	1	1	100
6.	Humanities Science - 2	HS 206	Language Laboratory	0	0	2	2	1	100
7.	Basic Science - 6	BS 207	Chemistry Laboratory	0	0	3	3	1.5	100
8.	Engineering Science - 7	ES 208	Programming for Problem Solving Lab	0	0	4	4	2	100
9.	Engineering Science - 8	ES 209	Workshop on Manufacturing Practices	0	0	4	4	2	100
10.	Mandatory Course - 2	MC 210	Environmental Science	3	0	0	3	0	100
			Total :	**15**	**2**	**13**	**30**	**20.5**	**1000**

THIRD SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 2	HU 301	Effective Technical Communication	3	0	0	3	3	100
2.	Basic Science - 7	BS 302	Mathematics-III	2	1	0	3	3	100
3.	Basic Science - 8	BS 303	Biology for Engineers	2	0	0	2	2	100
4.	Engineering Science - 5	ES 304	Engineering Mechanics	2	1	0	3	3	100
5.	Program Core - 1	PC EC 305	Electronic Devices	3	1	0	4	4	100
6.	Program Core - 2	PC EC 306	Digital Electronics	4	0	0	4	4	100
7.	Program Core - 3	PC EC 307	Electronic Devices Lab	0	0	2	2	1	100
8.	Program Core - 4	PC EC 308	Digital Electronics Lab	0	0	2	2	1	100
9.	Program Core - 5	PC EC 309	Python Programming Lab	0	0	2	2	1	100
10.	Mandatory Course - 3	MC 310	Indian Constitution	2	0	0	2	0	100
			Total :	**18**	**3**	**6**	**27**	**22**	**1000**

FOURTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 3	HU 401	Engineering Economics and Accountancy	3	0	0	3	3	100
2.	Humanities Science - 4	HU 402	Universal Human Values-II: Understanding Harmony	2	1	0	3	3	100
3.	Program Core - 6	PC EC 403	Analog Circuits	3	1	0	4	4	100
4.	Program Core - 7	PC EC 404	Microprocessor & Microcontrollers	3	0	0	3	3	100
5.	Program Core - 8	PC EC 405	Electromagnetic Theory	3	0	0	3	3	100
6.	Program Core - 9	PC EC 406	Signals and Systems	4	0	0	4	4	100
7.	Program Core - 10	PC EC 407	Analog Circuits Lab	0	0	2	2	1	100
8.	Program Core - 11	PC EC 408	Microcontrollers Lab	0	0	2	2	1	100
9.	Program Core - 12	PC EC 409	Basic Simulation Laboratory	0	0	2	2	1	100
10.	Mandatory Course - 4	MC 410	Essence of Indian Knowledge Tradition	2	0	0	2	0	100
			Total:	**20**	**2**	**6**	**28**	**23**	**1000**

FIFTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science -5	HU 501	Professional Practice, Law and Ethics	2	0	0	2	2	100
2.	Program Core-13	PC EC 502	Digital System Design	3	0	0	3	3	100
3.	Program Core-14	PC EC 503	Control System Engineering	3	0	0	3	3	100
4.	Program Core-15	PC EC 504	Analog and Digital Communication	4	0	0	4	4	100
5.	Program Core-16	PC EC 505	Embedded Systemsand IOT	3	0	0	3	3	100
6.	Program Core-17	PC EC 506	Network Theory	3	0	0	3	3	100
7.	Program Core-18	PC EC 507	Digital System Design Lab	0	0	2	2	1	100
8.	Program Core-19	PC EC 508	Control System Engineering Lab	0	0	2	2	1	100
9.	Program Core-20	PC EC 509	Analog and Digital Communication Lab	0	0	2	2	1	100
10.	Summer Internship-1	SI EC 510	Industry Internship - I	*0*	*0*	*0*	*0*	*1*	100
			Total :	**18**	**0**	**6**	**24**	**22**	**1000**

SIXTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Core-21	PC EC 601	Microwave Engineering	3	0	0	3	3	100
2.	Program Core-22	PC EC 602	Fiber Optic Communication	3	0	0	3	3	100
3.	Program Core-23	PC EC 603	VLSI	3	0	0	3	3	100
4.	Program Core-24	PC EC 604	Digital Signal Processing	3	0	0	3	3	100
5.	Program Core-25	PC EC 605	Microwave and Fiber Optic Communication Lab	0	0	2	2	1	100
6.	Program Core-26	PC EC 606	VLSI Lab	0	0	2	2	1	100
7.	Program Core-27	PC EC 607	Digital Signal Processing Lab	0	0	2	2	1	100
8.	Program Elective-1 (Any One)	PE EC 608	1) Electronic Measurement and Instrumentation 2) Power Electronics 3) Bio Medical Engineering	3	0	0	3	3	100
9.	Project - 1	PR EC 609	Mini Project	0	0	6	6	3	100
			Total :	**15**	**0**	**12**	**27**	**21**	**900**

SEVENTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-2 (Any One)	PE EC 701	1) Wireless and Mobile Communication 2) Image Processing 3) Computer Networking	3	0	0	3	3	100
2.	Program Elective-3 (Any One)	PE EC 702	1) Information Theory and Coding 2) Audio Video Engineering 3) Artificial Neural Network	2	0	0	2	2	100
3.	Open Elective-1	OE EC 703	**Refer to Annexure-I**	3	0	0	3	3	100
4.	Open Elective-2	OE EC 704	**Refer to Annexure-II**	2	0	0	2	2	100
5.	Project - 2	PR EC 705	Project Work Intermediate	0	0	12	12	6	200
6.	Summer Internship-2	SI EC-706	Internship - II	0	0	0	0	1	100
7.	Seminar - 1	SE EC 707	Seminar on Contemporary Engineering Topics - I	0	0	2	2	1	100
			Total :	10	0	14	24	**18**	**800**

EIGHTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-4	PE EC 801	1) Satellite and RADAR Engineering 2) Nano Electronics 3) Fuzzy Logic and Its Applications	3	0	0	3	3	100
2.	Program Elective-5	PE EC 802	1) Antenna and Wave Propagation 2) Advanced VLSI 3) Introduction to Artificial Intelligence	2	0	0	2	2	100
3.	Open Elective-3	OE EC 803	**Refer to Annexure-III**	3	0	0	3	3	100
4.	Open Elective-4	OE EC 804	**Refer to Annexure-IV**	2	0	0	2	2	100
5.	Project - 3	PR EC 805	Project Work Final	0	0	12	12	6	200
6.	Seminar - 2	SE EC 806	Seminar on Contemporary Engineering Topics - II	0	0	2	2	1	100
7.	Online Course	SW EC 807	SWAYAM Courses	0	0	0	0	1	100
			Total :	10	0	14	24	**18**	**800**

Tripura University

(A Central University)

Curriculum Structure For

B.Tech in Electronics and

Communication Engineering

Third Semester

2021

THIRD SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 2	HU 301	Effective Technical Communication	3	0	0	3	3	100
2.	Basic Science - 7	BS 302	Mathematics-III	2	1	0	3	3	100
3.	Basic Science - 8	BS 303	Biology for Engineers	2	0	0	2	2	100
4.	Engineering Science - 5	ES 304	Engineering Mechanics	2	1	0	3	3	100
5.	Program Core - 1	PC EC 305	Electronic Devices	3	1	0	4	4	100
6.	Program Core - 2	PC EC 306	Digital Electronics	4	0	0	4	4	100
7.	Program Core - 3	PC EC 307	Electronic Devices Lab	0	0	2	2	1	100
8.	Program Core - 4	PC EC 308	Digital Electronics Lab	0	0	2	2	1	100
9.	Program Core - 5	PC EC 309	Python Programming Lab	0	0	2	2	1	100
10.	Mandatory Course - 3	MC 310	Indian Constitution	2	0	0	2	0	100
			Total :	**18**	**3**	**6**	**27**	**22**	**1000**

1. Effective Technical Communication (HS 301)

Course Code	HS 301
Course Title	Effective Technical Communication
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	1st year B.Tech
Course Category	Humanities Science (HS)
Number of classes	36 hours

Course Outcomes:

At the end of the course, the student will be able to -

CO Number	CO Description	K-level
CO-1	Explain the nature and objective of Technical Communication relevantfor the work place as Engineers	K2
CO-2	Apply the technical writing for the purposes of Technical Communication and itsexposure in various dimensions.	K3
CO-3	Builteffective verbal and non-verbal communication skills.	K3
CO-4	Analyze ethical, legal, cultural, and global issues affecting Technical Communication and Develop appropriate life skills.	K4

Module 1: Essentials of Communication(09 hours)

What is Communication, Process of Communication, Levels of communication, The flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group) Communication Barriers to communication, Non-verbal Communication, , Technology Enabled communication, Impact of Technology, Selection of appropriate communication Technology, Importance of Technical Communication, Differences between general and technical communication.

Module 2: Technical Writing Skills (09 hours)

Technical writing process – Choosing right words, phrases and sentence patterns, clarity of purpose, planning content, effective style of writing, formatting, proofreading.

Technical Reports & Proposals: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Writing of Reports & Proposals.

Business letters:Sales & Credit letters; Claim and Adjustment Letters; Letters of Enquiry, Order Placement letters.

Email Writing: Reasons for popularity; guiding principles for composition; some common pitfalls; maintaining common etiquette.

Module: 3 Workplace Communication (09 hours)

Applying for a job: Skimming advertisements; Writing job applications; Preparing CV, Resume.

Group Discussions: Group Discussion types; GD as a part of selection process; Key skills to succeed in group discussions; Dos and Don'ts of group discussions; Use of body language in GDs.
Job Interviews: Objectives; Types; Stages of Interview, Face to face Interviews; Telephonic Interviews.
Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; Visual aids in presentations; Power Point Presentations
Ethics in Communication: Communication challenges in culturally diverse workforce; Bias-free communication.

Module: 4 Developing soft skills/ Life Skills (09 hrs)

Introduction to soft skills: Soft skills as a competitive weapon in today's changing workplace.
Classification of soft skills: Time management, Attitude, Responsibility, Ethics & Values, self-confidence, Teamwork and Interpersonal skills, Problem solving skills.
Personality Development: Developing Right personality to enhance Life Skills, Personality types; Personality attributes; and Leadership Qualities.
Body Language: Emotions displayed by body language: Aggressive, Submissive, Attentive, Nervous, Upset, Bored, Relaxed, Defensive; Hand Shake; Eye Contact; Posture and Positioning.
Personality traits and soft skills in early stages of career advancement and for future career advancement.

LIST OF SOFTWARE/LEARNING WEBSITES

1. http://www.free-english-study.com/
2. http://www.english-online.org.uk/course.htm
3. http://www.english-online.org.uk/
4. http://www.talkenglish.com/
5. http://www.learnenglish.de/

***RECOMMENDED BOOKS*:**

1) Sanjay Kumar &Pushp Lata Communications Skills , 2nd Edition,Oxford University Press
2) Meenakshi Raman & Sangeeta Sharma Technical Communication: Principles & Practice Oxford University Press
3) Barun Kumar Mitra, Personality Development and Soft Skills Oxford University Press.
4) Personality Development, Harold R. Wallace & L. Ann Masters, Cengage Learning, NewDelhi.
5) Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
6) Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
7) Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, McGraw Hill & Co. Ltd., 2001, New Delhi.
8) A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
9) Skills for Effective Business Communication by Michael Murphy, Harward University, U.S

****

2. Mathematics-III (BS 302)

Course Code	BS 302
Course Title	Mathematics-III
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	B.Tech 1st Year Mathematics
Course Category	Basic Science (BS)
Number of classes	36 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Solve problems in 1st and 2nd order linear Partial Differential Equations	K3
CO-2	Apply Fourier series expansion of a given function and solve PDEs by variables separable method	K3
CO-3	Identify mean and variance of a given probability distribution	K3
CO-4	Solve numerically algebraic/transcendental equation and ordinary differential equations	K3

Course Content:-

Module 1: Partial Differential Equations (10 hours)

First order partial differential equations, solutions of first order linear and quasi-linear partial differential equation (Pp + Qq =R) by Lagrange method. Homogeneous and non-homogeneous type of second order linear differential equation with constant coefficients by complimentary function and particular integral method.

Module 2: Fourier series(08 hours)

Expansion of a function in Fourier series for a given range - Half range sine and cosine expansions. One-dimensional wave equation and one-dimensional heat flow equation - method of separation of variables - Fourier series solution.

Module 3: Probability (08 hours)

Classical and axiomatic definition of probability, conditional probability, Bayes' theorem, independent events, random variables, expectation and higher order moments, probability mass function and probability density function, distribution function, Sample space, Events, Random Variables; Definitions of probability, conditional Probability, examples of discrete and continuous distributions: Normal, Poisson, Binomial distributions.

Module 4: Numerical Analysis (10 hours)

Numerical solution of algebraic and transcendental equations by Regula-Falsi method Newton-Raphson's method; Finite Differences - Newton's Forward, backward difference interpolation formulae - Lagrange interpolation; Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8

rule; Solving first order differential equations –Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method of 4th order.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:-**

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 1965.
2. Rajnish Verma& H.K. Dass, Higher Engineering Mathematics, S Chand, 2014.
3. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993
4. Jain, Iyengar and Jain, Numerical methods for Scientific and Engineering Computation, New Age International Publications, 2008.
5. ErwynKreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition, 2008.

****

3. Biology for Engineers (BS-303)

Course Code	BS-303
Course Title	Biology for Engineers
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	-
Course Category	Basic Science (BS)
Number of classes	26 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Demonstrate the understanding of biology and its branches, major classifications of life, Cells, Cellular systems their functions and biological molecules.	K2
CO-2	Illustrate the molecular basis of genetic information and the flow of genetic information from DNA to RNA to protein and the concept of mutations, re-combinations and its applications.	K2
CO-3	Classify microorganisms, growth, nutrition with their various methods used for the isolation, identification, control and maintenance of microbial cultures.	K4
CO-4	Explain the fundamental principles of energy transactionsin physical and biological and physiological systems, basic metabolisms.	K2

Course Content:

Module 1: Introduction to Biology, Classification and Biomolecules (8 hours).

Detailed content of the module: Introduction to Biology and its branches. Molecular taxonomy- three major kingdoms of life. Prokaroytic and Eukaryotic cells. Energy and Carbon utilization. Cells: Animal and Plant cell structures and functions. Cell cycle and Cell division.Transport across cell membrane. Cell signaling.

Molecules of life. Monomeric units and polymeric structures. Sugars, starch and cellulose. Lipids, Amino acids and proteins. Nucleotides, DNAand RNA. Proteins- structure and function. Proteins as enzymes, transporters, receptors and structural elements. Enzyme classification. Mechanism of enzyme action. Enzyme kinetics.

Module 2: Fundamentals of genetics and flow of informations (6 hours)

Detailed content of the module: General principles of genetics, Concept of segregation and independent assortment.Molecular basis of information transfer, molecular basis of coding and decoding genetic information. DNA as genetic material. Concept of genetic code. Define gene in terms of complementation and recombination. Mutation. Recombinant DNA technology. Gene mapping. Application of recombinant DNA technology, recombinant products available in the market and at laboratory scale.

Module 3: Microbiology and applications (6 hours)

Detailed content of the module: Microorganisms and environment: Identification and classification of microorganisms. Ecological aspects of single celled organisms.Microbial integrations.Growth, nutrition and reproduction. Growth kinetics.Isolation and identification of microorganisms. Pure cultures and their characteristics. Maintenance of cultures. Sterilization.Physical and chemical methods of control of microorganisms. Management of toxic industrial wastes.

Module 4:Fundamentals of energy transaction and metabolism (6 hours)

Detailed content of the module: Thermodynamics –laws and its application in biological systems. Energy yielding and energy consuming biochemical processes.
Metabolism- Glycolysis & Krebs cycle, Role of ATP and concept of energy change.Equilibrium constant. Physiological steady-state, Living body as a thermodynamic system.
Fundamental aspects of analysis of living systems; quantitative aspects of physiology and engineering applications to clinical medicine based on body fluid balance, solute transport, basic endocrinology, reproduction physiology, neurophysiology, skeletal and smooth muscle physiology.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.;Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd. 12th Edition, 2020
2. Guyton and Hall, Medical Physiology, 14th Edition, Elsevier Saunders, 2020
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman andCompany.
4. Principles of Genetics, D. Peter Snustad and Michael J. Simmons. 7th Edition, Wiley Publisher, 2015
5. Prescott's Microbiology, Joanne Willey and Kathleen Sandman and Dorothy Wood, 2020. 11th Edition McGraw Hill

****

4. Engineering Mechanics (ES 304)

Course Code	ES 304
Course Title	Engineering Mechanics
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	10+2 Mathematics &Physics
Course Category	Engineering Science (ES)
Number of classes	36 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Differentiate coplanar, concurrent & non-concurrent forces and their resultants and confidently tackle equilibrium equationsand its applications.	K3
CO-2	Explain centroid of simple figures, centre of gravity, moment of inertia of composite sections & mass moment of inertia of circularplates, cylinder, cone, sphere & hook.	K2
CO-3	Analyze simple truss, compound truss, frame & virtual work.	K4
CO-4	Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, analyze D'Alembert's principle and differentiate longitudinal, transverse, torsional and damped vibrations.	K2

Course Content:-

Module 1: Fundamentals of Engineering Mechanics: (09 Hours)

Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particleequilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces,Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant ofForce System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium ofCoplanar Systems and Spatial Systems; Static Indeterminacy

Friction covering, Types of friction, Limiting friction, Laws of Friction, Static andDynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 2: Centre of Gravity & Moment of Inertia: (09 Hours)

Centroid and Centre of Gravity covering, Centroid of simple figures from first principle,centroid of composite sections; Centre of Gravity and its implications;
Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia,Moment of inertia of standard sections and composite sections; Mass moment inertia of circularplate, Cylinder, Cone, Sphere, Hook.

Module 3: Trusses, Frames & Virtual Work :(09 Hours)

Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections;Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zeroforce members; Beams & types of beams; Frames & Machines;

Virtual Work and Energy Method- Virtual displacements, principle of virtual work forparticle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems withfriction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational),energy equation for equilibrium. Applications of energy method for equilibrium. Stability ofequilibrium.

Module 4: Dynamics& Mechanical Vibrations :(09Hours)

Dynamics - Basic terms & General principles of dynamics, Types of motion, Instantaneous centre of rotation in plane motion, D'Alembert's principle and its application, Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

Vibration - Basic concepts of Longitudinal, Transverse and Torsional vibrations, Free & Forced vibration, Resonance and its effects, Damped vibration.

***TEXT BOOKS / REFERENCES*:**

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and RudraPratap (2011), Introduction to Statics and Dynamics, Oxford UniversityPress
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications
11. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education.
12. Bansal R.K. (2010), A Text Book of Engineering Mechanics by Laxmi Publications.
13. Irving, H.Shames, Engineering Mechanics-Statics and Dynamics, by Prentice-Hall of India.
14. Khurmi R. S. (2010), Engineering Mechanics, S. Chand & Co.
15. NPTEL web or video courses on Engineering Mechanics.
16. Timoshenko&D.H.Young, EngineeringMechanics, Tata McGraw-Hill publishing Co. Ltd.

****

5. Electronics Devices (PC EC 305)

Course Code	PC EC 305
Course Title	Electronics Device
Number of Credits	4 (L: 3, T: 1, P: 0)
Prerequisites	10+2 Physics
Course Category	Program Core
Number of classes	50 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Analyse the properties of semiconductor materials and application of semiconductor electronics	K4
CO-2	Analyse PN junctions in semiconductor devices under various conditions.	K4
CO-3	Analysethe fundamental physical processes of optoelectronic transitions and apply the concepts to different optoelectronic device	K4
CO-4	Explain current conduction mechanism of BJT.	K2
CO-5	Explain and utilize the mathematical models of MOS capacitor and MOS transistors.	K2

Course Content:

Module 1: Introduction to Semiconductor Physics (14 hours)

Free electron theory, Electron levels in a periodic potential, Bloch's theorem, Born-von Karman boundary condition, Kronig-Penny model (to introduce origin of band gap), Density of states and energy band diagrams, Direct and indirect bandgaps, Compound Semiconductor, Types of electronic materials: metals, semiconductors, and insulators, Concept of Effective mass.

Intrinsic and extrinsic semiconductors, Fermi Dirac Distribution, Concept of Fermi level, calculation of carrier density, Dependence of Fermi level on carrier concentration and temperature (equilibrium carrier statistics), Degenerate and nondegenerate semiconductor, Highly doping effect.

Module 2: PN Junction (14 hours)

Carrier transport: diffusion current, drift current, mobility and resistivity, design of resistors,Carrier generation and recombination, Carrier injection process, Poisson and continuity equation, P-N junction, Forward and reverse bias characteristics, concept of quasi fermi level. Transition and Diffusion Capacitances, Charge storage and Transient behavior, Drift and Diffusion current conduction mechanism in PN junction, I-V characteristics, Different breakdown Mechanism, Avalanche breakdown, Zener diode, Tunnel process, Tunnel Diode, Thermionics Emission process Metal-semiconductor junction (Ohmic and Schottky Junction).

Module 3: Light-semiconductor interaction (12 hours)

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission, Rate equations for carrier density, Radiative and non-radiative recombination mechanisms in semiconductors, concept of Phonons, Joint density of states, Density of states for photons, Electro Luminescence, Photo Luminescence, LED: device structure, materials, characteristics, Photodetector: device structure, materials, characteristics, Solar Cell: device structure, materials, characteristics.

Module 4: Transistor (10 hours)

BJT: Device structure, Operations, Early effect, Current equations, Input and Output characteristics of CE, CB, CC, Ebers Moll Model, Gummel Poon-model. MOS Device: Device structure, Accumulation, depletion and Inversion, CV characteristics of MOS device. MOSFET: Device Structure, Threshold voltage, IV characteristics, E-MOSFET, D-MOSFET

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
2. D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.
6. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. 1995.
7. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2007.
8. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley, 2008.
9. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India,1997.

****

6. Digital Electronics (PC EC 306)

Course Code	PC EC 306
Course Title	Digital Electronics
Number of Credits	4 (L: 4, T: 0, P: 0)
Prerequisites	Basic electronics
Course Category	Program Core (PC)
Number of classes	48 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain the number systems, code conversions and their applications.	K2
CO-2	Apply Boolean algebra and design & analyze combinational logic circuits using basic, Universal and derived gates	K3
CO-3	Construct modular combinational circuits with MSI devices like MUX/DEMUX, Decoder, Encoder etc	K3

CO-4	Analyze and design procedures for synchronous and asynchronous sequential circuits with FF's	K4
CO-5	Explain the concept of various interfacing circuits ex. Digital-to-Analog and Analog-to-Digital converters.	K2

Course Content:

Module 1: Number system and Boolean algebra (14 hours)

Introduction to number system and codes. Boolean algebra; Review of Boolean expression and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps, Queen Mccluskey method, Don't care conditions Binary codes, Boolean identities, basic logic functions, standard forms of logic expressions, simplification of logic expressions, AND, OR, NOT, NAND, NOR, X-OR & X-NOR gates.

Module 2: Combinational logic and Binary codes (12 hours)

Half adders, full adders, parallel adder, BCD adder, decoder, BCD to seven segment decoder, octal to binary encoder, decimal to BCD encoder, priority encoder, subtractors, multiplexers, de-multiplexers, comparators, parity bit checker/generator, Hazards in combinational circuits, weighted and non weighted codes, cyclic codes, Gray code, XS 3 code, error detecting and correcting codes, codes conversion.

Module 3: Sequential circuits and logic families (12 hours)

Latches and Flip Flops (SR, D, JK, T); Master-Slave JK FF, Edge triggered FF, Timing in sequential circuits; Shift register; Counters – synchronous, asynchronous; Sequential circuit design examples, brief overview of Transistor as a switch; Logic gate characteristics – propagation delay, speed, noise margin, fan-out and power dissipation; Standard TTL, ECL, RTL and static CMOS gates.

Module 4: Interface circuits (10 hours)

Digital to Analog converter (DAC) - weighted resistor method, R-2R ladder method; Analog to Digital converter (ADC) - parallel comparator method, counter method, successive approximation method, dual-slope method.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Mano M.M., Ciletti M.D., "Digital Design", Pearson India, 4th Edition.
2. Wakerly J.F., "Digital Design: Principles and Practices," Pearson India, 4th 2008 Edition.
3. Taub& Schelling - Digital Integrated Electronics – McGraw Hill International Edition.
4. Malvino& Leach - Digital Electronics and Circuit design — TMN.
5. Harris D., Harris S., "Digital Design and Computer Architecture", Elsevier Publications, 2nd 2007 Edition.

****

7. Electronics Devices Lab (PC EC 307)

Course Code	PC EC 307
Course Title	Electronics Device Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	10+2 Physics
Course Category	Program Core
Number of classes	20 – 24 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Analyze circuits in different biasing modes of PN junction	K4
CO-2	Analyze circuits in different breakdown mechanism of PN junction	K4
CO-3	Analyze IV characteristics of optoelectronics devices	K4
CO-4	Interpret different modes of BJT	K2

List of Experiments*(Minimum 6experiments to be performed). Use of virtual laboratory to perform few experiments may be exploredif available.*

1. To study and plot the IV Characteristics of P-N Junction Diode
2. To study and plot the IV Characteristics of Zener Diode
3. To study and plot the IV Characteristics of Tunnel Diode
4. To study and plot the Input and Output Characteristics of Transistor CE Configuration
5. To study and plot the Input and Output Characteristics of Transistor CB Configuration
6. To study and plot the Input and Output Characteristics of Transistor CC Configuration
7. To study and plot the characteristics of Light Emitting Diode
8. To study and plot the characteristics of Solar Cell
9. To study and plot the characteristics of Photo Diode

Design, Simulation and Implementation of following experiments using any TCAD Software

10. To study and analyze the CV characteristics of PN junction diode
11. To study and analyzation of doping effect on Built in potential, Depletion Width, junction Capacitance etc.
12. To study and plot the IV Characteristics of MOSFET
13. To study and plot the CV Characteristics of MOS Capacitor

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
2. D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M.Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, “Operation and Modeling of the MOS Transistor,” Oxford Univ. Press, 2011.
6. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. 1995.
7. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2007.

8. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley, 2008.
9. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India,1997.

****

8. Digital Electronics Lab (PC EC 308)

Course Code	PC EC 308
Course Title	Digital Electronics lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Basic electronics
Course Category	Program Core (PC)
Number of classes	20-24 hours

Course Outcome:

After studying the subject students will be able:

CO Number	CO Description	K-level
CO-1	Examine the truth table of different logic gates and verify the law of Boolean algebra.	K4
CO-2	Examine De Morgan's theorem.	K4
CO-3	Built various combinational circuits such as Half Adder, Full Adder, Half & Full Sub tractor, Different Code Converters.	K3
CO-4	Built and analyze Encoder, Decoder, Magnitude Comparator, Multiplexers, De-multiplexers.	K3
CO-5	Examinethe truth table different flip-flops and understand working of Shift Registers, counters, ADC's and DAC's.	K4

List of Experiments*(Minimum 6experiments to be performed). Use of virtual laboratory to perform few experiments may be exploredif available.*

1) Study of different basic digital logic gates and verification of their Truth Table
2) Study and verification of the law of Boolean Algebra and De-Morgan's Theorem
3) Construction and verification of various combinational circuits such as Half Adder, Full Adder, Half & Full Subtractor, Different Code Converters.
4) Construction and verification of Encoder, Decoder, Magnitude Comparator.
4) Study of Multiplexer, De-multiplexer.
5) Construction and verification of various types of Flip-Flops using gates and IC's
6) Construction and Verification of different Shift Registers.
7) Construction and verification of different types of Counters.
8) Study of different types of ADC and DAC.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Lab Manual.
2. Mano M.M., Ciletti M.D., "Digital Design", Pearson India, 4th Edition.
3. Wakerly J.F., "Digital Design: Principles and Practices," Pearson India, 4th 2008 Edition.

4. Taub& Schelling - Digital Integrated Electronics – McGraw Hill International Edition.
5. Malvino& Leach - Digital Electronics and Circuit design — TMN.
6. Harris D., Harris S., "Digital Design and Computer Architecture", Elsevier Publications, 2nd 2007 Edition.

****

9. Python Programming Lab (PC EC 309)

Course Code	PC EC 309
Course Title	Python Programming Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	ES 208(Programming for Problem Solving Lab)
Course Category	Program Core (PC)
Number of classes	20-24 hours

Course Outcome:
After studying the subject students will be able:

CO Number	CO Description	K-level
CO1	Demonstrate different number data types, number operations and input text file.	K2
CO2	Examine to create, concatenate and print a string, sub-string.	K4
CO3	Apply python script for various operations and create, append, and remove lists in python.	**K3**
CO4	Make use of tuples, directories and modules in python programs.	**K3**
CO5	Create python class for number operations and string.	**K6**

List of Experiments*(Minimum 6 experiments to be performed). Use of virtual laboratory to perform few experiments may be explored if available.*

1) Write a program to
   a) Demonstrate different number data types in Python.
   b) Perform different Arithmetic and Logical Operations on numbers in Python.
   c) Find largest of three numbers.
2) Write a Python program to
   a) Construct the given pattern, using a nested for loop.
   b) Find factorial of a number using Recursion.
3) Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.
4) Write a program to create, concatenate and print a string and accessing sub-string from a given string.
5) Write a python script to
   a) Print prime numbers less than 20,
   b) Print the current date in the format "Day Month DD hh:mm:ss IST yyyy".

6) Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be input and written to the second file.
7) Write a program to create, append, and remove lists in python.
8) Write a program to demonstrate working with tuples and dictionaries in python.
9) Write a python program to define a module to find Fibonacci Numbers and import the module to another program.
10) Write a Python class to convert an integer to a roman numeral, implement pow(x, n) and reverse a string word by word

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India
2. R. Nageswara Rao, "Core Python Programming", dream tech
3. Wesley J. Chun. "Core Python Programming - Second Edition", Prentice Hall
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Pyhon", Wiley
5. Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication

10. Indian Constitution (MC 310)

Course Code	MC 310
Course Title	Indian Constitution
Number of Credits	0 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Mandatory Course (MC)
Number of classes	25 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Explain about framing and nature of Indian Constitution.	K2
CO-2	Identify thefundamental rights and duties of individual and demonstrate the knowledge on Directive Principles of State Policy.	K3
CO-3	Outline the Federal Structure, Centre- State relation, Union Executive and Amendment Procedure	K2
CO-4	Demonstrate the meaning of local self govt., types of local self govt. in rural and urban areas.	K2

Course Content:

Module 1: Constitutional Framework(05 hours)

1. Meaning of Constitutional Law and Constitutionalism.
2. Historical perspective of the Constitution of India.

3. Salient features of the Constitution of India.

Module 2: Fundamental Rights, Duties and Directive Principles of State Policy(06 hours)

1. Fundamental Rights- Articles 14, 19 and 21.
2. Fundamental Duties.
3. Directive Principles of State Policy; Its Legal Status and Significance

Module 3: Nature of India's Political System(07 hours)

1. Federal structure, Distribution of Legislative and Financial Powers between the Union and States.
2. Parliamentary Form of Government- Powers and Position of President of India.
3. Emergency Provisions.
4. Amendment Procedures of the Constitution of India.

Module 4: Rural and Urban Local Self Govt. (07 hours)

1. 73rd Amendment of the Constitution and Panchayati Raj Institutions.
2. 74th Amendment of the Constitution and Urban Local Self Govt. (Municipal Corporation, Municipal Council and Nagar Panchayat).
3. TTAADC

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Fadia, B.L- "Indian Govt. and Politics "Sahitya Bhawan, Agra.
2. D.D.Basu- "An introduction to the Constitution of India"Lexis Nexis publishers.
3. M.V.Pylee- "Constitutional Govt. in India" S.Chand and Company Ltd.
4. S.C.Kashyap(ed)- "Perspectives on the constitution" Shipra Publication.
5. B.K. Sharma- "Introduction to the Constitution of India" Prentice Hall India Private Ltd.
6. Bhattacharya, D.C. and Banerjee, Malay- "Indian Govt. and Politics" Vijaya Publishing House
7. J.C. Johari- "Indian Govt. and Politics" (2 vols)
8. Das Nityananda- "Grassroot Democracy and Panchayati Raj in Tripura" Progressive Publishers

****

Tripura University
(A Central University)

Detailed syllabus for

B.Tech in Electronics and

Communication Engineering

Fourth Semester

2021

FOURTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Humanities Science - 3	HU 401	Engineering Economics and Accountancy	3	0	0	3	3	100
2.	Humanities Science - 4	HU 402	Universal Human Values-II: Understanding Harmony	2	1	0	3	3	100
3.	Program Core - 6	PC EC 403	Analog Circuits	3	1	0	4	4	100
4.	Program Core - 7	PC EC 404	Microprocessor & Microcontrollers	3	0	0	3	3	100
5.	Program Core - 8	PC EC 405	Electromagnetic Theory	3	0	0	3	3	100
6.	Program Core - 9	PC EC 406	Signals and Systems	4	0	0	4	4	100
7.	Program Core - 10	PC EC 407	Analog Circuits Lab	0	0	2	2	1	100
8.	Program Core - 11	PC EC 408	Microcontrollers Lab	0	0	2	2	1	100
9.	Program Core - 12	PC EC 409	Basic Simulation Laboratory	0	0	2	2	1	100
10.	Mandatory Course - 4	MC 410	Essence of Indian Knowledge Tradition	2	0	0	2	0	100
			Total:	20	2	6	28	**23**	**1000**

1. Engineering Economics and Accountancy(HS 401)

Course Code	HS 401
Course Title	Engineering Economics and Accountancy
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	10+2
Course Category	Humanities Science (HS)
Number of classes	38 hours

Course Outcomes:

At the end of the course, the student will be able to

CO Number	CO Description	K-level
CO-1	Explain the importance of engineering economics in business.	K2
CO-2	Explain the necessary knowledge and skills for running a business organization.	K2
CO-3	Explain the financial statement and position of an organization.	K2
CO-4	Analyze the accounting information for decision making.	K4
CO-5	Built theknowledge & skill on business and management.	K3

Course Content:

Module 1: Engineering economics (9 hours)

Engineering economy and its importance; Demand& supply: Wants, satisfaction of wants, demand, supply, elasticity of demand, estimation of demand, supply chain economy; Production-Factors of production (land, labor, capital, and entrepreneurship), Laws of return. Money – Value of money, quantity theory; inflation and deflection.

Module 2: Business Skills for Engineers (9 hours)

Business Structure: Proprietorship, Partnership and Joint Stock Company; Basic management for **businesses:** Basic functions of management, Risk Management: Type of risk, Risk management steps; Entrepreneur and Leadership: Leadership styles, Qualities of a good leader for a business; Financing and the business: Objectives and sources of funds; Taxation: Basics of Income tax & Goods and Services Tax (GST).

Module 3: Financial Accounting for Business (10 hours)

Transactions: Financial event, Features of transactions; Recording of transactions; Basic accounting: Ledger, Trail balance, Cash book (double column only); Final account: Objectives, Preparation of final accounts (Trading A/C, Profit & Loss A/C and Balance Sheet).

Module 4: Managerial Accounting for Decision-making (10 hours)

Cost classifications – Material cost control, labor cost control and overhead cost control (only theory); Cost sheet: Objective and preparation of Cost sheet (Basic problem); Capital budgeting: Objectives Pay-back period and NPV method for feasibility testing of investment Working capital management: Factors and sources of WC; Ratio analysis: Interpretation for industrial control, Basic ratios- Current Ratio, Debt-equity ratio, profit ratio.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Fundamentals of Engineering Economics, 4th Edition, by Chan S. Park, Pearson Publishing;
2. Engineering Economics And Financial Accounting Paperback, by Arasu, Scitech publication
3. Engineering Economics and Financial Accounting for Anna University Paperback by A. Bagad,Technical Publications;
4. Financial Management- An analytical framework , Nayak& Manna, Parul Library;
5. Principles of Management, Ghose and Basu,ABS Publishing House;

****

02. Universal Human Values-II: Understanding Harmony (HU-402)

Course Code	HU-402
Course Title	Universal Human Values-II: Understanding Harmony
Number of Credits	3(L: 2, T: 1, P: 0)
Prerequisites	Induction Programme and Universal Human Values -I
Course Category	Humanities Science (HS)
Number of classes	36 hours

Course Outcome:

At the end of the course, the student will be able to

CO Number	CO Description	K-level
CO-1	Explain the term self-exploration and its application for self-evaluation and development.	K2
CO-2	Identify the holistic perception of harmony at level of self, family, society, nature and explain it by various examples.	K3
CO-3	Illustrate the role of a human being in ensuring harmony in society and nature.	K2
CO-4	Distinguish between ethical and unethical practices, and start identifying a strategy to actualize a harmonious environment wherever they work.	K4

Module1: (08 Hours)

Course Introduction-Need, Basic Guidelines, Content and Process for Value Education

Self-Exploration – what is it? Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Module2: (10Hours)

Understanding Harmony in the Human Being

Understanding human being as a co-existence of the sentient 'I'and the material 'Body'. Understanding the needs of Self ('I') and 'Body'-happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding values in human-human relationship; meaning of Justice(nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention andcompetence. Understanding the harmony in the society (society being an extension offamily):Resolution, Prosperity, fearlessness (trust) and co-existence ascomprehensiveHumanGoals

Module 3: (08 Hours)

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

Module4: (10Hours)

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Competenceinprofessionalethics:

a) Ability to utilize the professional competence for augmenting universal human order.
b) Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,
c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

REFERENCEBOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, GPB agaria, Excel Books, New Delhi,2010.
2. JeevanVidya:Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.

3. HumanValues,A.N.Tripathi,NewAgeIntl.Publishers,NewDelhi,2004.
4. The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi.
5. Bharat Mein Angreji Raj-Pandit Sunderlal
6. Re-discovering India-by Dharampal
7. Hind Swarajor Indian HomeRule- by MohandasK.Gandhi
8. India Wins Freedom-Maulana Abdul Kalam Azad
9. Vivekananda-Romain Rolland(English)
10. Gandhi-Romain Rolland(English)

****

3. Analog Circuits (PC EC 403)

Course Code	PC EC 403
Course Title	Analog Circuits
Number of Credits	4 (L: 3, T: 1, P: 0)
Prerequisites	Basics of Electronics Devices
Course Category	Program Core (PC)
Number of classes	48 hours

Course Outcome:

At the end of this course students will demonstrate the ability to:

CO Number	CO Description	K-level
CO-1	Construct various diode circuits and amplifier models.	K3
CO-2	Construct and analyze high frequency transistor models.	K3
CO-3	Explain sinusoidal and non-sinusoidal oscillators	K2
CO-4	Explain the functioning of OP-AMP and design OP-AMP based circuits.	K2
CO-5	Construct ADC and DAC circuits.	K3

Module- 1: Diode Circuits, Amplifier models (14 hours)

Diode Circuits:clipper, clamper P-N Junction as a rectifier, Half wave rectifier, Full wave rectifier, Bridge rectifier. Harmonic components in a rectifier circuit, Inductor filter, Capacitor filter, L-section filter, π- section filters and comparison of various filter circuits, Voltage regulation using zener diode, voltage multipliers circuit.
Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

Module 2: High Frequency Transistor Models (10 hours)

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascade amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Module- 3: Oscillators and Differential Amplifiers (12 hours)

Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load.
Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

Module-4: OP-AMP applications (12 hours)

Review of inverting and non-inverting amplifiers, integratorand differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications.
Active filters: Low pass, high pass, band pass and band stop, design guidelines. Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistorstring etc. Analogto-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.
Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

***TEXT/REFERENCE BOOKS*:**

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11
5. Publishing, Edition IV 6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

****

4. Microprocessor and Microcontrollers (PC EC 404)

Course Code	PC EC 404
Course Title	Microprocessor and Microcontrollers
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Digital Electronics
Course Category	Program Core (PE)
Number of classes	38 hours

Course Outcome:

At the end of this course students will demonstrate the ability to:

CO Number	CO Description	K-level
CO-1	Explain the architecture of 8085 and 8051 Microcontroller.	K2
CO-2	Apply the knowledge of Assembly level language to write the programming in 8085 and 8051.	K3
CO-3	Classify the different addressing mode of the Assembly level instructions.	K4

CO-4	Explain the concept of machine cycle and Timing diagram.	K2
CO-5	Demonstrate interfacing method of the various programmable peripheral devices with the 8085 and 8051.	K2
CO-6	Make use of external code and data memory for interfacing various external unit/devices with 8051.	K3

Course Content:

Module 1: Architecture of 8085 (9Hrs.)

Introduction to 8085A CPU, architecture-register organization, addressing modes and their features. Pin description and features and Reset Operation of 8085 Microprocessor. Software instruction set and Assembly Language Programming. Instruction cycle, machine cycle, Timing diagram, Bus Idle Machine Cycle & INA Machine Cycle.

Module 2: Interrupt and peripheral (10 Hours.)

Hardware Interfacing: Interfacing of memory, peripheral chips (IO mapped IO & Memory mapped IO).Interrupts of 8085 Microprocessor: Software Interrupts, Hardware Interrupts & Vectored Interrupts.Peripherals: 8255PPI, 8251Usart and 8253/ 8254 Timer/ Counter. Synchronous, Asynchronous, Interrupt driven and DMA Modes of Date Transfer Techniques.

Module 3: Architecture of 8051 (9 Hours.)

Introduction to 8051 Micro-Controller, its Architecture and Pin Configurations.Registers, Timers Counters, Flags, Special Function Registers, DPTR, PC, PSW, SP Internal RAM &ROM, Input/ Output pins, Ports, Serial Data Input/ Output.
Interrupts:- Different Modes of Interrupts of 8051 Micro-controller.

Module 4:8051 Assembly Programming and Interfacing Techniques: (10 Hours.)

Simple 8051 Micro-Controller based Assembly Level Language programming, Assembling and running an 8051 program. Addressing modes and accessing memory using various addressing modes. Instruction Set of 8051 Micro Controller and programming, Single bit instructions and programming, Timer/counter programming in the 8051Micro-Controller.
Interfacing Techniques of External Memory units, Peripheral Devices, Analog to Digital & Digital Converters with 8051 Micro-controller.

***REFERENCES*:**

1) Microprocessor architecture, programming and applications with 8085/8085A, Wiley eastern Ltd, 1989 by Ramesh S. Gaonkar.
2) Intel Corp: The 8085 / 8085A. Microprocessor Book – Intel marketing communication, Wiley inter science publications, 1980.
3) Advanced Microprocessors by Ray and Bhurchandi - TMH
4) Intel Corp. Micro Controller Handbook – Intel Publications, 1994.
5) Assembly Language Programming the IBM PC by Alan R. Miller, SubexInc, 1987
6) Textbook On Microprocessor Based Laboratory Experiments And Projects, A. K. Mukhopadhyaya, Wheeler Publishing
7) Fundamentals Of Microprocessors And Microcomputers, B. Ram, Dhanpat Rai
8) Advanced Microprocessors and Interfacing, B. Ram, TMH.
9) 8051 Microcontroller & Embedded systems By Madizi M.A.

****

5. Electromagnetic Theory (PC EC 405)

Course Code	PC EC 405
Course Title	Electromagnetic Theory
Number of Credits	3 (L: 3, T:0 ,0: 0)
Prerequisites	10+2 Physics
Course Category	Electronics and Communication Engineering
Number of classes	38 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Analyze fields a potentials due to static changes	K4
CO-2	Analyze static magnetic fields	K4
CO-3	Explain how materials affect electric and magnetic fields	K2
CO-4	Illustrate the relation between the fields under time varying situations	K2
CO-5	Explain the principles of propagation of uniform plane waves.	K2

Course Content:-

Module- 1: STATIC ELECTRIC FIELD (12 hours)

Introduction to Different Co-ordinate System, Introduction to line, Surface and Volume Integrals, Curl, Divergence and Gradient, Stokes theorem and Divergence theorem,

Electric Field: Coulomb's Law, Electric Field Intensity, Electric Field due to charges distributed uniformly on an infinite and finite line, Electric Field on the axis of a uniformly charged circular disc, Electric Field due to an infinite uniformly charged sheet.
Electric Scalar Potential, Relationship between potential and electric field, Potential due to infinite uniformly charged line, Potential due to electrical dipole, Electric Flux Density, Gauss Law and its Applications. Electric field in multiple dielectrics, Boundary conditions, Poisson's and Laplace's equation, Capacitance

Module- 2:STATIC MAGNETICFIELD (10 hours)

Lorentz force, magnetic field intensity (H), Biot-Savart's Law, Ampere's Circuit Law, H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B), B in free space, Magnetic materials, Magnetization, Magnetic field in multiple media, Boundary conditions, scalar and vector potential, Determination of Self Inductance of a Solenoid and Toroid and Mutual Inductance Between a Straight, Long Wire and a Square Loop Wire in the Same Plane, Energy Stored and Intensity in a Magnetic Field.

Module- 3:TIME VARYING ELECTRIC AND MAGNETIC FIELDS (8 hours)

Faraday's Law of Electromagnetic Induction, Statically and Dynamically Induced E.M.F, Transformers and mutual induction, Continuity equation for steady and time varying current. Displacement current, Establishing Maxwell's equations from different laws of Electric & magnetic fields. ampere's law and it's inconsistency for time varying fields

Maxwell's four equations in integral form and differential form. Maxwell's equation in point form.

Poynting Vector and the flow of power, Power flow in a co-axial cable, Instantaneous Average and Complex Poynting Vector.

Module- 4: ELECTROMAGNETIC WAVES (8 hours)

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material.

Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect.

Linear, Elliptical and circular polarization, Wave propagation in dielectrics and conductors, normal incidence, Oblique incidence, Snell's law, and total internal reflection.

REFERENCES/ SUGGESTED LEARNING RESOURCES:-

TEXT BOOKS:-

1. W H.Hayt& J A Buck : "Engineering Electromagnetics" TATA McGraw-Hill,
2. E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems." Pearson Education/PHI

REFERENCES:-

1. Matthew N.O.Sadiku: "Elements of Engineering Electromagnetics" Oxford University Press.
2. Narayana Rao, N : "Elements of Engineering Electromagnetics" Pearson Education, New Delhi.
3. Ramo, Whinnery and Van Duzer: "Fields and Waves in Communications Electronics" John Wiley & Sons.
4. G.S.N. Raju, Electromagnetic Field Theory & Transmission Lines, Pearson Education.

****

6. Signal and Systems (PC EC 406)

Course Code	PC EC 406
Course Title	Signal and Systems
Number of Credits	4 (L: 4, T: 0, P: 0)
Prerequisites	Electrical Circuits, Basic Mathematics
Course Category	Electronics & Communication Engineering
Number of classes	48 hours

Course Outcome:

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

CO Number	CO Description	K-level

CO-1	Identify different types of signals and systems.	K3
CO-2	Make use of different operation on signal.	K3
CO-3	Make use of Fourier transform for frequency analysis	K3
CO-4	Solve the problems with Laplace and Z-transform and their inverses	K3
CO-5	Explain Sampling theorem.	K2
CO-6	Interpret random signals and systems	K2

Course Content:

Module 1: Introduction to Signal and Systems(12 hours)

Introduction to signal and systems: Continuous and discrete time signals: Classification of Signals – Periodic aperiodic even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals – periodicity –unit impulse – unit step – Transformation of independent variable of signals: time scaling, time shifting. System properties: Linearity, Causality, time invariance and stability. Dirichlet's conditions, Determination of Fourier series coefficients of signal.

Module 2:Signal Transformation (12 hours)

Signal Transformation: Fourier transformation of continuous and discrete time signals and their properties. Laplace transformation- analysis with examples and properties. Parseval's theorem; Convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems.

Module 3: Laplace and Z- Transform(12 hours)

Laplace Transform: Recapitulation, Analysis and characterization of LTI systems using Laplace transform: Computation of impulse response and transfer function using Laplace transform.
Z-Transforms: Basic principles of z-transform - z-transform definition –, Relationship between z-transform and Fourier transform, region of convergence – properties of ROC – Properties of z-transform – Poles and Zeros – inverse z-transform using Contour integration - Residue Theorem, Power Series expansion and Partial fraction expansion.

Module 4: Sampling of signals(12 hours)

Sampling Theorem: Representation of continuous time signals by its sample –Types of sampling, Sampling theorem. Reconstruction of a Signal from its samples, aliasing –sampling of band pass signals.

Random Signals & Systems: Definitions, distribution & density functions, mean values & moments, function of two random variables, concepts of correlation, random processes, spectral densities, response of LTI systems to random inputs.

***REFERENCES*:**

1) Signals and Systems by Tarun kumar Rawat.
2) Circuits and Systems: A Modern Approach" by A. Papoulis
3) Signals and Systems: Continuous and Discrete" by R.F. Ziemer, W.H. Tranter and D.R. Fannin.
4) Signals and Systems" by A.V. Oppenheim, A.S. Willsky and I.T. Young.

5) Signals and Systems : Pearson New International Edition" by Alan V Oppenheim, S. Hamid, Alan S. Willsky.
6) Problems and Solutions in Signals and Systems" by R. Gopal.
7) Continuous and Discrete Signals and Systems" by Samir S. Soliman, Mandyam D. Srinath

****

7. Analog Circuits Lab (PC EC 407)

Course Code	PC EC 407
Course Title	Analog Circuits Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Basics of electronics devices
Course Category	Program Core (PC)
Number of classes	20 - 24 hours

Course Outcome:

At the end of this course students will demonstrate the ability to:

CO Number	CO Description	K-level
CO-1	Construct and analyze different rectifier circuits using diode.	K2
CO-2	Explain the knowledge of transistor biasing methods.	K2
CO-3	Construct and analyze different op-amp circuits.	K3
CO-4	Analyze transistorized Phase shift, Wein-bridge , Hartley, Collpit oscillators	K4
CO-5	Analyze the output of Class A Power Amplifier (Transformer less), Class B Complementary Symmetry Amplifier.	K4

Course Content:

List of Experiments*(Minimum 6 experiments to be performed). Use of virtual laboratory to perform few experiments may be explored if available.*

1. Study of diode rectifier circuits (half wave, full wave, bridge rectifiers without filters and with filters).
2. Study of transistor biasing methods for BJT (CE, CB, CC).
3. Study of transistor biasing methods for FET (CS, CG, CD).
4. OP AMP Applications as Adder, Subtractor, Comparator Circuits.
5. Integrator and Differentiator Circuits using IC 741
6. Schmitt Trigger Circuits using IC 741.
7. IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.
8. Study of Transistorized oscillators – Phase shift
9. Study of Class A Power Amplifier (Transformer less).
10. Study of Class B Complementary Symmetry Amplifier.

***TEXT/REFERENCE BOOKS*:**

1. Lab Manual
2. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and

applications, McGraw Hill, 1992.
3. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
4. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
5. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11
6. Publishing, Edition IV 6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

****

8. Microcontrollers Lab (PC EC 408)

Course Code	PC EC 408
Course Title	Microprocessor and Microcontrollers
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Digital Electronics
Course Category	Program Core (PE)
Number of classes	20- 24 hours

Course Outcome:-
After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Explain the execution of program in Assembly level languages of 8085 microprocessors and 8051 microcontroller using hardware kit and software tools.	K2
CO-2	Interpret the generation of waveform using DAC by interfacing with 8051.	K2
CO-3	Demonstrate the BCD to Binary Conversion and vice-versa.	K2
CO-4	Illustrate Binary to ASCII conversion and vice-versa (Using Subroutine Call)	K2
CO-5	Built Traffic Light Controller using 8085 microprocessors and 8051 microcontroller based system.	K6

List of Experiments*(Minimum 8experiments to be performed).Use of virtual laboratory to perform few experiments if available may be explored.*

1. Execution of Assembly level languages program to perform Arithmetic operation.
2. Execution of Assembly level languages program to perform Logical operation.
3. Execution of Assembly level languages program to find out largest, smallest number from a group of number.
4. Execution of Assembly level languages program to find larger, smaller number from two numbers, to find out negative number, to count negative number from a data array.
5. Execution of assembly level language program for sorting of data array in ascending and descending order.
6. BCD to Binary Conversion and vice-versa.
7. Familiarization with 8051 Simulator on PC. Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical).
8. Different waveforms generation using 8051 microcontroller based DAC.
9. Binary to ASCII conversion and vice-versa (Using Subroutine Call)
10. Design Traffic Light Controller using 8051 microcontroller based system.

***REFERENCES*:**

References / Suggested Learning Resources:-

1. Bhurchandi and Ray, Advanced Microprocessors and Peripherals, Third Edition McGraw Hill.
2. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design,Pearson Education.
3. Douglas V. Hall, SSSP Rao, Microprocessors and Interfacing, Third Edition, McGrawHill Education.
4. Barry B. Brey, The Intel Microprocessors – Architecture, Programming and Interfacing, Eigth Edition, Pearson Education.
5. A. NagoorKani, Microprocessors and Microcontrollers, Second Edition, Tata McGraw Hill.

****

9. Basic Simulation Laboratory (PC EC 409)

Course Code	PC EC 409
Course Title	Basic Simulation Laboratory
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Engineering Mathematics
Course Category	Program Core
Number of classes	20-24 hours

Course Outcome:

On completion of the course the students shall be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate the creation of arrays and matrices and perform simple matrix operations.	K3
CO-2	Experiment with the arithmetic, trigonometric and logical operations on matrices	K3
CO-3	Interpret the different string operations on a string.	K2
CO-4	Illustrate script-file and function files for different operations	K2
CO-5	Demonstrate the knowledge of basic plotting functions.	K2
CO-6	Apply knowledge of Simulink to design simple circuits	K3

Course Content:

List of experiments: (Minimum 6 experiments to be performed). Use of virtual laboratory to perform few experiments if available may be explored.

1. Create 1-D arrays and matrices of given size and perform arithmetic operations- Addition, Subtraction, Multiplication and Exponentiation.
2. Perform matrix operation to obtain Obtaining Modified Matrix - Inverse, Transpose, with Appended and Deleted Elements.
3. Create a matrix of given size and perform matrix manipulation operation Concatenating, Indexing, Sorting, Shifting,
4. Perform matrix operation for Reshaping, Resizing and Flipping about a Vertical Axis / Horizontal Axis
5. Create a matrix of given size and perform trigonometric, relational and logical operations.
6. Create a matrix of given size and demonstrate the operation of various built-in functions like sum,

cumulative sum, standard deviation, product, cumulative product etc.
7. Generate a string and perform various string operation
8. Write script files for simple arithmetic and logical operations.
9. Write function files for user-defined operations
10. Perform basic plotting, plot multiple graphs in a plot, demonstrate the use of sub-plot command, stylize the plots. Illustrate A Rectangular Plot, (B).A Semi log Plot,(C).A log-log Plot.
11. Model simple circuits, equations using simulink
12. Createa Structure, An Array of Structures and Write Commands toaccess the elements of the created structure and array of structures.

***REFERENCES/ SUGGESTED LEARNING RESOURCES*:-**

1. MATLAB: A Practical Introduction to Programming and Problem Solving : Stormy Attaway
2. MATLAB For Dummies : Jim Sizemore
3. MATLAB for Beginners: A Gentle Approach : Peter I. Kattan
4. A Guide to MATLAB®: For Beginners and Experienced Users : Hunt, Lipsman, Rosenburg
5. MATLAB Programming for Engineers : Stephen Chapman

Suggested software/learning websites:

1. MATLAB,SCILab,Octave
2. MIT Open Courseware
3. NPTEL
4. MATLAB Online

****

10. Essence of Indian Knowledge Tradition (MC-410)

Course Code	MC-410
Course Title	Essence of Indian Knowledge Tradition
Number of Credits	0 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Mandatory Course (MC)
Number of classes	26

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Outline Vedic literature, Puranic Literature and other ancient knowledge tradition of India.	K2
CO-2	Explain about scientific heritage of ancient India along with comprehending its relevance and application in various modern scientific disciplines.	K2
CO-3	Demonstrate Indian Philosophical systems with a conscious emphasis on their relevance and application in modern scientific enquiry.	K2
CO-4	Illustrate Indian Linguistic tradition along with its branches.	K2

CO-5	Critically analyse the worth of Indian intellectual heritage, traditional practices and Indian lifestyle from scientific lenses.	K4

Course Content:

Module 1: Introduction to Vedic Literature, Dharmaśāstra and Purāṇas (08 hours)

General structure of Vedic Literature, Different theories on the age of the Vedas, Educational system in the Vedic times, Subject-matter of Ṛgveda-samhitā, *Sāmaveda -Saṁhitā, Yajurveda-Saṁhitā, Atharvaveda-Saṁhitā, Brāhmaṇa*and *Āraṇyaka* literature, Upaveda, Vedāṅga Literature, History of Dharmaśāstra, Basic concepts of *Purāna*s.

Module 2: Indian Knowledge System, Yoga and Health care (06 hours)

Origin and Development of Indian Knowledge System, Concept of Dharma in Indian knowledge tradition, General ideas about Yoga, Origin and Development of Pātañjala Yoga, Origin and Development of Āyurveda and its relevance

Module 3: Introduction to Indian Philosophy (06 hours)

General introduction to Indian Philosophical systems, i.e. Orthodox and Heterodox, Concept of *Puruṣārtha*s in Indian Philosophy, General introduction of Upaniṣadic literature, Indian Philosophy and Modern Science, Principles in different philosophical systems, Relevance of Indian Philosophy in Modern time

Module 4: Indian Linguistic and Artistic Tradition (06 hours)

Origin and Definition of Language, Branches and aspects of Science of language, Vedic and Classical Sanskrit, Indo-European family of Language, Role of Sanskrit in comparative Philology, Sanskrit Phonology and Phonetic laws, History of Sanskrit Grammar, Introduction to Śikṣā literature , Origin and Development of Artistic tradition

REFERENCES / SUGGESTED LEARNING RESOURCES :

1) Capra, Fritjof. *The Tao of Phisics*. New York: Harpercollins, 2007.
2) Capra, Fritjof. *The Web of Life*. London: Harpar Collins Publishers, 1996.
3) Chaitanya, Krishna. *Arts of India*, Abhinav Publications, 1987.
4) Chatterjee, S.C &Datta, D.M. *An Introduction to Indian Philosophy*, Calcutta: University of Calcutta, 1984.
5) Cowell, E.B and Gough. A.E (Ed.), *Sarvadarśanasaṅgraha*. Sadguru Publications, 2008.
6) Dasgupta, Surendranath& De, Sushil Kumar. *A History of Sanskrit Literature.*Delhi: MotilalBanarsidass, 2017.
7) Dasgupta, Surendranath. *A History of Indian Philosophy*. Delhi: MotilalBanarsidass, 1991.
8) GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*,VidyanidhiPrakashan, Delhi 2016.
9) Gonda, Jan. *A History of Vedic Literature*. Delhi: Monohar Publishers and Distributors, 2020.
10) Jha, R.N. *Science and Consciousness Psychotherapy and Yoga Practices*. Delhi: VidyanidhiPrakashan, 2016.
11) Jha, V.N. Language, *Thought and Reality*.
12) Kane. P.V. *History of Dharmasastra*, Poona: Bhandarkar Oriental Research Institute, 1930.
13) Knowledge traditions and practices of India, CBSE Publications.

14) Max Muller. *Ancient Sanskrit Literature*, London: Spottiswoode and Co., 1859.
15) Nagaswamy, R. *Foundations of Indian Art*, Tamil Arts Academy, 2002.
16) Pride of India, New Delhi: Samskrita Bharati, 2006.
17) Shastri, Gourinath. *A History of Vedic Literature*, Kolkata: Sanskrit Pustak Bhandar, 2006.
18) Sinha, Jadunath. *Indian Philosophy*. Delhi: Motilal Banarsidass,1938.
19) Subrahmanialyer,K.S. *Vakyapadia of Bhrarthrihari*. Pune: Deccan College, 1965.
20) V. Sivarama krishnan (Ed.), *Cultural Heritage of India-course material*. Mumbai: Bharatiya Vidya Bhavan, 5th Edition, 2014.
21) Wujastiyk, Dominik. *The Roots of Ayurveda*. India: Penguin India, 2000.

****

Tripura University
(A Central University)

Detailed syllabus for

B.Tech in Electronics and

Communication Engineering

(Fifth Semester)

2021

FIFTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science -5	HU 501	Professional Practice, Law and Ethics	2	0	0	2	2	100
2.	Program Core-13	PC EC 502	Digital System Design	3	0	0	3	3	100
3.	Program Core-14	PC EC 503	Control System	3	0	0	3	3	100
4.	Program Core-15	PC EC 504	Analog and Digital Communication	4	0	0	4	4	100
5.	Program Core-16	PC EC 505	Embedded Systemsand IOT	3	0	0	3	3	100
6.	Program Core-17	PC EC 506	Network Theory	3	0	0	3	3	100
7.	Program Core-18	PC EC 507	Digital System Design Lab	0	0	2	2	1	100
8.	Program Core-19	PC EC 508	Control System Lab	0	0	2	2	1	100
9.	Program Core-20	PC EC 509	Analog and Digital Communication Lab	0	0	2	2	1	100
10.	Summer Internship-1	SI EC 510	Industry Internship - I	0	0	0	0	1	100
			Total :	18	0	6	24	**22**	**1000**

1. Professional Practice, Law and Ethics(HS 501)

Course Code	HS 501
Course Title	Professional Practice, Law & Ethics
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	10+2
Course Category	Humanities Science (HS)
Number of classes	26 hours

Course Outcome:-

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

CO Number	CO Description	K Level
CO 1	Develop ideas of the professionalism, values and ethics in a profession	K3
CO 2	Develop a good insight into contracts and contracts management in engineering, arbitration anddispute resolution mechanisms	K3
CO 3	Interpret laws governing engagement of labour in construction related works and other related areas	K2
CO 4	Demonstrate an understanding of Intellectual Property Rights and Patents	K2

Course Content:

Module1: Professionalism, Values and Ethics in Profession (06 hours)

Professionalism: Professional characteristics, professional education, professional development in Industry. Values and Ethics in Profession- Value system- goodness, means and ends; Ethics-ethical premises, expectation, conflicts and practices; Moral and ego,Ethics and morality

Right, virtue ethics and justice, utility and justice, privacy, challenges to privacy, privacy on the Internet.

ProfessionalEthics–Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures.

Module2: General Principles of Contracts Management and Arbitration (10 hours)

Indian ContractAct,1972 and amendments covering General principles of contracting; Valid & Voidable Contracts; Prime and Subcontracts Tenders, Request For Proposals, Bids &Proposals; Bid Evaluation; Cost escalation; Delays, Suspensions &Terminations; Time extensions &Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance &Taxation.

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system*:* Arbitration– meaning, scope and types–distinction between laws of 1940 and 1996; Arbitration agreements–essential and kinds, validity, reference and interim measures by court; Arbitration tribunal–appointment, challenge, jurisdiction of

arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting as ideal award, Enforcement, Appeal and Revision.

Module3:EngagementofLabour&otherconstruction-relatedLaws (05hours)

Role of Labour in Civil Engineering; Methods of engaging labour-on rolls, labour sub-contract, piece rate work; Industrial Disputes Act,1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act,1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act(1996) and Rules (1998); RERAAct2017, NBC 2017

Module4:LawrelatingtoIntellectualproperty (05 hours)

Introduction– meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Copy Rights Act, 1957,Meaning of copyright–computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet– Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India. Process of obtaining patent–application, examination, opposition and sealing of patents. Duration of patents–law and policy considerations, Infringement and related remedies;

***TEXT/REFERENCEBOOKS*:**

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. TheNationalBuildingCode,BIS,2017
3. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
4. Neelima Chandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai.
5. Avtar singh (2002),Law of Contract, Eastern Book Co. 7.Dutt(1994), Indian Contract Act Eastern Law House
6. T. Ramappa (2010),Intellectual Property Rights Law in India, Asia Law House 9.Baretext (2005),Right to Information Act.
7. O.P.Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
8. Ethics in Engineering- M.W. Martin & R. Schinzinger, McGraw-Hill
9. EngineeringEthics,National InstituteforEngineeringEthics,USA.
10. Ethics & Mgmt and Ethos , Ghosh, VIKASH
11. Business Ethics; Concept and Cases, Velasqez, Pearson

****

2. Digital System Design (PC EC 502)

Course Code	PC EC 502
Course Title	Digital System Design
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Digital Electronics
Course Category	Program Core
Number of classes	38 hours

Course objectives: After completing the course, the students will be able to-

CO Number	CO Description	K-level
CO-1	Construct Mealy and Moore state machines for common applications	K3
CO-2	Identify design methodologies in digital system using Verilog HDL	K3
CO-3	Illustrate datatypes, module and ports of Verilog HDL	K2
CO-4	Apply the concepts of gate level, dataflow and behavioral style of modeling in Verilog HDL	K3
CO-5	Demonstrate the working principles of programmable logic devices.	K2

Module-1: State Machine (8)

Review of Sequential logic circuits. Flip flop excitation tables.Introduction to state machines. Classification of State Machines. State Machine Applications. Analysis State Machine, State table, State Diagram, State Equation, State reduction and State assignment. Design of Synchronous State Machine.

Module-2: Verilog HDL Part I (10)

Generalized HDL-based design flow, trends in HDLs, Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. Basic Conecpts: Lexical conventions, data types, system tasks, compiler directives.

Module-3: Verilog HDL Part II(10)

Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not typegates, rise, fall and turn-off delays, min, max, and typical delays.Fundamental concept of dataflow and behavioural modelling.

Module-4: Programmable Logic Devices(10)

Advantages of PLDs. Classification of PLDs. Concept of PROM, PAL, PLA, Registered PAL, Configurable PAL, GAL – Architecture and Comparison. CPLD and FPGA architecture. Simulation and testing, types of FPGAs, Xilinx solutions: Xilinx CPLDs and applications areas, JTAG Development and Debugging Support. Soft Processor.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1) Modern Digital Design, R.P. Jain, TMH.
2) Digital Logic Design, M. Morris Mano, PHI
3) Digital Logic and State Machine Design, Comer, OUP
4) Modern Digital Design, R.S. Sandige, MGH.
5) Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.
6) Advanced Digital Design with Verilog HDL - Michel D. Ciletti, PHI, 2009.
7) Design Through Verilog HDL, T.R. Padmanabhan, B Bala Tripura Sundari, Wiley 2009.
8) Digital System Design with FPGA, CemUnsalan and Tar Bora, McGrawHill, 2017
9) The Designer's Guide to VHDL, Morgan Kaufman Publishers(Elsevier), LPE.

10) Design Warrior's Guide to FPGAs: Devices Tools and Flows, Clive "Max" Maxfield, Elsevier Publication.
11) Field-Programmable Gate Array Technology, S. Trimberger, ed., Kluwer Academic Publishers.

****

3. Control System Engineering (PC EC 503)

Course Code	PC EC503
Course Title	Control System Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Electrical Circuits, Basic Mathematics
Course Category	Program core
Number of classes	38 hours

Course Outcome:

After completing the course, the students will be able to-

CO Number	CO Description	K-level
CO-1	Explain basics of Control dynamics, mathematical modeling of systems and different components used for control System	K2
CO-2	Explain stability analysis, State variable analyses of Systems	K2
CO-3	Apply the modeling of Systems which are essential for Industrial applications and also for higher courses of Electrical Engineering	K3
CO-4	Identify thetime & Frequency responses of Systems, predict systems behavior based on time and frequency domain analysis	K3

Course Content:

Module 1:Introduction to Control Systems (10 hours)

Classification of control systems with examples. Block diagram representation and Signal flow graph representation of Systems. Properties of Control Systems: System dynamics, sensitivity, steady-state & transient errors, Error constants, System types. Time response of system: Time domain specifications, Step response of second order system, concept of dominant poles, Effect of addition of Poles & Zeroes in second Order Systems. Basic Control actions: Proportional, integral, derivative, and their combinations, design of controllers to meet system specification.

Module 2:Control System Components (10 hours)

DC & AC Servo motors, Amplidyne, Synchros, Position & velocity Sensors, encoders, Gears and different Mechanical Parameters, Examples of DC and AC servomechanisms, Effect of velocity feedback with or without controller. Instrumentation Systems for control Engineering and their implementations.
Frequency response of Second order System: Frequency Domain Specifications in open loop, closed loop systems and their significance, Concept of Bandwidth and Cut-off frequency, frequency responses of different function of Systems.

Module 3: Stability of Linear Systems (8hours)

Routh-Hurwitz criterion, Root locus techniques, Polar Plot, Nyquist criterion, Bode & Nichols Plots, Stability margins. Effects of system on stability, Introduction to Lag, lead and lead-lag compensators and their frequency responses.

Module4:State Variable Formulation of Control System (10 hours)

State variable formulation of control system, diagonalization. Time response of state model of linear time-invariant system. Representations in state space of Systems in cascade form, parallel form, controllable canonical form, observable canonical form. Elementary concept of controllability & observability with physical examples and testing methods of Controllability & Observability. Control Law design for full state feedback of linear control Systems. Pole placement by state feedback.

***REFERENCE BOOKS*:**

1. Norman S. Nise, Control Systems Engineering, 6th edition, Wiley, 2011.
2. I.J.Nagrath and M.Gopal, Control Systems Engineering, 5th edition, New Age International, 2009.
3. Benjamin C. Kuo and Farid Golnaraghi, Automatic Control Systems, 9th edition, Wiley; 2009.
4. M. Gopal, Control Systems Principles and Design, 3rd edition, Tata Mgraw Hill, 2008.
5. Naresh K. Sinha, Control Systems, 3rd edition, New Age International, 2004.
6. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 12th Edition.

****

4. Analog and Digital Communication (PC EC 504)

Course Code	PC EC 504
Course Title	Analog and Digital Communication
Number of Credits	4 (L: 4, T: 0, P: 0)
Prerequisites	Signals and systems
Course Category	Program Core (PC)
Number of classes	48 hours

Course Outcome:

At the end of this course students will demonstrate the ability to:

CO Number	CO Description	K-level
CO-1	Compare different analog modulation schemes for their efficiency and bandwidth	K2
CO-2	Explain the communication system in presence of noise	K2
CO-3	Apply the knowledge of pulsed modulation system and analyze their system performance	K3
CO-4	Identify and explain different digital modulation schemes and can compute the bit error performance	K3
CO-5	Explain digital modulation tradeoffs and equalization	K2

Module 1: Analog modulation and noise: (12 hours)

Review of signals and systems, Frequency domain representation of signals, Principles of AmplitudeModulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Review of probability and random process. Gaussian and white noise characteristics,Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Module 2: Pulse modulation (12 hours)

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Module 3: Digital modulation (12 hours)

Elements of Detection Theory, Optimum detection of signals in noise,Coherent communication with waveforms- Probability of Error evaluations. BasebandPulse Transmission- Inter symbol Interference and Nyquist criterion.Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying,Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Module 4: Digital Modulation tradeoffs and Equalization (12 hours)

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

***TEXT/REFERENCE BOOKS*:**

1) Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2) Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3) Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4) Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering", John Wiley, 1965.
5) Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6) Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

****

5. Embedded Systems &IoT (PCEC 505)

Course Title:	Embedded Systems & IoT
Course Code	PCEC 505
Number of credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Microcontrollers
Course Category	Program Core
Total no. of lecture periods	38

Course Outcome:-
On completion of the syllabus, the Students will be able to:-

CO Number	CO Description	K-level
C.O.1	Illustrate the concept of Embedded systems and RTOS.	K2
C.O.2	Relate to the concept of ARM-7.	K2
C.O.3	Experiment with arduino, raspberry pi coding for IoT implementation	K3
C.O.4	Outline the Basic idea of IoT, Sensing, Actuation, Networking, CommunicationProtocols, Sensor Networks.	K2
C.O.5	Summarize the real-life applications of IoT in various fields	K2

Course Content:

Module I- Introduction to Embedded systems (10 Hours)

Introduction to embedded systems. Features of embedded systems. Characteristics of Embedded Systems. Classification of embedded systems. Examples of embedded systems.
Architecture of embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC. Real time systems, examples of real time systems. Types of real time systems.Introduction to RTOS, difference between RTOS and General-purposeOS. Need for RTOS in embedded systems. kernel and its functions.Case study on automatic washing machine and electronic micro-oven.

Module II–Introduction to ARM-7 (10 Hours)

ARM 7 Architecture, ARM Development tools, Instruction set: Data processing, Data transfer,Control flow. Addressing modes, Memoryorganization.Writing simple assembly languageprograms, Pipelining, Brief introduction toexceptions and interrupts handling.Overview and features of LPC 2478. Case study on embedded system: Washing machine, Microwave oven etc.

Module III–Introduction to IoT (10 Hours)

Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols,
Sensor Networks.Machine-to-Machine Communications, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.

Module IV- Interoperability of IoT (08 Hours)

Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi. Introduction to SDN, SDN for IoT. Introduction to cloud computing, fog computing. IoT Case Study: Agriculture, Healthcare, Activity Monitoring, smart home, smart city, smart grid.

***SUGGESTED LEARNING RESOURCES*:**

1. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications",

Penram Intl, 1996.
2. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
3. Real Time Operating System-Rajib Mall
4. Introduction to embedded systems, Shibu K. V., McGraw Hill
5. ARM System on chip Architecture, Steve Furber, Pearson, edition second
6. Embedded systems an integrated approach, Laya B. Das, Pearson, Third impression, 2013
7. ARM system developer‟s guide, Andrew N. Sloss, Dominic Symes, Chris Wright, Morgan Kaufmann Publishers.
8. Embedded system design A Unified hardware/software Introduction, Frank Vahid, Tony Givargis, Wiely .
9. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj andAnupama C. Raman (CRC Press)
10. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)

SUGGESTED SOFTWARE/LEARNING WEBSITES:
1. https://www.arduino.cc/reference/en/
2. https://learn.adafruit.com/category/learn-arduino
3. NPTEL

****

6. Network Theory (PC EC 506)

Course Code	PC EC 506
Course Title	Network Theory
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic mathematics and physics
Course Category	Program core
Number of classes	38 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Illustrate Type of source transformation, graph theory, Resonance and Active filter	K2
CO-2	Explain Laplace transform in a circuit theory, Sinusoidal steady state analysis of RLC circuit, Frequency and time domain analysis of RLC circuit.	K2
CO-3	Solve the problems related to coupled circuit, Two port network analysis, Application of network theorem in AC circuit	K3
CO-4	Apply the knowledge of transmission line, its parameters, characteristics, etc.	K3

Course Content:

Module 1: Introduction to Network Theory (10 Hours)

Type of Source transformation – Dot convection and formation of loop and node analysis.
Network theorems-Thevenin's theorem, Norton's theorem, Superposition law, maximum power transfer law, reciprocity theorem, compensation theorem, Millman's theorem, Tellegen's theorem, and AC network theorems.
Introduction to graph theory - graph of a network, relation between twigs and links, properties of tree in a graph, number of tree in a graph, tie-set matrix, incidence matrix, fundamental cut set and fundamental circuit matrices**.**
Resonance – Series and parallel resonance, Resonance between parallel RL and RC circuit, Parallel resonance of RLC circuit.

Module 2: Transient and Steady State Analysis (8 Hours)

Laplace transform of various signal of excitation, wave form synthesis, Laplace transform network, determination and representation of initial condition,response of impulse function and its relation to network admittance.
Transient and steady state analysis of series & parallel R-L,R-C,R-L-C circuits, Frequency responses of different combinations of series & parallel Circuits, Cut-off frequency & Bandwidth. Time response of Electric circuits due to Step, Ramp and periodic signals. Concept of Transfer function and its relation with step response of an Electric Circuit, Introduction to the 1^{st}& 2^{nd} order R-C Active Filters, its frequency responses, Design of 2^{nd} order Active Filters.

Module 3: Coupled Circuits and Two Port Networks (10 Hours)

Analysis of coupled circuit – self and mutual inductances,coefficient of coupling, series and parallel connection of coupled circuit, dot convention in coupled circuit, electrical equivalent of magnetically coupled circuit.
Two port network analysis – network element, driving point and transfer function, Z-parameter, Y-parameter, H-parameter, ABCD-parameter, condition of Reciprocity and Symmetry in two port parameter, inter-relationship between parameters, different type of interconnection(series, parallel, cascade).

Module 4: Transmission Line (10 Hours)

Transmission line – Type, parameter, Transmission line Equation, primary and secondary constant, Expression for characteristic impedance, propagation constant, phase and group velocity, infinite line concept, lossless/loss characterization, distortion condition for distortion less and medium attenuation, loading –type of loading related problem, input impedance relations, SC and OC line, reflection coefficient, VSWR.UHF line as a circuit element: $\frac{\lambda}{2}$,$\frac{\lambda}{4}$,$\frac{\lambda}{8}$ lines, impedance transformation. Smith chart-configuration and application, single and double stub matching.

REFERENCE BOOKS:

1. Network Analysis and Synthesis by S Ghosh& A Chakraborty
2. Network Analysis by M. E. Van Valkenburg&T.S. Rathore
3. Network Theory By A V Bakshi&U A Bakshi
4. Circuit Theory - Analysis and Synthesis by Abhijit Chakrabarti
5. Electrical Circuit Theory by B.L.Theraja, M.E.Van.Valkenburg
6. Fundamentals of Electric Circuits by Charles K. Alexander, Matthew N.O. Sadiku

7. Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Steven M. Durbin

****

7. Digital System Design Laboratory(PC EC 507)

Course Code	PC EC 507
Course Title	Digital System Design Laboratory
Number of Credits	1(L: 0, T: 0, P: 2)
Prerequisites	Digital Electronics
Course Category	Program Core
Number of classes	24 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Demonstrate the Verilog HDL design flow to implement Logic Gates and Boolean function	K2
CO-2	Develop Verilog HDL model of combinational logic circuits and implement them CPLD/FPGA	K3
CO-3	Develop Verilog HDL model of sequential logic circuits and implement on CPLD/FPGA	K3
CO-4	Construct State machines in Verilog HDL and implement on CPLD/FPGA	K3

List of Experiments ***(Minimum 6 experiments to be performed). Use of virtual laboratory to perform few experiments may be explored if available.***

Prepare Verilog HDL model to design and implement of the following digital circuits/systems on CPLD/FPGA platform.

1) Logic gates and Boolean function
2) Decoder and Encoder
3) Multiplexer and De-multiplexer
4) Full adder and Full subtractor
5) 8-bit Arithmetic logic unit
6) Flip flops
7) Counters
8) Universal shift register
9) Sequence detector
10) Traffic light controller

***REFERENCES/ SUGGESTED LEARNING RESOURCES*:-**

1) Digital Logic Design, M. Morris Mano, PHI
2) Digital Logic and State Machine Design, Comer, OUP
3) Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.
4) Advanced Digital Design with Verilog HDL - Michel D. Ciletti, PHI, 2009.
5) Design Through Verilog HDL, T.R. Padmanabhan, B Bala Tripura Sundari, Wiley 2009.

6) Digital System Design with FPGA, CemUnsalan and Tar Bora, McGrawHill, 2017
7) Fundamentals of Digital logic with Verilog design-2e, Brown Vranesic, McGrawHill education

****

8. Control System Engineering Lab (PC EC 508)

Course Code	PC EC 508
Course Title	Control System Engineering Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Basic Mathematics, Electrical circuits
Course Category	Program core
Number of classes	20-24 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Analyze the characteristics of Synchro Transmitter, Receiver and differential Transducer	K4
CO-2	Solve transfer function of D.C. Servo Motor by applying Step input and verification from frequency response graph of D,C. Servomotor	K3
CO-3	Examine the error / steady state error of DC Servomechanism due to Step, Ramp and Parabolic inputs	K4
CO-4	Analyze the position Control of second order DC Servomechanism and determination of Parameters of the System from the experimental Results	K4
CO-5	Experiment with Velocity feedback on Position control of DC Servomechanism and determination of Parameters due to velocity feedback at different values	K3
CO-6	Analyze the control of D.C. Servo Mechanism using P, P+I, P+D, P+I+D Controllers to study the characteristics of second order System and indication of Position Control using Gray-coded disk	K4

Course Content:

List of Experiments*(Minimum 6experiments to be performed). Use of virtual laboratory to perform few experiments may be exploredif available.*

The following Experiments are required to be carried out using Hardware Trainers and Experiments using Hardware Trainers from Sl. No. 2 to 10 are required to be interfaced with Computers for Experimentations.

1. Study of Characteristics of Synchro Transmitter, Receiver and differential Transducer (Transmitter).
2. Determination of Transfer function of D.C. Servo Motor by applying Step input.
3. Verification of Transfer function from frequency response graph of D,C. Servomotor (at different Mechanical loadings) as in Experiment No. 2.
4. Determination of error / steady state error of DC Servomechanism due to Step, Ramp and Parabolic inputs.

5. Position Control of second order DC Servomechanism and determination of Parameters of the System from the experimental Results.
6. Study the effect of Velocity feedback on Position control of DC Servomechanism and determination of Parameters due to velocity feedback at different values.
7. Position control of D.C. Servo Mechanism using P, P+I, P+D, P+I+D Controllers to study the characteristics of second order System and indication of Position Control using Gray-coded disk.
8. Experimentation for Speed Control of a DC Servo Motor with PI Controller+ derivative output Compensation technique.

REFERENCE BOOKS:

1. Norman S. Nise, Control Systems Engineering, 6th edition, Wiley, 2011.
2. I.J.Nagrath and M.Gopal, Control Systems Engineering, 5th edition, New Age International, 2009.
3. Benjamin C. Kuo and FaridGolnaraghi, Automatic Control Systems, 9th edition, Wiley; 2009.
4. M. Gopal, Control Systems Principles and Design, 3rd edition, Tata Mgraw Hill, 2008.
5. Naresh K. Sinha, Control Systems, 3rd edition, New Age International, 2004.
6. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 12th Edition.

****

9. Analog and Digital Communication Lab(PC EC 509)

Course Code	PC EC 509
Course Title	Analog and Digital Communication Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Signals and systems
Course Category	Program Core (PC)
Number of classes	24 hours

Course Outcome:

At the end of this course students will demonstrate the ability to:

CO Number	CO Description	K-level
CO-1	Experiment with different amplitude modulation schemes (AM, SSB, DSB).	K3
CO-2	Experiment with frequency modulation, demodulation.	K3
CO-3	Analyze the noise effects, pre-emphasis and de-emphasis.	K4
CO-4	Experiment with pulse code, deferential pulse code and delta modulation.	K3
CO-5	Compare and analyze various digital modulation techniques (ASK, FSK, PSK).	K4

Course Content:

List of Experiments*(Minimum 6 experiments to be performed). Use of virtual laboratory to perform few experiments may be explored if available.*

1. Study of amplitude modulation and demodulation.
2. Study of Double Side Band Suppressed Carrier (DSB-SC) & Demodulation technique.
3. Study of Single Side Band Suppressed Carrier (SSB-SC) & Demodulation technique.
4. Study of Frequency Modulation and demodulation.

5. Study of Noise Effect in communication system.
6. Study of pre-emphasis and de-emphasis.
7. Study of Pulse code modulation
8. Study of Differential pulse code modulation.
9. Study of Delta modulation.
10. Study of Amplitude, Frequency and Phase shift keying.
11. Software simulation of Amplitude, Frequency and Phase shift keying.

***TEXT/REFERENCE BOOKS*:**

7) Lab Manual
8) Haykin S., "Communications Systems", John Wiley and Sons, 2001.
9) Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
10) Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
11) Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
12) Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
13) Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

****

10. Industry Internship – I (SIEC 510)

Course Code	SIEC 510
Course Title	Industry Internship – I
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Summer Internship (SI)
Number of classes	-

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course of study	K3
CO-2	Develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organizational setting	K3
CO-3	Demonstrate the skill to communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means	K2
CO-4	Show professional ethics by displaying positive disposition during internship.	K2
CO-5	Decide career options by considering opportunities in company, sector, industry, professional, educational advancement and entrepreneurship;	K5

Course Content:-

The industry internship aims to provide the student with:

1. A practice-oriented and 'hands-on' working experience in the real world or industry, and to enhance the student's learning experience.
2. An opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.
3. An opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.
4. Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

Each student shall

1) Identify an internship program of relevance in his/her branch of engineering to undergo during summer break between 4^{th} and 5^{th} semester,
2) Get approval of the concerned HOD,
3) Undergo the industry internship program for minimum 4 weeks duration
4) Prepare their own report
5) Present in the class among fellow students and faculty members / deliver viva voce.
6) Submit the report and participation/course completion certificate.

****

Tripura University
(A Central University)

Detailed syllabus for

B.Tech in Electronics and

Communication Engineering

(Sixth Semester)

2021

SIXTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Core-21	PC EC 601	Microwave Engineering	3	0	0	3	3	100
2.	Program Core-22	PC EC 602	Fiber Optic Communication	3	0	0	3	3	100
3.	Program Core-23	PC EC 603	VLSI	3	0	0	3	3	100
4.	Program Core-24	PC EC 604	Digital Signal Processing	3	0	0	3	3	100
5.	Program Core-25	PC EC 605	Microwave and Fiber Optic Communication Lab	0	0	2	2	1	100
6.	Program Core-26	PC EC 606	VLSI Lab	0	0	2	2	1	100
7.	Program Core-27	PC EC 607	Digital Signal Processing Lab	0	0	2	2	1	100
8.	Program Elective-1	PE EC 608	4)Electronic Measurement and Instrumentation 5)Power Electronics 6)Bio Medical Engineering	3	0	0	3	3	100
9.	Project - 1	PR EC 609	Mini Project	0	0	6	6	3	100
			Total :	15	0	12	27	**21**	**900**

1. Microwave Engineering (PC EC 601)

Course Code	PC EC 601
Course Title	Microwave Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	EM Theory
Course Category	Program Core (PC)
Number of classes	36 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain various microwave Frequency bands and Transmission Lines	K2
CO-2	Explain the properties of various Passive and Active Microwave Devices.	K2
CO-3	Explain the properties of various Microwave Semiconductor Devices and Tube Devices.	K2
CO-4	Develop microwave systems for different practical application.	K3

Course Content:-

Module-I: Introduction to RFandMicrowaveTransmissionLines (9Hours)

Microwave Frequency bands; Applications ofMicrowaves.

Rectangular Wave guides : Introduction, TE/TM mode analysis, Dominant and Degenerate Modes. Power Transmission and Power Losses in Rectangular Guide.
Circular Waveguides: Introduction, TE/TM mode analysis, Dominant and Degenerate Modes. Power Transmission and Power Losses in Rectangular Guide
Micro strip Lines: Introduction, Effective Dielectric Constant, Characteristic Impedance, , Losses, Q factor.

Module-II: Passive and Active Microwave Devices (9Hours)

Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers.

Module-III: MicrowaveSemiconductorDevices and Tube Devices (9Hours)

Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tube Devices: Klystron, TWT, Magnetron.

Module-IV: MicrowaveMeasurements (9Hours)

Description of Microwave Bench – Different Blocks and their Features, Precautions; Microwave Power Measurement. Measurement of Attenuation, Frequency, VSWR, Cavity Q. Impedance Measurements. MeasurementofMicrowaveantennaparameters.

***TEXT/REFERENCEBOOKS*:**

1. Microwave Engineering by M. kulkarni
2. Annapurna Das and Sisir K. Das, Microwave Engineering ,McGrawHill.

3. K.C.Gupta and I.J.Bahl, Microwave Circuits, Artech house
4. R.E. Collins, Microwave Circuits, McGraw Hill
5. Samuel Liao - Microwave devices and circuits, PHI
6. Dennis Roddy - Microwave Technology, PHI
7. G. Kennedy - Electronic Communication systems, McGraw-Hill Book Company
8. Sitesh kumar Roy & Manojit Mitra - Microwave semiconductor devices, PHI
9. A. K. Gautam - Microwave engineering, (S. K. Kataria pub)
10. Sanjeev Gupta, Microwave Engineering, Khanna Pub.

****

2. FIBER OPTIC COMMUNICATION (PCEC 602)

Course Code	PCEC 602
Course Title	Fiber Optic Communication
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Optics
Course Category	Program Core (PC)
Number of classes	36 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain fiber-optic communication system.	K2
CO-2	Explain theoperationofoptical Sources and detectors.	K2
CO-3	Explain thepropertiesofvarious opticalcomponents.	K2
CO-4	AnalyzesystemperformanceofOptical Networks.	K4

Course Content:-

Module-I: Optical fibres and their properties (09 Hours)

Principles of light propagation through a fiber, Different types of fibres and their properties, Acceptance angle, Numerical aperture, Signal degradationonopticalfiberdueto- Attenuation, Absorption losses, Scattering losses, Dispersion , Radiation losses.

Module-II: Optical Sources and detectors (09 Hours)

Optical Source-LEDs and Lasers . Optical detectors – PIN-diodes, APDs.

Module-III: Components(09 Hours)

Couplers, isolators and circulators, multiplexers and filters, optical amplifiers, transmitters, switches, wavelength converters and problems.

Module-IV: Optical Networks (09 Hours)

Optical transmitters and receivers, System block diagram , point to point

link , link design, power budget analysis. WDM, DWDM and SONET/SDH. Introduction to AON , PON and FTH.

TEXT/REFERENCEBOOKS

1. J. Keiser, Fiber Optic communication, McGraw-Hill, 5thEd.2013(Indian Edition).
2. *Ajoy Ghatak*, Optics, Tata McGraw-Hill Education
3. *John M. Senior, Optical Fiber Communications* , PHI, 3rd Edition,
4. T.Tamir,Integratedoptics,(TopicsinAppliedPhysicsVol.7),Springer-Verlag,1975.
5. J.Gowar, Optical communication systems, Prentice Hall India,1987.
6. S.E.MillerandA.G.Chynoweth,eds.,Opticalfiberstelecommunications,AcademicPress,1979.
7. G.Agrawal, Nonlinearfiberoptics,AcademicPress,2ndEd.1994.
8. G.Agrawal, Fiber opticCommunicationSystems, JohnWileyandsons, NewYork, 1997

****

3. VLSI (PC EC 603)

Course Code	PC EC 603
Course Title	VLSI
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Electronic Devices
Course Category	Program Core (PC)
Number of classes	38 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Interpret the concepts of MOS transistors operations and their AC , DC characteristics and scaling.	K2
CO-2	Relate the fabrication process of CMOS technology and its layout design rules.	K1
CO-3	Explain the concepts of CMOS invertors and their sizing methods, dynamic CMOS logic, pass transistor and transmission gates.	K2
CO-4	Assume about VLSI system component circuits.	K4
CO-5	Explain low power VLSI design techniques	K2

Course Content:

Module 1: MOS Capacitor and MOSFET device physics (10 hours)

MOS capacitor, Simple MOS capacitance Models, Detailed MOS gate capacitance model, Detailed MOS Diffusion capacitance model., Inversion, depletion and accumulation, MOS transistor theory – Introduction, Enhancement mode transistor action, NMOS and PMOS transistors, CMOS logic, Ideal I-V characteristics, DC transfer characteristics, Threshold voltage, Body effect- Design equations. MOS models and small signal AC characteristics, scaling, short channel effects..

Module 2: VLSI Fabrication (10 hours)

CMOS fabrication and Layout, CMOS technologies, P -Well process, N -Well process, twin -tub process, Diffusion, Ion implantation, Lithography, MOS layers stick diagrams and Layout diagram, Layout design rules, Latch up in CMOS circuits, CMOS process enhancements, Technology – related CAD issues, Fabrication and packaging.

Module 3: Inverters and Dynamic CMOS (10 hours)

Resistive load inverter, enhancement and depletion load inverter, NMOS and CMOS Inverters, Inverter ratio, DC and transient characteristics , switching times, Super buffers, Driving large capacitance loads, CMOS logic structures, pass transistors, Transmission gates, Static CMOS design, dynamic CMOS design, NORA, Domino logic, Zipper circuits.

Module 4: VLSI system components and low power VLSI design (08 hours)

Multiplexers, Decoders, comparators, priority encoders, Shift registers. Arithmetic circuits – Ripple carry adders, Carry look ahead adders, High-speed adders, Multipliers, Power dissipation in cmos and its types, low power vlsi design techniques,.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Neil H.E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Pearson Education ASIA, 2nd edition, 2000.
2. John P. Uyemura "Introduction to VLSI Circuits and Systems", John Wiley & Sons, Inc., 2002.
3. Kang and Leblebici – CMOS digital integrated circuits – McGraw Hill International Edition.
4. Pucknell, "Basic VLSI Design", Prentice Hall of India Publication, 1995.
5. Eugene D. Fabricius, Introduction to VLSI Design McGraw Hill International Editions, 1990

****

4. Digital Signal Processing (PC EC 604)

Course Code	PC EC 604
Course Title	Digital Signal Processing
Number of Credits	03 (L:3,T:0,P:0)
Prerequisites	Set Theory
Course Category	Program Core (PC)
Number of classes	38 hours

Course Outcome:

After successful completion of this course, students will be able to-

CO Number	Description	K- Level
CO-1	Classify the concept of Discrete Fourier Series and Discrete Fourier Transform	K2
CO-2	Solve the problems related to DFT by FFT	K3

CO-3	Analyze FIR and IIR systems	K4
CO-4	Design Digital FIR and IIR filters	K6
CO-5	Interpret the Digital Signal Processor Architecture	K2
CO-6	Make use of to simulate DSP Algorithms by using TMS320 series	K3

Course Content:

Module 1: Fourier Analysis of Discrete Time Signals (10 hours)

Review of Discrete Fourier series and Discrete Time Fourier Transform, Frequency domain sampling, Discrete Fourier Transform, Properties, Circular convolution, Linear convolution using DFT, Linear filtering of long data sequences, Overlap add and overlap save methods, Computation of DFT by FFT, Decimation in Time and Decimation in Frequency algorithms.

Module 2: Structures for realization of Discrete Time Systems(10 hours)

Structures for realization of discrete time systems, Signal flow graph representation, structures for FIR and IIR systems, direct form, cascade form, parallel form, lattice, and transposed structures representation of numbers & errors due to rounding and truncation, Quantization of filter coefficients, round off effects in digital filters.

Module 3:Design of Digital Filters (10 hours)

Design of Digital filters, Types of digital filters, FIR and IIR filters, Specifications of digital filters, Design of FIR filters, Linear phase Characteristics: Window method, Optimal method and Frequency Sampling method, Design of IIR filters from analog filters, Impulse invariant and bilinear transformation methods, Frequency transformation in the analog and digital domains.

Module 4: Computer Architectures for Signal Processing(8 hours)

Computer Architectures for signal processing, Harvard Architecture, Pipelining, Multiplier, Accumulator, Special Instructions for DSP. General Purpose DSP Processors, Implementation of DSP Algorithms for various operations, Special purpose DSP hardware, Hardware Digital filters and FFT processors, Case study and overview of TMS320 series processor.

***TEXT/ REFERENCE BOOKS*:**

1. J.G. Proakis& D.G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications.,PHI/Pearson
2. Chen, Digital Signal Processing, OUP
3. Meyer-Basse U, Digital Signal Processing with FPGA, Spriger India
4. Ingle, Digital Signal Processing using MATLAB, Vikas
5. Babu R, Digital Signal Processing , Scitech
6. S. Salivahanan et al, Digital Signal Processing, TMH
7. S.K.Mitra, Digital Signal Processing - A Computer based approach, TMH

****

5.MICROWAVEANDFIBEROPTICCOMMUNICATIONENGINEERINGLAB (PC EC 605)

Course Code	PC EC 605
Course Title	MicrowaveandFiberOpticCommunicationEngineeringLab.
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	EM Theory and Optics
Course Category	Program Core (PC)
Number of classes	20 - 24 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Make use of Optical fiber for signal communication link establishment.	K3
CO-2	Make use of Optical fiber for Loss measurement.	K3
CO-3	Analyse the performance of plastic fiber.	K4
CO-4	Make use of Microwave bench setup to measure different parameters.	K3

Course Content

List of Experiments*(Minimum 6 experiments to be performed). Use of virtual laboratory to perform few experiments may be exploredif available.*

1. Settingupofa fiberoptic analoglink.
2. Settingupofafiberopticdigitallink.
3. Settingupofa fiberoptic voicelink.
4. Studyoflossesinopticalfiber.
5. Studyofcharacteristicsoffiberoptic.
6. Studyofnumericalapertureofopticalfiber.
7. DeterminationofFrequency&WavelengthofRectangular Waveguide.
8. DeterminationofVSWRofaTransmissionLine.
9. DeterminationofReflectionCoefficient ofaTransmissionLine.
10. RadiationPatternsMeasurementsofAntenna.
11. StudyofcharacteristicsofKlystronTube.
12. StudyofI-Vcharacteristics ofGunnDiode.

TEXT/REFERENCE BOOKS

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997

7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

****

6. VLSI Lab (PC EC 606)

Course Code	PC EC 606
Course Title	VLSI Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Electronic Devices
Course Category	Program Core (PC)
Number of classes	20 - 24 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Analyze a simulated CMOS inverter and Buffer at circuit level using CAD tool and be familiar with its various dc characteristics.	K4
CO-2	Analyze a simulated CMOS inverter and Buffer at layout level using CAD tool and be familiar with its various electrical aspects and behavior.	K4
CO-3	Interpret various combinational and sequential VLSI circuits using CAD tool.	K2
CO-4	Build a small project where they can apply whole of their analytical and engineering skill that they learn throughout the course.	K3

List of experiments: Use of virtual laboratory to perform few experiments may be explored if available.

1) Simulation of logic gates using schematic & layout diagram by CAD tool.
2) Draw a schematic structure of CMOS inverter and buffer to evaluate its various characteristics like delay, power consumption, V-I characteristics, etc, by CAD tool.
3) Simulate a CMOS inverter and buffer using its layout diagram by CAD tool.
4) Simulation of combinational circuits using CAD tools.
5) Simulation of sequential circuits using CAD tools.
6) Simulation of counter using CAD tool.
7) Simulation of state machines using CAD tool.
8) Project(Simulation/ Implementation of VLSI circuit at schematic and layout level) using CAD tool.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. CMOS Digital Integrated Circuit by Sung-Mo Kang and Yusuf Leblebici.
2. VLSI Design and EDA Tools by Angsuman Sarkar.
3. Low Power CMOS VLSI Circuit Design by Kaushik Roy.
4. CMOS Circuit Design, Layout and Simulation by R. Jacob Baker.
5. VLSI Design by Deba prasad Das.

****

7. Digital Signal Processing Laboratory (PC EC 607)

Course Code	PC EC 607
Course Title	Digital Signal Processing Laboratory
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Set Theory
Course Category	Program Core
Number of classes	20 - 24 hours

Course Outcome: After successful completion of this course, a student will be able to-

CO Number	CO Description	K- Level
CO-1	Make use of software to demonstrate generation of test signal and various signal operations.	K3
CO-2	Make use of software to demonstrate the convolution, correlation operations.	K3
CO-3	Analyse LTI system using software.	K4
CO-4	Develop program to compute Z-transform, inverse Z-transform, DFT, IDFT and circular convolution.	K6
CO-5	Determine FIR and IIR filter in software.	K5
CO-6	Develop FIR/IIR Filter design on digital signal processors.	K3

LIST OF EXPERIMENTS: Use of virtual laboratory to perform few experiments may be explored if available.

Perform at least 6 experiments (3 using Software simulation and 3 using DSP kit)

Perform the following exercises using suitable (Prefer MATLAB) software:

1. To develop elementary signal function modules for unit sample, unit step, unit ramp and exponential sequences.
2. To develop program modules based on operation on sequences like signal shifting, signal folding, signal addition and signal multiplication.
3. To develop program for discrete convolution and correlation.
4. To develop program for finding response of the LTI system described by the difference equation.
5. To develop program for computing Z transform and inverse Z-transform.
6. To develop program for computing DFT and IDFT.
7. To develop program for computing circular convolution.
8. To develop program for cascade realisation of IIR and FIR filters.
9. To develop program for designing FIR/IIR filter.

Perform the following exercises using TMS320C50 or Higher Board:

1. To study the architecture of DSP chips – TMS320C50 or higher.
2. To verify linear convolution.
3. To verify the circular convolution.
4. To design FIR filter (LP/HP) using windowing technique
    a. Using rectangular window

b. Using triangular window
c. Using Kaiser window

5. To Implement IIR filter (LP/HP) on DSP Processors, N-point FFT algorithm.

***TEXT/ REFERENCE BOOKS*:**

1. J.G. Proakis& D.G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications.,PHI/Pearson
2. Chen, Digital Signal Processing, OUP
3. Meyer-Basse U, Digital Signal Processing with FPGA, Spriger India
4. Ingle, Digital Signal Processing using MATLAB, Vikas
5. Babu R, Digital Signal Processing , Scitech
6. S. Salivahanan et al, Digital Signal Processing, TMH
7. S.K.Mitra, Digital Signal Processing - A Computer based approach, TMH

****

Program Elective-1.1: Electronic Measurement and Instrumentation (PEEC 608/1)

Course Code	PEEC 608/1
Course Title	Electronic Measurement and Instrumentation
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic Electrical Engineering
Course Category	Program Elective-1
Number of classes	38 hours

Course Outcome:

After successful completion of this course, a student will be able to-

CO Number	CO Description	K-level
CO-1	Explain importance of measurement and various error in measurement.	K2
CO-2	Explain the working principles of different Electrical Measuring Instruments and their characteristics.	K2
CO-3	Analyse the unknown quantities of different components using DC &AC bridges.	K4
CO-4	Combine different power & energy measuring instruments with working principle.	K6

Course Content:

Module 1: Measurement and error (8 Hours.)

Introduction, Definition, significance of measurement, Measurement characteristics, Calibration of instruments, Static & dynamic characteristics. Types of errors, Statistical analysis, Probability of errors, Limiting error with examples.

Module 2: Electrical and Electronic Measuring instruments(10 Hours.)

Classification of instruments, Overview of PMMC, Moving iron, Dynamometer type instruments, Galvanometer, different types of galvanometer and its application. Overview of Ammeter, Voltmeter & Multi-meter, True r.m.s voltmeter, Potentiometers. Extension of range of instruments- shunts & multipliers- Current transformers- Potential Transformers.Measurement of quality factor (Q), Digital voltmeter (DVM)-Ramp type, Integrating type, ADC, Digital frequency meter, CRO, Construction, Time based circuit, Measurement with CRO, CRO probes. DSO-construction, working principle and applications.Function generator-Square, triangular Sinusoidal waveform generator, Spectrum analyzer.

Module 3: A. C And D. C Bridges(10 Hours.)

General equation for bridge balance, D.C. bridges, Wheatstone bridge, Kelvin's double bridge, General form of an A.C. bridge, Maxwell's inductance –capacitance bridge, Hay's bridge, Anderson's bridge, Schering bridge, Wien's bridge, Sources of errors in bridge measurement, Wagner earthing device.

Module 4: Measurement of Power and Energy (10 Hours.)

Definitions of power, types, Measurement of power, different methods, construction and working of Electrodynamometer type of Wattmeter. Errors in power measurements. Energy, Induction type energy meter, Indicating type Frequency meter, Electrodynamometer type P.F. meter- construction and working principle, advantages, disadvantages of all.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Electrical and Electronic Measurements & Instrumentation By A.K. Sawhney - Dhanpat Rai.
2. Electronic Measurement & Instrumentation By H. Cooper - PHI.
3. Electronic Instrumentation by H. S. Kalsi - McGraw HilI.
4. Electrical and Electronics Measurements and Instrumentation by PrithwirajPurkait - McGraw HilI.
5. Electrical and Electronic Measurements & Instrumentations By J.B. Gupta – KATARIA.

****

Program Elective 1.2:Power Electronics (PEEC-608/2)

Course Code	PEEC-608/2
Course Title	Power Electronics
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Electronic Devices
Course Category	Program Elective-1
Number of classes	36 hours

Course Outcome:-

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

CO No	CO Description	K-level
CO-1	Explain and extend knowledge about various power semiconductor devices.	K2
CO-2	Apply and construct different power converter circuits.	K3
CO-3	Demonstrate the different modern power semiconductor devices.	K2
CO-4	Construct various topologies and make use of the operation of power electronic circuits such as ac to dc, dc to dc, ac to ac and dc to ac converters	K3
CO-5	Explain PWM, various power regulation and Power systems.	K2

Course Content:-

Module- 1: Characteristics of Semiconductor Power Devices (09 Hours)

Power diode : Special features of construction & v-i characteristics Turn on & turn off characteristics, reverse recovery time, reverse recovery current.**Power BJT :** Construction, working principle Special features, quasi saturation, primary breakdown, secondary breakdown.**Power MOSFET :**Construction, working principle, special features of construction Special properties of power MOSFET with V-groove structure.**IGBT:** Construction & working principle. Comparative study of important performance parameters of power BJT, MOSFET & IGBT

Module- 2: Thyristor, Controlled rectifiers and AC voltage controllers (09Hours)

Thyristors : Construction, working principle. di/dt& dv/dt protection, snubber circuit. Series & parallel operation, static & dynamic equalization network. Commutation circuits: - natural commutation &self commutation. **AC voltage controllers (AC/AC) :**Single phase half wave & full wave controllers Single phase cyclo-converter. Single phase PWM AC voltage controllers.**Controlled rectifiers (AC/DC): -** Single phase semi converter, full converter, dual converter.

Module- 3: Choppers and Inverter (10Hours)

Choppers/Switched mode converters (DC/DC) : Principle of step up/step down operation. Classifications – A.B.C.D.E. Buck, boost, buck-boost, Cuk regulators Principle of operation (qualitative) of full bridge converter. **PWM switch mode inverters (DC/AC) :**Principle of operation. Harmonic profile: - harmonic factor for nth harmonic (HF_n), Total harmonic distortion (THD), Distortion factor (DF), Lowest order harmonic (LOH). Single phase bridge inverter: - operating principle & harmonic profile. Voltage control of single-phase bridge inverter: - single pulse width modulation, multiple pulse width modulation, sinusoidal pulse width modulation; - estimation of RMS output and harmonic factor in each case.Three phase 120 and 180 degree conduction with star connected resistive load and R-L load.

Module- 4:Applications (8Hours)

Power supplies: Overview of SMPS, its merits over linear regulated DC power suppliesWorking principle of various techniques of SMPS, - fly back, feed forward, push-pull, half bridge & full bridge.**UPS**– Construction and operating principle.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:-**

1.M.H. Rashid, „Power Electronics: Circuits, Devices and Applications", Pearson Education, PHI Third edition, New Delhi 2011.
2.M.D. Singh, K.B. Khanchandani, "Power Electronics", TMH Publishing Co. Ltd., 2008.
3.Ned Mohan, Tore.M.Undeland, William.P.Robbins, „Power Electronics: Converters, Applications and Design", John Wiley and sons, third edition, 2009.
4.Vidhyathil Joseph, "Power Electronics Principles and Applications", McGraw-Hill, 2013.
5.Williams, B. W., Power Electronics: Devices, Drivers, Applications, and Passive Components, McGraw Hill, 2nd edition 1992.
6.Andrzej M. Trzynadlowski " Introduction to Modern Power Electronics" Wiley India Pvt. Ltd., Second edition 2012
7.P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition 2003

****

Program Elective 1.3: Bio-Medical Engineering (PEEC-608/3)

Course Code	PE EC608/3
Course Title	Bio-Medical Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Biology, Electrical Measurement & Instrumentation
Course Category	Program Elective (PE)
Number of classes	36 hours

Course Outcome:

After completing the course in Bio-Medical Engineering, the students will be able to:

CO Number	CO Description	K-level
CO-1	Relate the basic fundamental concept of biomedical engineering	K1
CO-2	Demonstrate how to monitor the condition of patients using different electrical application based instruments.	K2
CO-3	Compare the different modern Imaging System used in biomedical applications	K4
CO-4	Relate the working of different therapeutic Equipment used in biomedical applications	K1

Course Content:

Module 1: Introduction to Bio-Medical Engineering (8 hours)

The age of Biomedical Engineering, Development of Biomedical Instrumentation, Physiological system of the body, Problem encountered in measuring a living system.Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Bioelectric potentials examples (ECG, EEG, EMG, ERG, EOG,EGG, etc. introduction only.)

Module 2: Patient Monitoring Instruments (8 hours)

Concept of ECG, EEG, EMG, ERG. Measurement of heart rate and blood flow, concept of pulse oximeters, Bio telemetry system and its importance, Concept of spirometry, Holter monitor and cardiac stress test, Blood gas analyzer. Measurement of blood pressure.

Module 3: Modern Imaging System (12 hours)

Different types of analytical and diagnostic instruments. Working concept of X-Ray machine, computed tomography (CT), magnetic resonance imaging system (MRI), Ultrasonography. Doppler ultrasonography and contrast ultrasonography. Pulmonary function measurements. Plethysmography: Photo Plethysmography and Body Plethysmography.Ultrasonic imaging systems: Basic pulse echo system, propagation of ultrasonic through tissues and reflections, display types, A-Scan, B-Scan, M-Scan, applications, real-time ultrasonic imaging systems and probes. Magnetic Resonance Imaging – Basic NMR components, Biological effects and advantages of NMR imaging.

Module 4: Therapeutic Equipment (8 hours)

Cardiac pacemaker with classification, Concept of cardiac defibrillators – its importance and types, principle of surgical diathermy, safety aspects in electro surgical units, applications of laser in bio-medical field, concept and working of haemodialyzer machine, concept of ventillators, its classifications, Concept of Heart-Lung machine.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Handbook of Biomedical Instrumentation, by: R.S Khandpur (Tata McGraw Hill, 3e)
2. Biomedical Instrumentation and Measurements, by : Leslie Cromwell, Fred J. weibell, Erich A. Pfeiffer (PHI publications)
3. Essentials of Biomedical instruments and Techniques by : C.S Datta (AITBS publishers)
4. Biomedical Instrumentation and Measurements, by : R. AnandaNatarajan (PHI publications)
5. Text book of Biomedical Instrumentation, by : K.N Scott, A.K Mathur (CBS publishers)

****

9. Mini Project (PR EC 609)

Course Code	PR EC 609
Course Title	Mini Project
Number of Credits	3 (L: 0, T: 0, P: 6)
Prerequisites	Nil
Course Category	Project(PR)
Number of classes	70 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Demonstrate a through and systematic understanding of project contents	K2
CO-2	Identify the methodologies and professional way of documentation and communication	K3
CO-3	Illustrate the key stages in development of the project	K2
CO-4	Develop the skill of working in a Team	K3
CO-5	Apply the idea of mini project for developing systematic work plan in major project	K3

Course Content:-

The mini project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Perform detailed study about various components of a project.
2) Study about methodologies and professional way of documentation and communication related to project work.
3) Develop idea about problem formulation.

4) Knowledge of how to organize, scope, plan, do and act within a project thesis.
5) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
6) Demonstrate the implementation of a mini project work.

****

Detailed syllabus for

B.Tech in Electronics and Communication Engineering

(Seventh Semester)

2021

SEVENTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-20 (Any One)	PE EC 701	4)Wireless and Mobile Communication 5) Image Processing 6)Computer Networking	3	0	0	3	3	100
2.	Program Elective-3 (Any One)	PE EC 702	4)Information Theory and Coding 5)Audio Video Engineering 6)Artificial Neural Network	2	0	0	2	2	100
3.	Open Elective-1	OE EC 703	**Refer to Annexure-I**	3	0	0	3	3	100
4.	Open Elective-2	OE EC 704	**Refer to Annexure-II**	2	0	0	2	2	100
5.	Project - 2	PR EC 705	Project Work Intermediate	0	0	12	12	6	200
6.	Summer Internship-2	SI EC-706	Internship - II	0	0	0	0	1	100
7.	Seminar - 1	SE EC 707	Seminar on Contemporary Engineering Topics - I	0	0	2	2	1	100
			Total :	**10**	**0**	**14**	**24**	**18**	**800**

Program Elective-2.1: Wireless and Mobile Communication(PEEC-701/1)

Course Code	PEEC-701/1
Course Title	Wireless and Mobile Communication
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Analog and Digital Communication, Electromagnetic Theory, Antenna and Wave Propagation.
Course Category	Program Elective-2 (PE)

Number of classes	38 hours

Course Outcome:

On the completion of this course, the students will be able to:

CO Number	CO Description	K-level
CO-1	Apply their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.	K3
CO-2	Compare different technologies for wireless communication systems.	K2
CO-3	Apply their understanding on multiple access techniques, digital modulation methods, multicarrier modulation ,OFDM for Wireless Communication	K3
CO-4	Apply their understanding on cellular concepts and cellular system design fundamentals.	K3
CO-5	Compare different generations of Cellular System	K2

Course Content:

Module 1: Overview of Wireless Communication (08 Hours)

Introduction to Wireless Communication: unique constraints and challenges, advantage and applications of Wireless Communication, wireless local loop (WLL), cellular concept.
Recent wireless technologies: multicarrier modulation, OFDM, MIMO system, diversity-multiplexing tradeoff in wireless communication.

Module 2: Multiple Access Techniques and Overview of trending Wireless Networks (10 Hours)

Multiple Access Techniques:Contention-free multiple access schemes (FDMA, TDMA, CDMA, SDMA and hybrid), Contention-based multiple access schemes (CSMA, ALOHA), CSMA/CA vs CSMA/CD.
Recent Trends: Wireless Personal Networks (Bluetooth, ZigBee), Software Defined Radio, Wireless Local Area Networks (IEEE 802.11, architecture, medium access methods, WLAN standards), Wireless Metropolitan Area Network (WiMax), Introduction to Wireless Ad-hoc Network, security issues and challenges in Wireless Network.

Module 3: Cellular concepts: (10 Hours)

System design fundamentals: Cellular system, hexagonal geometry cell, frequency reuse, improving capacity and coverage of cell, cell splitting, cell sectorization, channel assignment, hand-off, interference, distance to frequency reuse ratio, co-channel interference reduction factor,S/I ratio consideration and calculation for Minimum Co-channel and adjacent interference, co-channel measurement design of antenna system, antenna parameter and their effects.
Introduction to Digital Modulation techniques: BPSK, QPSK and variants, QAM, MSK and GMSK.

Module 4: Overview of generations of Cellular Systems: (10 Hours)

Overview of 2G standards: GSM architecture, ISM-136 (D-AMPS), ISM-95, GPRS, EDGE (2.75G)

3G cellular standards: UMTS, CDMA2000
Introduction to LTE, Introduction to 5G.

REFERENCES / SUGGESTED LEARNING RESOURCES:

TEXT BOOKS:

1. "Wireless Communications", Andrea Goldsmith, Cambridge University Press, 2005.
2. "Wireless Communication the Fundamental and Advanced Concepts" ,Sanjay Kumar, River Publishers, Denmark, 2015 (Indian reprint).
3. "Mobile Communications Engineering", William C. Y. Lee, Mc Graw Hill Publications.
4. "Mobile and personal Communication system and services", Rajpandya, IEEE press (PHI).
5. "From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Martin Sauter, Third Edition.

REFERENCE BOOKS

1. "Wireless Communications and Networks", Vijay K Garg, Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint)
2. "Mobile Communication", J. Schiller, 2/e, Pearson Education, 2012.
3. Adhoc Mobile Wireless network, C.K.Toh ,Pearson.
4. Mobile Communication Handbooks, IEEE Press.
5. "Fundamentals of LTE ",Arunabha Ghosh, First Edition,Pearson.

****

Program Elective-2.2: Image Processing (PEEC-701/2)

CourseCode	PE EC 701/2
Course Title	Image Processing
Number of credits	3(L: 3, T: 0, P: 0)
Prerequisites	Basic Knowledge of Mathematics and Signals
Course Category	Program Elective
Number of classes	36 hours

CourseOutcome: At the end of the course, the students will be able to:

CO Number	CO Description	K-level
CO-1	Construct Mathematical representation of images and analyze different relationships and operations on them.	K3
CO-2	Apply different techniques employed for the enhancement of images	K3
CO-3	Analyze various colour image models and restoration approaches.	K4
CO-4	Develop algorithms for image compression and coding.	K6

Course Content

Module1: Digital Image Fundamentals (08 hours)

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, imagesampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures. Simple Operations- Arithmetic, Logical, Geometric Operations. Mathematical Preliminaries - 2D Linear Space Invariant Systems - 2D Convolution - Correlation 2D Random Sequence - 2D Spectrum.

Module2: Image Transforms and Enhancement(10 hours)

Image Transforms: 2D Orthogonal and Unitary Transforms-Properties and Examples. 2D DFT- FFT – DCT - Hadamard Transform - Haar Transform - Slant Transform - KL Transform -Properties And Examples. Image Enhancement:- Histogram Equalization Technique- Point Processing-Spatial Filtering-In Space And Frequency - Nonlinear Filtering-Use Of Different Masks.

Module3: Color Models and Image Restoration (08hours)

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.
Image Observation And Degradation Model, Circulant And Block Circulant Matrices and Its Application In Degradation Model - Algebraic Approach to Restoration- Inverse By Wiener Filtering - Generalized Inverse-SVD and Interactive Methods - Blind De-convolution-Image Reconstruction From Projections.

Module4: Image compression and Segmentation (10hours)

Redundancy and Compression Models -Loss Less AndLossy. Loss Less- Variable-Length, Huffman, Arithmetic Coding - Bit-Plane Coding, Loss Less Predictive Coding, Lossy Transform (DCT) Based Coding, JPEG Standard - Sub Band Coding, Image Segmentation: Edge Detection - Line Detection - Curve Detection - Edge Linking And Boundary Extraction, Boundary Representation, Region Representation and Segmentation, Morphology-Dilation, Erosion, Opening and Closing. Hit And Miss Algorithms Feature Analysis.

***REFERENCES/SUGGESTED LEARNING RESOURCES*:**

1) Digital Image Processing R.C. Gonzalez and R.E. Woods, , Second Edition, Pearson Education 3rd edition 2008
2) Fundamentals of Digital Image Processing Anil Kumar Jain, , Prentice Hall of India.2nd edition 2004
3) Digital Image Processing, Kenneth R Castleman, Pearson Education,1995.
4) Digital Image Procesing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education ,2009. Pvt Ltd, NewDelhi
5) A Practical Approach for Image Processing & Computer Vision In MATLAB,Prof. NeerajBhargava, Dr. RituBhargava, AbhishekPandey, CreateSpace Independent Publishing Platform (December 26, 2016)

****

Program Elective-2.3: Computer Networking (PEEC-701/3)

Course Code	PE EC 701/3
Course Title	Computer Networking
Number of Credits	03 (L:3,T:0,P:0)
Prerequisites	Operating System and Computer Architecture
Course Category	Program Elective
Number of classes	38 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Interpret the different building blocks of communication network and its architecture.	K2
CO-2	Analyze error and flow control mechanisms in data link layer.	K4
CO-3	Apply sub-netting and analyze the performance of network layer	K3
CO-4	Construct and examine various routing protocols	K3
CO-5	Illustrate the suitable Application layer protocols for specific applications and its respectivesecurity mechanisms	K2

Course Content:

Module 1: Networking Principles and layered architecture (9 hours)

Data Communications and Networking: A Communications Model – Data Communications - Evolution of network, Requirements, Applications, Network Topology (Line configuration, DataFlow), Protocols and Standards, NetworkModels (OSI, TCP/IP)

Switched Communications Networks – Circuit Switching – Packet Switching – Comparison ofCircuit Switching and Packet Switching – Implementing Network Software, NetworkingParameters(Transmission Impairment, Data Rate and Performance)

Module 2: Data link layer (10 hours)

Error Detection and Correction – Hamming Code , CRC, Checksum- Flow control mechanism – Sliding Window Protocol - GoBack - N - Selective Repeat - Multiple access Aloha - Slotted Aloha- CSMA, CSMA/CD – Multiple Access Networks (IEEE 802.3), Token Ring(IEEE 802.5) andWireless Networks (IEEE 802.11, 802.15).

Module 3: Network layer (10 hours)

IPV4 Address Space – Notations – Classful Addressing – Classless Addressing – Network AddressTranslation – IPv6 Address Structure – IPv4 and IPv6 header format.

Routing-Link State and Distance Vector Routing Protocols- Implementation-PerformanceAnalysis- Packet Tracer.

Module 4: Transport layer & Application layer (9 hours)

TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters
Application layer-Domain Name System-Case Study : FTP-HTTP-SMTP-SNMP.
Recent Trends in Computer Networks.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Computer Networks, Tanenbaum, Pearson.
2. Routing TCP/IP, Volume 1, Jeff Doyle , Jennifer DeHaven Carroll, Cisco Press; 2nd edition .
3. Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education.
4. Internetworking with TCP/IP, Vol. III: Client-Server Programming and Applications, Douglas Comer, David Stevens, Pearson,
5. UNIX Network Programming, W. Richard Stevens, Prentice Hall.

****

Program Elective-3.1:Information Theory and Coding(PEEC 702/1)

Course Code	PE EC 702/1
Course Title	Information Theory and Coding
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Digital Communication
Course Category	Program Elective
Number of classes	26 hours

Course Outcome: After completing the course, the students will be able to-

CO Number	CO Description	K-level
CO-1	Demonstrate the concept of Information and Entropy with their properties	K2
CO-2	Construct Shannon Fano Code, Huffman Code, Limpel Ziv Code.	K3
CO-3	Explain Galois algebra and their relationship in channel coding.	K2
CO-4	Apply linear block codes in random error correction.	K3
CO-5	Construct convolutional code to reduce bit error rate in the communication channel	K3

Module- 1:Information theory (07 Hours)

Information and entropy - properties of entropy of a binary memoryless source - extension of a binary memoryless source - source coding theorem - Shannon fano coding - Huffman coding - Lempel ziv coding - discrete memoryless source - binary symmetric channel - mutual information - properties - channel capacity - channel coding theorem.

Module 2:Introduction to algebra (06 Hours)

Groups - fields - binary field arithmetic - construction of Galois field - basic properties - computations - vector spaces – matrices.

Module 3:Coding I (07 Hours)

Linear block codes - generator matrices - parity check matrices - encoder - syndrome and error correction - minimum distance - error correction and error detection capabilities – cyclic coding and decoding.

Module 4:Coding II (06 Hours)

Convolutional codes - encoder - generator matrix - transform domain representation - state diagram - distance properties - maximum likelihood decoding - viterbi decoding –Introduction to Turbo coding and LDPC.

BOOKS:

1. Simon Haykins, Communication Systems, John Wiley
2. Shu Lin, Costello D.J., Error Control Coding - Fundamentals and Applications, Prentice Hall Inc. Englewood Cliffs
3. Sklar, Digital Communication, Pearson Education
4. Ranjan Bose, Information Theory Coding And Cryptography, McGraw-Hill
5. J S Chitode, Information Theory and Coding, Technical Publication, Pune

****

Program Elective-3.2: Audio &Video Engineering(PEEC 702/2)

Course Code	PEEC 702/2
Course Title	Audio and Video Engineering
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Basics of signal processing, antennas
Course Category	Communication Engineering (CE)
Number of classes	24 hours

Course Outcome: After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explainworking of Audio system.	K2
CO-2	Explain various TV fundamentals.	K2
CO-3	Demonstrate theworking of Monochrome TV Receivers.	K2
CO-4	Outlinethefundamental working principle of Colour TV Receivers.	K2

Module-I: Audio systems (6Hours)

Microphones, loudspeakers, recording & reproduction of sound; high fidelity stereophonic systems.

Module-II: TV fundamentals (6Hours)

Scanning, synchronization & blanking, composite video, Aspect Ratio, picturetubes,phosphor screen, persistence of vision, roll of aluminized coating and shadow mask.

Module-III: Monochrome TV Receivers (6Hours)

Block diagram of TV transmitter & receiver, RF tuner, AGC, Video Detector, Sound Channel Separation, Sync Separation Circuits, Vertical and Horizontal Deflection Circuits, E.H.T.

Module-IV: Colour Television(6Hours)

PAL colour system. Cable and satellite TV,HDTV,3DTV, DTH. Video displays: LCD, LED and PLASMA screens.

CASE STUDIES:

1. Ramya, G., & Kulkarni, S. (2020). Visual saliency based video summarization: A case study for preview video generation. In *Information, Photonics and Communication* (pp. 155-165). Springer, Singapore.
2. Zyka, K. (2019). The Digital Audio Broadcasting Journey from the Lab to Listeners-the Czech Republic Case Study. *Radioengineering*, *29*(2).
3. Lessel, P., Vielhauer, A., & Krüger, A. (2017, May). Expanding video game live-streams with enhanced communication channels: a case study. In *Proceedings of the 2017 CHI conference on human factors in computing systems* (pp. 1571-1576).
4. Lee, J. Y., & Kim, S. K. (2018, April). Development for Audio-Visual Archiving System of The National Archives of Korea: A Case Study. In *Archiving Conference* (Vol. 2018, No. 1, pp. 133-138). Society for Imaging Science and Technology.
5. Jokisch, O., Strutz, T., Leipnitz, A., Siegert, I., & Ronzhin, A. AUDIO AND VIDEO PROCESSING OF UAV-BASED SIGNALS IN THE HARMONIC PROJECT.

***TEXTBOOKS*:**

1. R G Gupta, Television Engineering and Video Systems, Tata McGraw-Hill Education.
2. R G Gupta, *Audio* & Video Systems, Tata McGraw-Hill Education
3. A.M.Dhake, "Television and Video Engineering", McGraw Hill Publications.
4. R.R.Gulati,"MonochromeandColourTV",NewAgeInternationalPublication.

***REFERENCEBOOKS*:**

1. S.P.Bali, Colour Television Theory and Practice, TMH.
2. R.R.Gulati,"ModernTelevisionPractice–Principles,TechnologyandService",NewAgeInternational Publication.
3. B.GrobandC.E.Herndon,"BasicTelevisionandVideoSystems",McGrawHill

****

Program Elective-3.3:Artificiel Neural Networks (PEEC 702/3)

Course Code	PEEC 702/3
Course Title	Artificial Neural Networks
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Logical and analytical skills, basic electronics.
Course Category	Program Elective-3
Number of classes	24 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Explain the biological neural network.	K2
CO-2	Model equivalent neuron models.	K3
CO-3	Extend the knowledge of learning strategies and learning rules	K2
CO-4	Illustrate the architecture, learning algorithm and issues of various feed forward and feedback neural networks	K2

Course Content:-

Module- 1:Introduction to Neural Networks(06)

Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks.

Module- 2: Introduction to Learning Process (06)

Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

Module- 3: Single Layer & Multi-layer Feed forward Neural Networks(06)

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

Module- 4:Back Propagation (06)

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:-**

1. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu MC GRAW HILLEDUCATION 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House,Ed. 2006
5. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
6. Rajasekharan and Rai, “Neural Networks, Fuzzy logic, Genetic algorithms:synthesis and applications”, PHI Publication.
7. S.N.Sivanandam, S.Sumathi, S.N.Deepa, “Introduction to Neural Networks using MATLAB 6.0 “TMH, 2006

8. J.M.Zurada, “Artificial Neural Networks”.
9. Timothy.J.Ross, “Fuzzy logic Applications”.
10. James A Freeman and Davis Skapura, “Neural Networks”, Pearson Education, 2002.
11. Simon Hakins, “Neural Networks”, Pearson Education
12. C.Eliasmith and CH.Anderson, “Neural Engineering”, PHI Bart Kosko, “Neural Networks & Fuzzy systems”.

****

3. Open Elective-1: Refer to Annexure-I

****

4. Open Elective-2: Refer to Annexure-II

****

5. Project Work Intermediate (PR EC 705)

Course Code	PR EC 705
Course Title	Project Work Intermediate
Number of Credits	6 (L: 0, T: 0, P: 12)
Prerequisites	Nil
Course Category	Project (PR)
Number of classes	130 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Demonstrate a sound technical knowledge of their selected project topic	K2
CO-2	Develop the skill of working in a Team	K3
CO-3	Design engineering solutions to complex problems utilizing a systematic approach	K6
CO-4	Design the solution of an engineering project involving latest tools and techniques	K6
CO-5	Develop the skill of effective communication with engineers and the community at large in written an oral forms	K3
CO-6	Demonstrate the knowledge, skills and attitudes of a professional engineer	K2

Course Content:-

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
6) Develop project report as per the suggested format to communicate the findings of the project work.
7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Develop knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
10) Demonstrate the implementation of a project work.

****

6. Industry Internship – II(SIEC 706)

Course Code	SIEC 706
Course Title	Industry Internship – II
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Summer Internship (SI)
Number of classes	-

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course of study	K3
CO-2	Develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organizational setting	K3
CO-3	Demonstrate the skill to communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means	K2
CO-4	Show professional ethics by displaying positive disposition during internship	K2

CO-5	Decide career options by considering opportunities in company, sector, industry, professional and educational advancement	K5

Course Content:-

The industry internship aims to provide the student with:

1. A practice-oriented and 'hands-on' working experience in the real world or industry, and to enhance the student's learning experience.
2. An opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.
3. An opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.
4. Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

Each student shall

1) Identify an internship program of relevance in his/her branch of engineering to undergo during summer break between 6^{th} and 7^{th} semester,
2) Get approval of the concerned HOD,
3) Undergo the industry internship program for minimum 4 weeks duration
4) Prepare their own report
5) Present in the class among fellow students and faculty members / deliver viva voce.
6) Submit the report and participation/course completion certificate.

****

7. Seminar on Contemporary Engineering Topics – I(SE EC 707)

Course Code	SE EC 707
Course Title	Seminar on Contemporary Engineering Topics – I
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Seminar (SE)
Number of classes	24 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Identify contemporary topics in respective branch of engineering	K3
CO-2	Survey literature to understand insight of the selected topic	K4
CO-3	Develop report writing and presentation making skill	K3
CO-4	Utilize suitable aid to present the topic among audience.	K3

Course Content:-

Each student shall

1. Identify a topic of current relevance in his/her branch of engineering,
2. Get approval of the faculty concerned/HOD,
3. Collect sufficient literature on the selected topic, study it thoroughly (literature survey),
4. Prepare their own report and presentation slides and
5. Present in the class among fellow students and faculty members.

****

Tripura University
(A Central University)

Detailed syllabus for

B.Tech in Electronics and

Communication Engineering

(Eighth Semester)

2021

EIGHTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-4 (Any One)	PE EC 801	4)Satellite and RADAR Engineering 5)Nano Electronics 6)Fuzzy Logic and Its Applications	3	0	0	3	3	100
2.	Program Elective-5 (Any One)	PE EC 802	4)Antenna and Wave Propagation 5)Advanced VLSI 6)Introduction to Artificial Intelligence	2	0	0	2	2	100
3.	Open Elective-3	OE EC 803	**Refer to Annexure-III**	3	0	0	3	3	100
4.	Open Elective-4	OE EC 804	**Refer to Annexure-IV**	2	0	0	2	2	100
5.	*Project - 3*	*PR EC 805*	*Project Work Final*	0	0	12	12	6	200
6.	*Seminar - 2*	*SE EC 806*	*Seminar on Contemporary Engineering Topics - II*	0	0	2	2	1	100
7.	*Online Course*	*SW EC 807*	*SWAYAM Courses*[#]	0	0	0	0	1	100
			Total :	10	0	14	24	**18**	**800**

Program Elective-4.1:Satellite and Radar Engineering (PE EC 801/1)

Course Code	PE EC 801/1
Course Title	Satellite and RADAR Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basics of electromagnetics, signalprocessing, antennas and digital communications
Course Category	Program Elective (PE)
Number of classes	36 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain Principles of satellite Communication systems	K2

CO-2	Explain the properties of various Satellite sub-systems, Modulation schemes and Multiple Access Techniques.	K2
CO-3	Explain the fundamentals of Radar system.	K2
CO-4	Analyze system performance of Tracking Radar.	K4

Course Content:-

Module-I: Introduction to Satellite Communication and Orbital Mechanics (09Hours)

Principles and architecture of satellite Communication,Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands usedforsatellitecommunication. Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit,evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day andSiderealday.

Module-II: Satellite sub-systems, Modulationschemes andMultipleAccessTechniques (09Hours)

Study of Architecture and Roles of various sub-systems of a satellite systemsuch as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system(AOCS),Communicationsub-system,powersub-systemsetc. Satellitelinkbudget. Variousmodulationschemes, Multiple access schemes based on time,frequency,andcodesharingnamelyTDMA,FDMAandCDMA.

Module-III:Fundamentals of Radar System(09Hours)

Introduction to radar, radar block diagram and operation, radar frequencies, Applications of radar, Prediction of range performance, minimum detectable signal, receiver noise, probability density function, SNR, Integration of radar pulses, radar cross-section of targets, PRF and range ambiguities, transmitter power, system losses, Related problems.

Module-IV: Tracking Radar (09Hours)

Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar, Low angle tracking, Pulse compression, Block Diagrams of Synthetic Aperture Radar (SAR), Phased array Radars.

***TEXT BOOKS* :**

1. Merril. I. Skolnik, Introduction to Radar Systems, 2/e, MGH, 1981.
2. Mark A. Richards, James A. Scheer and William A. Holm, Principles of Modern Radar: Basic Principles, Yes Dee Publishing Pvt. Ltd., India, 2012.
3. Byron Edde, Radar: Principles, Technology, Applications, Pearson, 2008.
4. Timothy Pratt and Charles Bostian, Satellite Communications, John Wiley, 1986.
5. Dennis Roddy, Satellite Communications, MGraw Hill, Millan, 4th edition, 2013.

****

Program Elective-4.2:Nano Electronics (PE EC 801/2)

Course Code	PE EC 801/2
Course Title	Nano Electronics

Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Solid State Physics
Course Category	Program Elective (PE)
Number of classes	36 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain various aspects of nano-technology and the processes involved in making nano components and material.	K2
CO-2	Explain advantages of the nano-materials and appropriate use in solving practical problems	K2
CO-3	Utilise various aspects of nano-technology and the processes involved in making nanocomponents and material.	K3
CO-4	Explain transport of charge in Nanostructures under Electric field and Magnetic field.	K2
CO-5	Utilise the concepts of silicon MOSFET and Quantum Transport Devices.	K2

Course Content:

Module 1: Introduction to Nanotechnology (10 hours)

Introduction: Discussion of the International Technology Roadmap characteristics: Need for new concepts in electronics from microelectronics towards biomolecule electronics. Application of Nanotechnology
Molecular Nanotechnology: Electron Microscope, Scanning Electron Microscope, Atomic Force Microscope, Scanning Tunneling Microscope.
Nanomaterials Preparation: Chemical Vapor Deposition, Physical Vapor Deposition

Module 2: CMOS Scaling (08 hours)

Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig- Penny Model. Brillouin Zones.
CMOS Scaling, Nanoscale MOSFET, Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot, DIBL.

Module 3: Transport Phenomena in Nano electronics (08 hours)

Transport of charge in Nanostructures under Electric field, parallel transport, hot electrons, perpendicular transport, Quantum transport in nanostructures, Transport of charge in magnetic field, Effect of magnetic field on a crystal, Aharonov-Bohm effect, the Shubnikov-de Hass effect, quantum Hall effect. 2D semiconductors.

Module 4: Silicon MOSFETS & Quantum Transport Devices (10 hours)

Nanoscale MOSFET, Transport in Nano MOSFET, FINFETs, Vertical MOSFETs, double gate transistors, Silicon on insulator (SOI), PDSOI (partially depleted SOI) and FDSOI (fully depleted SOI) Ultrathin body SOI,

Electron tunnelling, resonant tunneling diodes, resonant tunneling devices,Single electron devices for logic applications, Single electron devices, applications of single electron devices to logic circuits.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. G.W. Hanson, Fundamentals of Nano electronics, Pearson, 2009.
2. W. Ranier, Nano electronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

****

Program Elective-4.3:Fuzzy Logic and Its Applications (PE EC 801/3)

Course Code	PE EC 801/3
Course Title	Fuzzy Logic and Its Applications
Number of Credits	03 (L:3,T:0,P:0)
Prerequisites	Set Theory
Course Category	Program Elective (PE)
Number of classes	38 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain basic knowledge of the fuzzy sets, operations and their properties.	K-2
CO-2	Explain the fundamental concepts of Fuzzy functions and Fuzzy logic	K-2
CO-3	Apply the concepts of Fuzzy sets in Decision Making	K-3
CO-4	Apply the concepts of Fuzzy sets in image processing , Pattern reorganization and construct and examine various routing protocols	K-4

Course Content:

Module 1: Fuzzy sets: (12 hours)

Basic concepts of fuzzy set, t-norm, t-conorms, membership function, α-cut, Algebra of fuzzysets , distance between fuzzy sets, fuzzy relation.Fuzzy numbers , Arithmetic operations of fuzzy numbers , Extension principle, Interval arithmetic, Defuzzification.

Module 2 : Fuzzy function (12 hours)

Fuzzy valued functions , fuzzy equations, fuzzy inequalities , system of fuzzy . linearequations , maximum and minimum of fuzzy functions. Fuzzy Logic :Classical Logic – Multi-valued Logics – Fuzzy ropositions – Fuzzy Quantifiers – Linguistic hedges – Inference from conditional Fuzzy proposition**.**

Module 3 :Applications of Fuzzy set theory: (07 hours)

Fuzzy sets in Decision making , Optimization in Fuzzy environment, Fuzzy set application inimage processing , Fuzzy set application in Pattern reorganization.

Module 4 :Artificial Neural Networks: (07 hours)

Basic concepts - Architecture of ANN, Activation Functions,Training of ANN- Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.Application of ANN in Pattern Analysis.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Fuzzy sets and Fuzzy logic Theory and applications, George J.Klir and Bu Yuan, (PHI)
2. Fuzzy sets and systems, Didier Bubois and Henri Prade , Academic Press.
3. Introduction to Artificial Neural Networks, S.N. Sivanandam, M. Paul Raj ,VIKAS
4. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
5. Neural Networks and Learning Machines Simon Haykin (PHI)

****

Program Elective-5.1:Antenna and Wave Propagation (PEEC 802/1)

Course Code	PE EC 802/1
Course Title	Antenna and Wave Propagation
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Communication
Course Category	Program Elective (PE)
Number of classes	26 hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	Explain basic of an antenna	K2
CO-2	Explain properties about different Antenna Arrays	K2
CO-3	Identify and design the different types of antenna.	K3
CO-4	Develop different antenna parameter to design a system	K6
CO-5	Explain fundamental concepts of wave Propagation	K2

Course Content:

Module 1:Antenna Fundamentals (08 Hours)

Review of electromagnetic fields, Electromagnetic radiations, Review of Maxwell's Equation, Antenna Parameters: Introduction, Isotropic radiators, Radiation pattern, Gain, Directive gain, Directivity, Reciprocity theorem & its applications, effective aperture, radiation resistance, terminal impedance, noise temperature, elementary ideas about self & mutual impedance, front-to-back ratio, antenna beam width, antenna bandwidth, antenna beam efficiency, antenna beam area or beam solid angle, polarization, antenna temperature.

Module 2: Antenna Arrays (08 Hours)

Antenna Arrays: Introduction, various forms of antenna arrays, arrays of point sources, non-isotropic but similar point sources, multiplication of patterns, arrays of n-isotropic sources of equal amplitude and spacing (Broad-side & End-fire array cases), array factor, directivity and beam width, array of n-isotropic sources of equal amplitude and spacing end-fire array with increased directivity, scanning arrays, Dolph-Tchebysceff arrays, tapering of arrays, binomial arrays, continuous arrays, rectangular arrays, super directive arrays.

Module 3: Practical Antennas (05 Hours)

Aperture Antennas, loop antennas, slot radiators, scanning antennas, signal processing antennas, travelling wave antennas, Smart Antennas. long wire antenna, V-antenna, Rhombic antenna, Folded dipole antenna, Yagi-Uda antenna, and helical antenna,Horn antennas, slot antenna, microstrip or patch antennas, and turnstile antenna, frequency independent antennas, and microwave antennas, antenna measurement.

Module 4: Wave Propagation (05 Hours)

Propagation Mechanism- Reflection, refraction and Transmission, Scattering and diffraction, structure of atmosphere, basic idea of ground wave propagation, surface wave propagation, and space wave propagation, troposphere propagation and duct propagation.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Krauss J D, "Antennas", 4th edition, McGraw – Hill Inc., New York (1991).
2. Balanis A Constantine, "Antenna Theory, analysis and design", 2nd edition, Wiley, New York.(1997).
3. Prasad K D, "Antenna and Wave Propagation", 3rd edition, Satya Prakashan, New Delhi (1996).
4. Stutzman W L, Thieele G A, "Antenna Theory and Design", 2nd Ed., Wiley (1997).
5. C ABalanis, Antenna Theory: Analysis and Design, John Wiley & Sons publications, 2nd edition, 2014.

****

Program Elective-5.2:Advanced VLSI (PE EC 802/2)

Course Code	PE EC 802/2
Course Title	Advanced VLSI
Number of Credits	2 (L: 2, T: 2, P: 0)
Prerequisites	VLSI Design
Course Category	Program Elective (PE)
Number of classes	26 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain basic device physics of MOS transistors.	K2
CO-2	Explain design issues, switching activity, power reduction techniquesof CMOS circuits.	K2
CO-3	Explain various CMOS combinational circuits and their working.	K2
CO-4	Apply various CMOS sequential circuits and their working.	K3

Course Content:

Module 1: MOS Transistor Basics (06 Hours)

Semiconductors, Junctions and MOSFET Overview: Introduction, Semiconductors, Conduction,Contact Potentials, P-N Junction.

Basic Device Physics:

Two Terminal MOS Structure: Flat -band voltage, Effect of Gate- substrate voltage on surfacecondition, Inversion,

Three Terminal MOS Structure: Contacting the inversion layer, Body effect, Regions ofinversion, Pinch-off voltage;

Four Terminal MOS Transistor: Transistor regions of operation, general charge sheet models,regions of inversion in terms of terminal voltage.

Module 2: VLSI circuit techniques (08 Hours)

Basic principles of low power design, transistor and gate sizing, pin ordering. Adjustable threshold voltages, logic-signalgating, clock gating. Power reduction in clocked networks, delay balancing. Switching activity reduction, parallelvoltage reduction, operator reduction, adiabatic computation.

Module 3: Combinational MOS Logic Circuits(06 Hours)

MOS logic circuits with depletion loads, CMOS logicgates, CMOS transmission gates, pseudo-NMOS domino logic gates, complex logic gates. Multilevelgate circuits and design, pass transistor logic.

Module 4: Sequential MOS Logic Circuits&CMOS OPAMP (06 Hours)

CMOS latch, clocked latch and flip-flop, Schmitt trigger circuit. Synchronous dynamic circuit techniques, high-performance dynamic CMOS circuits.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. CMOS Digital Integrated Circuit by Sung-Mo Kang and Yusuf Leblebici.
2. VLSI Design and EDA Tools by Angsuman Sarkar.
3. Low Power CMOS VLSI Circuit Design by Kaushik Roy.
4. CMOS Circuit Design, Layout and Simulation by R. Jacob Baker.
5. VLSI Design by Debaprasad Das.

****

Program Elective-5.3:Introduction to Artificial Intelligence (PE EC 802/3)

Course Code	PE EC 802/3
Course Title	Introduction to Artificial Intelligence
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Mathematics, Analytics and Programming skills.
Course Category	Program Elective (PE)
Number of classes	26 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems	K2
CO-2	Apply Knowledge Representation, Problems in representing knowledge, Introduction to prolog.	K3
CO-3	Apply Network-based representation and reasoning	K3
CO-4	Analyze Adversarial search and Game theory, alpha-beta cut-offs, Introduction to natural language processing	K4
CO-5	Explain Reasoning in uncertain environments, Fuzzy logic, Probabilistic reasoning	K2

Course Content:

Module 1: Introduction: (6 hours)

Objective, scope and outcome, Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems; Breadth first search and depth first search techniques. Heuristic search Techniques: Hill Climbing, Iterative deepening DFS, bidirectional search. Analysis of search methods.A* algorithm, and their analysis.Introduction to Genetic Algorithms.

Module 2: Knowledge Representation :(6 hours)

Problems in representing knowledge, knowledge representation using propositional and predicate logic, logical consequences, syntax and semantics of an expression, semantic Tableau.Forward and backward reasoning. Proof methods, substitution and unification, conversion to clausal form, normal forms, resolution, refutation, deduction, theorem proving, interference, monotonic and non-monotonic reasoning. Introduction to prolog.

Module 3: Language Processing (6 hours)

Network-based representation and reasoning, Semantic networks, Conceptual Graphs, frames.Description logic (DL), concept language, reasoning using DL.Conceptual dependencies (CD), scripts, reasoning using CD.Introduction to natural language processing.

Module 4: Fuzzy logic (8 hours)

Adversarial search and Game theory, classification of games, game playingstrategies, prisoner's Dilemma. Game playing techniques, minimax procedure, alpha-beta cut-offs. Complexity of alpha-beta search.Automated planning, classical planning problem, forward planning, partial order planning, planning with proposal logic, hierarchical task planning, multiagent planning.Reasoning in uncertain environments, Fuzzy logic, fuzzy composition relation, operations on fuzzy sets. Probabilistic reasoning, Bayes theorem, construction of Bayesian networks, belief propagation. Markov processes and Hidden Markov models.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill.
2. Introduction to AI & Expert System: Dan W.Patterson, PHI.
3. Artificial Intelligence by Luger (Pearson Education)
4. Russel & Norvig, Artificial Intelligence: A Modern Approach, Pearson Education
5. N. P. Padhy – Artificial Intelligence and Intelligence Systems, OXFORD publication.
6. B. YagnaNarayana - Artificial Neural Networks, PHI
7. Simon Haykin -Neural Networks PHI.

****

3. Open Elective-1: Refer to Annexure-III

****

4. Open Elective-2: Refer to Annexure-IV

****

5. Project Work Final (PR EC 805)

Course Code	PR EC 805
Course Title	Project Work Final
Number of Credits	6 (L: 0, T: 0, P: 12)
Prerequisites	Nil
Course Category	Project (PR)
Number of classes	130 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Demonstrate a sound technical knowledge of their selected project topic	K2
CO-2	Develop the skill of working in a Team	K3

CO-3	Design engineering solutions to complex problems utilizing a systematic approach	K6
CO-4	Design the solution of an engineering project involving latest tools and techniques	K6
CO-5	Develop the skill of effective communication with engineers and the community at large in written an oral forms	K3
CO-6	Demonstrate the knowledge, skills and attitudes of a professional engineer	K2

Course Content:-

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
6) Develop project report as per the suggested format to communicate the findings of the project work.
7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Develop knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
10) Demonstrate the implementation of a project work.

****

6. Seminar on Contemporary Engineering Topics – II (SE EC 806)

Course Code	SE EC 806
Course Title	Seminar on Contemporary Engineering Topics – II
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Seminar (SE)
Number of classes	24 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Identify contemporary topics in respective branch of engineering	K3
CO-2	Survey literature to understand insight of the selected topic	K4

CO-3	Develop report writing and presentation making skill	K3
CO-4	Utilize suitable aid to present the topic among audience.	K3

Course Content:-

Each student shall

1) Identify a topic of current relevance in his/her branch of engineering,
2) Get approval of the faculty concerned/HOD,
3) Collect sufficient literature on the selected topic, study it thoroughly (literature survey),
4) Prepare their own report and presentation slides and
5) Present in the class among fellow students and faculty members.

****

7. SWAYAM Courses (SW EC 807)

Course Code	SW EC 807
Course Title	SWAYAM Courses
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Online Course (SW)
Number of classes	-

Courses Outcome:-

After completion of the courses, students will be able to:

CO Number	CO Description	K-level
CO-1	Make use of digital learning platform to enhance knowledge and skill beyond the prescribed curriculum structure	K3
CO-2	Take part in proctored examination system to prepare oneself for similar future challenges	K4
CO-3	Utilize the opportunity to learn from best faculty in the countryfor professional development	K3
CO-4	Develop the skill of lifelong self-learning and become future ready	K3

Courses Content:-

SWAYAM (Study Webs of Active-learning for Young Aspiring Minds); India Chapter of Massive Open Online Courses. SWAYAM is an indigenous developed IT platform, initiated by Government of India, which is instrumental for self-actualization providing opportunities for a life-long learning. Learner can choose from hundreds of courses, virtually every course that is taught at the university/college/school level and these shall be offered by best of the teachers in India and elsewhere. Student having registered a course, having submitting the Assignments as per requirements of the course, shall at the end of each course, be accessed through a proctored examination. A student having successfully completed the course shall get a Certificate.

Each student has to undergo and qualify at least two relevant SWAYAM or equivalent courses (to be certified by concerned HOD) with certification during the entire course of B. Tech. program. The Head of the departments will approve the relevancy of a SWAYAM or equivalent course for respective branch of engineering.

****

PROGRAM OUTCOMES (POS) AS PER NATIONAL BOARD OF ACCREDITATION (NBA)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.