

COURSE: CRS PATTERN

Name of the Faculty: Technology and Engineering

Name of the Programme: Bachelor of Engineering- CRS Electronics

Mode of Learning: REGULAR

Semester Number (For Example 01,02,03, etc.):								01						
Maximum Courses/Papers for the present Semester:								11						
Minimum Courses/Papers for the present Semester:								11						
Maximum marks for the present Semester:								750						
Minimum marks for the present Semester:								00						
Total Credits for the present Semester:								23.5						
Sr. No.	Department (NAME OF THE DEPARTMENT WHICH IS TEACHING THE PAPER)	Type of Course Core/ Elective/ Foundation/ IDE/ Compulsory etc.	Title of Paper	Group (if any)	Hours of Teaching per week	Credit	Teaching Learning Method [TLM]	Assessment Method [AM]	Assessment Type [AT] UA/IA	UA Marks	IA Marks	Total Marks	Minimum marks for Passing	Remarks for Minimum /Maximum Course/Paper/Subject/ Selection
1	English	Foundation Compulsory	Communication Skills (ENG1002CS)	NA	02	02	Lecture	Theory	UA	50	--	50	20	UA=50
2	English	Foundation Compulsory	Communication Skills Lab (ENG1002LCS)	NA	01	0.5	Laboratory	Practical and Viva Voce	UA	50	--	50	20	UA=50
3	Applied Mathematics	Foundation Compulsory	Applied Mathematics-I-ELC (AMT1109CS)	NA	04	04	Lecture	Theory	UA	100	--	100	40	UA=100
4	Applied Physics	Foundation Compulsory	Applied Physics-I-ELC (APH1112CS)	NA	04	04	Lecture	Theory	UA	100	--	100	40	UA=100
5	Applied Physics	Foundation Compulsory	Applied Physics-I (TW, Practical and Viva) - ELC (APH1112LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
6	Civil Engineering	Foundation Compulsory	Fundamentals of Civil and Environmental Engineering-ELC (CVL1111CS)	NA	04	04	Lecture	Theory	UA	100	--	100	40	UA=100

7	Civil Engineering	Foundation Compulsory	Fundamentals of Civil and Environmental Engineering (TW, Practical and Viva) - ELC (CVL1111LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
8	Mechanical Engineering	Foundation Compulsory	Engineering Drawing-I-ELC (MEC1109CS)	NA	03	03	Lecture	Theory	UA	100	--	100	40	UA=100
9	Mechanical Engineering	Foundation Compulsory	Engineering Drawing-I (TW, Practical and Viva)- ELC (MEC1109LCS)	NA	04	02	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
10	Mechanical Engineering	Foundation Compulsory	Workshop Practices- ELC (MEC1119LCS)	NA	04	02	Laboratory	Term Work, Practical & Viva	UA	100	--	100	40	UA=100
11		Foundation Compulsory	Universal Human Values I (FTE1101CS)	NA	01	00	Lecture	Theory	UA	50	--	50	20	UA=100

Semester Number (For Example 01,02,03, etc.):						02								
Maximum Courses/Papers for the present Semester:						09								
Minimum Courses/Papers for the present Semester:						09								
Maximum marks for the present Semester:						750								
Minimum marks for the present Semester:						00								
Total Credits for the present Semester:						23								
Sr. No.	Department (NAME OF THE DEPARTMENT WHICH IS TEACHING THE PAPER)	Type of Course Core/ Elective/ Foundation/ IDE/ Compulsory etc.	Title of Paper	Group (if any)	Hours of Teaching per week	Credit	Teaching Learning Method [TLM]	Assessment Method [AM]	Assessment Type [AT] UA/ IA	UA Marks	IA Marks	Total Marks	Minimum marks for Passing	Remarks
1	Applied mathematics	Foundation Compulsory	Applied Mathematics – II-ELC (AMT1214CS)	NA	04	04	Lecture	Theory	UA	100	--	100	40	UA=100
2	Applied Mechanics	Foundation Compulsory	Engineering Mechanics-ELC (APM1212CS)	NA	04	04	Lecture	Theory	UA	100	--	100	40	UA=100
3	Applied Mechanics	Foundation Compulsory	Engineering Mechanics (TW, Practical and Viva)-ELC (APM1212LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50
4	Electrical Engineering and Applied Mathematics	Core Compulsory	Programming and Simulations-ELC (ELE1213LCS)	NA	04	02	Laboratory	Term Work, Practical and Viva	UA	100	--	100	40	UA=100
5	Electrical Engineering	Core Compulsory	Basic Electrical Engineering-ELC (ELE1211CS)	NA	04	04	Lecture	Theory	UA	100	--	100	40	UA=100
6	Electrical Engineering	Core Compulsory	Basic Electrical Engineering (TW, Practical and Viva)-ELC (ELE1211LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50

7	Electrical Engineering	Core Compulsory	Basic Electronics-ELC (ELE1216CS)	NA	03	03	Lecture	Theory	UA	100	--	100	40	UA=100
8	Electrical Engineering	Core Compulsory	Basic Electronics (TW, Practical and Viva)-ELC (ELE1216LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50
9	Metallurgical and Materials Engineering	Foundation Compulsory	Material Science-ELC (MME1203CS)	NA	03(03)	03	Lecture	Theory	UA	100	--	100	40	UA=100

Semester Number (For Example 01,02,03, etc.):						03								
Maximum Courses/Papers for the present Semester:						10								
Minimum Courses/Papers for the present Semester:						10								
Maximum marks for the present Semester:						800								
Minimum marks for the present Semester:						00								
Total Credits for the present Semester:						28								
Sr. No.	Department (NAME OF THE DEPARTMENT WHICH IS TEACHING THE PAPER)	Type of Course Core/ Elective/ Foundation/ IDE/ Compulsory etc.	Title of Paper	Group (if any)	Hours of Teaching per week	Credit	Teaching Learning Method [TLM]	Assessment Method [AM]	Assessment Type [AT] UA/IA	UA Marks	IA Marks	Total Marks	Minimum marks for Passing	Remarks for Minimum /Maximum Course/Paper/ Subject/ Selection
1	Electrical Engineering	Core Compulsory	Circuit Analysis & Synthesis-ELC (ELE1326CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
2	Electrical Engineering	Core Compulsory	Circuit Analysis & Synthesis (TW, Practical and Viva)-ELC (ELE1326LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
3	Electrical Engineering	Core Compulsory	Data Structure & C Programming-ELC (ELE1325CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
4	Electrical Engineering	Core Compulsory	Data Structure & C Programming (TW, Practical and Viva)-ELC (ELE1325LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50

5	Electrical Engineering	Core Compulsory	Signals & Systems-ELC (ELE1329CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
6	Electrical Engineering	Core Compulsory	Signals & Systems (TW, Practical and Viva)-ELC (ELE1329LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
7	Applied Mathematics	Foundation Compulsory	Applied Mathematics-III-ELC (AMT1314CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
8	Electrical Engineering	Core Compulsory	Analog Electronic Circuits-ELC (ELE1332CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
9	Electrical Engineering	Core Compulsory	Analog Electronic Circuits (TW, Practical and Viva)-ELC (ELE1332LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
10	Electrical Engineering	Core Compulsory	Electromagnetic Wave Theory-ELC (MEC1327CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30

Semester Number (For Example 01,02,03, etc.):						04								
Maximum Courses/Papers for the present Semester:						10								
Minimum Courses/Papers for the present Semester:						10								
Maximum marks for the present Semester:						700								
Minimum marks for the present Semester:						00								
Total Credits for the present Semester:						27								
Sr. No.	Department (NAME OF THE DEPARTMENT WHICH IS TEACHING THE PAPER)	Type of Course Core/ Elective/ Foundation/ IDE/ Compulsory etc.	Title of Paper	Group (if any)	Hours of Teaching per week	Credit	Teaching Learning Method [TLM]	Assessment Method [AM]	Assessment Type [AT] UA/IA	UA Marks	IA Marks	Total Marks	Minimum marks for Passing	Remarks
1	Electrical Engineering	Core Compulsory	Modern Filter Design-ELC (ELE1432CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
2	Electrical Engineering	Core Compulsory	Modern Filter Design (TW, Practical and Viva)-ELC (ELE1432LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50
3	Electrical Engineering	Core Compulsory	Electronic Measurements and Instruments-ELC (ELE1431CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
4	Electrical Engineering	Core Compulsory	Electronic Measurements and Instruments (TW, Practical and Viva)-ELC (ELE1431LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50
5	Mechanical Engineering	Foundation Compulsory	Industrial Engineering-ELC (MEC1416CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30

6	Electrical Engineering	Core Compulsory	Electrical Machines-ELC (ELE1433CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
7	Electrical Engineering	Core Compulsory	Electrical Machines (TW, Practical and Viva)-ELC (ELE1433LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50
8	Electrical Engineering	Core Compulsory	Digital Systems-ELC (ELE1434CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
9	Electrical Engineering	Core Compulsory	Digital Systems (TW, Practical and Viva)-ELC (ELE1434LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50
10		Foundation Compulsory	Universal Human Values-II (FTExxxx)	NA	03	03	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30

Semester Number (For Example 01,02,03, etc.):						05								
Maximum Courses/Papers for the present Semester:						08								
Minimum Courses/Papers for the present Semester:						08								
Maximum marks for the present Semester:						600								
Minimum marks for the present Semester:						00								
Total Credits for the present Semester:						20								
Sr. No.	Department (NAME OF THE DEPARTMENT WHICH IS TEACHING THE PAPER)	Type of Course Core/ Elective/ Foundation/ IDE/ Compulsory etc.	Title of Paper	Group (if any)	Hours of Teaching per week	Credit	Teaching Learning Method [TLM]	Assessment Method [AM]	Assessment Type [AT] UA/IA	UA Marks	IA Marks	Total Marks	Minimum marks for Passing	Remarks for Minimum /Maximum Course/Paper/ Subject/ Selection
1	Electrical Engineering	Core Compulsory	Broadcast System Engineering (ELE1510CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
2	Electrical Engineering	Core Compulsory	Broadcast System Engineering (TW, Practical and Viva) (ELE1510LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
3	Electrical Engineering	Core Compulsory	Microprocessors & Microcontrollers (ELE1511CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
4	Electrical Engineering	Core Compulsory	Microprocessors & Microcontrollers (TW, Practical and Viva) (ELE1511LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50

5	Electrical Engineering	Core Compulsory	Communication Theory (ELE1508CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
6	Electrical Engineering	Core Compulsory	Communication Theory (TW, Practical and Viva) (ELE1508LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
7	Electrical Engineering	Core Compulsory	Industrial Electronics (ELE1509CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
8	Electrical Engineering	Core Compulsory	Industrial Electronics (TW, Practical and Viva) (ELE1509LCS)	NA	02	01	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50

Semester Number (For Example 01,02,03, etc.):								06							
Maximum Courses/Papers for the present Semester:								09							
Minimum Courses/Papers for the present Semester:								09							
Maximum marks for the present Semester:								700							
Minimum marks for the present Semester:								00							
Total Credits for the present Semester:								23							
Sr. No.	Department (NAME OF THE DEPARTMENT WHICH IS TEACHING THE PAPER)	Type of Course Core/ Elective/ Foundation/ IDE/ Compulsory etc.	Title of Paper	Group (if any)	Hours of Teaching per week	Credit	Teaching Learning Method [TLM]	Assessment Method [AM]	Assessment Type [AT] UA/IA	UA Marks	IA Marks	Total Marks	Minimum marks for Passing	Remarks	
1	Electrical Engineering	Core Compulsory	Control Systems Engineering (ELE1607CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30	
2	Electrical Engineering	Core Compulsory	Control Systems Engineering (TW, Practical and Viva) (ELE1607LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50	
3	Electrical Engineering	Core Compulsory	VLSI Design (ELE1611CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30	
4	Electrical Engineering	Core Compulsory	VLSI Design (TW, Practical and Viva) (ELE1611LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50	
5	Electrical Engineering	Core Compulsory	Embedded Systems (ELE1612CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30	

6	Electrical Engineering	Core Compulsory	Embedded Systems (TW, Practical and Viva) (ELE1612LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50
7	Electrical Engineering	Core Compulsory	Microcomputer Architecture (ELE1620CS)	NA	04	04	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
8		Institute Elective	(ELExxxxIECS)	NA	03	03	Lecture	Theory	UA & IA	70	30	100	40	UA=70 IA=30
9	Electrical Engineering	Core Compulsory	Electronics Workshop (TW, Practical and Viva) (ELE1621LCS)	NA	02	01	Laboratory	Term Work, Practical and Viva	UA	50	--	50	20	UA=50

Semester Number (For Example 01,02,03, etc.):					07								
Maximum Courses/Papers for the present Semester:					05								
Minimum Courses/Papers for the present Semester:					05								
Maximum marks for the present Semester:					400								
Minimum marks for the present Semester:					00								
Total Credits for the present Semester:					17.5								
Sr. No.	Department (NAME OF THE DEPARTMENT WHICH IS TEACHING THE PAPER)	Type of Course Core/ Elective/ Foundation/ IDE/ Compulsory etc.	Title of Paper	Group (if any)	Hours of Teaching per week [Credit*]	Teaching Learning Method [TLM]	Assessment Method [AM]	Assessment Type [AT] UA/IA	UA Marks	IA Marks	Total Marks	Minimum marks for Passing	Remarks for Minimum /Maximum Course/Paper/Subject/ Selection
1	Electrical Engineering	Core Compulsory	Project Part – I (ELE 1711LCS)	NA	09(4.5)	Project	Project	UA	50	--	50	20	UA=50
								IA	--	--			
2	Electrical Engineering	Core Elective	Elective-I Options: (1) Digital Communications (ELE1713DECS) (2) Digital Control and Distributed Control System (ELE1715DECSCS)	NA	04(04)	Lecture	Theory	UA	70	--	100	40	UA=70 IA=30 Select only one subject from communication or Instrumentation Group
								IA	--	30			
3	Electrical Engineering	Core Elective	Elective-II Options: (1) Microwave Theory (ELE1707DECS) (2) Digital Instrumentation (ELE1714DECS)	NA	04(04)	Lecture	Theory	UA	70	--	100	40	UA=70 IA=30 Select only one subject from communication or Instrumentation
								IA	--	30			

													n Group and its respective laboratory
4	Electrical Engineering	Core Elective	Elective-II Lab Options: (1) Microwave Theory (TW, Practical and Viva) (ELE1707LDECS) (2) Digital Instrumentation (TW, Practical and Viva) (ELE1714LDECS)	NA	02(01)	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50
								IA	--	--			
5	Electrical Engineering	Core Elective	Elective-III Options: (1) Mobile Communication (ELE....CS) (2) Embedded Software and Administration (ELE1727DECS) (3) AI & Soft Computing (ELE1729DECS) (4) Wireless Sensor Network and IoT (5) Multicopter Design and Control	NA	04(04)	Lecture	Theory	UA	70	--	100	40	UA=70 IA=30 Select only one subject from the list
								IA	--	30			

Semester Number (For Example 01,02,03, etc.):					08									
Maximum Courses/Papers for the present Semester:					07									
Minimum Courses/Papers for the present Semester:					07									
Maximum marks for the present Semester:					600									
Minimum marks for the present Semester:					00									
Total Credits for the present Semester:					21									
Sr. No.	Department (NAME OF THE DEPARTMENT WHICH IS TEACHING THE PAPER)	Type of Course Core/ Elective/ Foundation/ IDE/ Compulsory etc.	Title of Paper	Group (if any)	Hours of Teaching per week [Credit*]	Teaching Learning Method [TLM]	Assessment Method [AM]	Assessment Type [AT] UA/ IA	UA Marks	IA Marks	Total Marks	Minimum marks for Passing	Remarks for Minimum /Maximum Course/Paper/Subject/ Selection	
1	Electrical Engineering	Core Compulsory	Applied Signal Processing (ELE1810CS)	NA	04(04)	Lecture	Theory	UA	70	--	100	40	UA=70 IA=30	
								IA	--	30				
2	Electrical Engineering	Core Compulsory	Applied Signal Processing-TW, Practical and Viva (ELE1810LCS)	NA	02(01)	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50	
								IA	--	--				
3	Electrical Engineering	Core Elective	Elective-IV Options: (1) Communiation Engineering (ELE1806DECS) (2) Industrial Instrumentation (ELE1807DECS)	NA	04(04)	Lecture	Theory	UA	70	--	100	40	UA=80 IA=20 Select only one subject from communication or Instrumentation Group and its respective laboratory	
								IA	--	30				
4		Core Elective	Elective-IV Lab Options:	NA	02(01)	Laboratory	Term Work,	UA	50	--				

	Electrical Engineering		1) Communication Engineering (TW, Practical and Viva) (ELE1806LDECS) 2) Industrial Instrumentation (TW, Practical and Viva) (ELE1807LDECS)				Practical & Viva	IA	--	--	50	20	UA=50
5	Electrical Engineering	Core Compulsory	Project Part – II (ELE1815LCS)	NA	12(6)	Project	Project	UA	150	--	150	60	UA=150 Project Part – II is in continuation to Project Part – I.
								IA	--	--			
6	Electrical Engineering	Core Elective	Elective-V Options: (1) Data Communiication Network (ELE1816DECS) (2) Biomedical Instrumentation (ELE1809DECS)	NA	04(04)	Lecture	Theory	UA	70	--	100	40	UA=80 IA=20 Select only one subject from communication or Instrumentation Group and its respective laboratory
								IA	--	30			
7	Electrical Engineering	Core Elective	Elective-V Lab Options: (1) Data Communiication Network (TW, Practical and Viva) (ELE1816LDECS) (2) Biomedical Instrumentation (TW, Practical and Viva) (ELE1809LDECS)	NA	02(01)	Laboratory	Term Work, Practical & Viva	UA	50	--	50	20	UA=50

Bachelor of Engineering : Electronics

First Semester of BE I

(1) Communication Skills (Theory + Laboratory)

- **Strengthening Grammar** : Articles, Prepositions, Verbs, Tenses, Adjectives, Concord, Error Analysis
- **Developing Reading Skills** : Reading Comprehension: Developing Vocabulary through Derivation, Conversion and Compounding. From a seen/unseen passage write single and multiple sentence answers
- **Developing Writing Skills** : Paragraph Writing: Sentence linkers and supporting sentences. Identification and organization of paragraph types. Guided compositions. Writing Letters and Report. Technical report: Reporting workshop jobs- Carpentry, Fitting, Smithy, Tin Smithy Letter Writing: Letter seeking Permission and Request letter, Letter of Inquiry
- **Consolidating Speaking Skills** : Dialogue Rendering and Writing: Greeting and taking leave, Introducing self and others, Congratulating and Inviting. Expressing sympathy and offering condolences

(2) Applied Mathematics I (Theory)

- Calculus : Reorientation, Functions of one variable Application of derivatives, Curvature, Successive differentiation, Partial derivatives, Leibnitz rule for the nth order derivative of a function, Techniques of partial derivatives.
- Infinite Series: Sequence and their convergence , convergence and divergence of infinite series, Geometric series, P – Series ,Necessary condition for convergence, Comparison test, ratio test Absolute convergence and conditional convergence of alternating series, Maclaurin's & Taylor's expansion with remainder form, Indeterminate forms L'Hospital's rule
- Complex Numbers: Complex numbers & their geometrical representation, Complex numbers in polar form, Demoivre's theorem and its applications, Exponential, logarithmic, trigonometric & hyperbolic functions.
- Differential Equations Reorientation, Modeling of engineering systems pertaining to first order differential equations, Exact differential equations, integrating factors, Unified approach to first order ordinary differential equations, Equations of first order and higher degree.
- Linear differential equations of higher order with constant coefficients and with variable coefficients Models of higher order differential equations, Method of variation of parameters, Simultaneous linear differential equations Method of solution in series
- Bessel and Legendre's equations, Properties of Bessel functions Introduction to Legendre polynomials

(3) Applied Physics I (Theory + Laboratory)

- Electromagnetic Waves: Basic laws and equations. Application for devices and instrumentation, Microscopes, Telescopes and camera, Resolution and magnifications, Optical vibration and correction.

- LASER and Matter Waves: Fundamentals, Generation, Spontaneous and stimulated emission, conditions for lasing action, population inversion, Types and Engineering applications – Laser and electron beam machining and other instruments
- Sound Waves: Sound waves characteristic and properties, Velocity, frequency, wavelength, intensity, loudness (expression), timber, reflection, echo, reverberation. Sabine's formula, remedies over reverberation; Absorption of sound, absorbent materials; Criteria for good acoustics of a building; • Ultrasonic: Production of ultrasonic waves, Detection of ultrasonics; Engineering applications of Ultrasonics (Non-destructive testing, Infrasound – Seismology (concept only))
- Solar cells : Principle of working, conversion efficiency, Single, multi-junction solar cells, Photovoltaic system engineering, Thermo-photovoltaic generation in electricity, Concentration and storage of electrical energy, Photovoltaic – systems and applications
- Introduction to physics of Buildings :Heat transfer and air circulation in buildings, effects of thermal expansion

(4) Fundamentals of Civil and Environmental Engineering (Theory + Laboratory)

- Building Material : Stone - Introduction to stone – Uses of stone – Characteristics of good building stone – Availability, suitability and properties of different stone. Bricks - Comparison between stone work and brick work – Advantages of bricks – Characteristics of good brick – Standard test for brick along with field test for brick. Lime - Classification of Lime, Precautions in handling Lime. Cement - Basic ingredient of ordinary cement – Physical properties of cement – Field examinations of cement – Storing of cement and its uses. Timber - Introduction to timber – Importance of seasoning – Wood base product. Steel - Introduction – Use of different form of steel – Marketable forms of steel. Aggregates. Bitumen. FRP. Optical fiber. Plastic - Properties of plastics – Types and uses of plastic.
- Environmental Science and Sustainable Development : Introductory Environmental Engineering Terminology— Introduction to various types of pollution- Water and land pollution and remedial measures for control, water and wastewater quality criteria – Disposal of wastes – Air pollution and remedial for control – Ecology, Environmental Protection and legislation. Hydrologic cycle, Rain water harvesting, Green building, Solid waste management, Environment Impact Assessment, Basic environmental chemistry, Sustainable development – clean development mechanism, Global warming, Ozone layer depletion, Acid rain, and Climate change.
- Surveying and Leveling : Surveying - Introduction – Principle – Object of survey – Classification – Basic instruments of linear and angular measurements – chain, tape, Offsetting, Types of offsets, Ranging methods. Prismatic compass, Types of meridians, Types of bearings. Traverse survey: open and closed Examples based on compass. Leveling – Definitions – Computation of reduced levels– Introduction to contour, Methods of leveling and Examples on Level. Modern tools: Introduction to Theodolite, Total station – Introduction to GPS, GIS, Remote sensing.
- Building Construction : Building Construction & Infrastructures: Types of constructions – roads, pipelines, transmission lines – Typical details of load bearing and framed structures – Brief discussion and illustrational sketches of typical important building components – Foundation – Functions, Types of foundations such as Spread footing, Stepped footing, Isolated and Combined column footing, Raft, and Grillage foundation. Lintels– Function, Types of lintel. Flooring, Roofing. Mortar and concrete

specifications – Ingredients for mortar and concrete – classification of mortar and concrete – selection of mortar and its uses – precaution in using mortar – Pre-stressed concrete – grades of concrete, Internet of things for buildings, Hydropower plants.

(5) Engineering Drawing – I (Theory + Laboratory)

- Introduction to Engineering Curves: Introduction to conic sections, types of conic sections, eccentricity, construction of conic sections(parabola, ellipse , hyperbola) by different methods, Construction of involutes, construction of cycloid, epicycloid and hypocycloid, construction of spiral, construction of normal and tangent to all curves.
- Free hand sketches: Parts of screw thread and its types, conventional representation of threads, screwed fastening- types of nuts, bolts, set screws, locking arrangement of nuts, foundation bolts, riveted and welded joints, forms and proportions of rivet heads, representation of welded joints, shaft keys and couplings- types of keys, cotter joint, knuckle joint, double cotter/sleeve joint, types of couplings.
- Projection of Point and Line : Introduction to principal planes of projections, projections of points located with respect to reference planes (in different quadrants), Projection of Lines, Line parallel to reference planes, Line parallel to one reference plane and inclined to other reference plane, Line inclined to both the reference planes, Application of all variants
- Projection of Planes : Projection of Planes (Polygons, circle, semi-circle, ellipse etc.). Plane parallel to one reference plane and inclined to other, Plane inclined to both the reference plane, Concept of auxiliary plane method for projection of plane.
- Orthographic projection : Fundamental of projection along with classification, Projections from the pictorial view of the object on the principal planes for view from front, top and sides using first angle projection method and third angle projection method, full sectional view
- Isometric Projections and Isometric View or Drawing: Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing of objects

(6) Workshop Practices (Laboratory)

- Introduction to workshop facility: Introduction to different shops of the workshop, general safety guidelines, familiarization with workshop facility
- Carpentry Shop: Introduction to different tools of carpentry shop, understanding drawing of the job to be made, making of finished job as per drawing out of the given raw material of wood.
- Fitting Shop: Introduction to different tools of fitting shop, understating drawing of the job to be made, making of finished job as per drawing out of the given raw material.
- Smithy Shop: Introduction to different tools of smithy shop, understating drawing of the job to be made, making of finished job as per drawing out of the given raw material.
- Introduction to Machine Tools: Demonstration on different machine tools eg. Lathe machine, Shaping machine, Drilling machine, Grinding machine. Preparation of job by turning on lathe involving step turning and thread cutting.
- Metal Joining Processes: Introduction to different tools of welding shop, Demonstration of welding process, Preparation of welding job as per drawing, Introduction to other metal joining processes such as soldering, brazing and riveting
- Moulding Practice: Introduction to different tools of moulding shop, Demonstration of moulding process, Preparation of mould assembly as per pattern.

- Press Working: Demonstration of press working operations like blanking, punching, piercing etc.

(7) Universal Human Values I (Theory - Online)

- Introduction to UHV, Aspirations and Concerns, Self-management, Health
- Relationships
- Society, Natural Environment, Self-evaluation

Second Semester of BE I

(1) Applied Mathematics II (Theory)

- Partial Differentiation: Function of two variables – Definition, limit, continuity and partial derivatives, Chain rule, Euler's theorem, implicit functions differentials, Applications of partial derivatives (Tangent plane and normal line, approximation, maxima and minima, Lagrange's multiplier's method), Jacobians and transformations
- Vector Calculus: Reorientation, scalar and vector fields gradient of a scalar function, Directional derivative divergence and curl of a vector field and their applications
- Analytical Geometry: Reorientation, curvilinear coordinates (polar, cylindrical and spherical), cone, cylinder Conicoids, Surfaces and solids of revolutions
- Tangent planes and normal lines to above surfaces (by calculus method) Tracing of curves: Cardioid, cycloid, lemniscates, spiral, four leaved rose
- Rank of a matrix : solution of homogeneous and non – homogeneous systems of linear equations, Eigen values and eigen vectors of a matrix, Cayley – Hamilton theorem
- Laplace Transforms: Laplace transforms of elementary functions, inverse Laplace transforms, linearity property, first and second shifting theorem. Laplace transforms of derivatives and integrals, applications of Laplace transform in solving ordinary differential equations.

(2) Engineering Mechanics (Theory + Laboratory)

- Statics: Introduction, Forces and force system: Coplanar forces. Resultant of concurrent and non concurrent forces, Operations with couples. Graphical methods, Free body diagram. Support reactions, Equations of statics. Graphical methods. Forces in the members of simple trusses.
- Statics: Center of Gravity, Moment of Inertia: Centroids of lines and plane figures, Moment of inertia of plane figures. Transfer theorem. Product of inertia. C.G. of rigid bodies.
- Statics: Transmission of power : The wedge-the screw-the screw jacks, Simple lifting machines. Power transmission in belt drives. Gearings. Train of wheels. Epicyclic gearing.
- Strength and Elasticity of Materials: Simple stresses and strains: Hooke's law, Elastic limit. Ultimate stress. Factor of safety. Lateral strain. Poisson's ratio. Temperature stress. Simple shear. Proof stress. Elastic-moduli-relation, Principal stresses. Strain energy. Thin cylindrical and spherical shells: Analysis and design. Riveted and welded joints: Analysis and design. Determination of internal forces in beams and shafts. Shear force, Bending and/Twisting moment diagrams.

(3) Programming and Simulations (Laboratory)

- Simulation of Different types of Electrical Wiring in Applet circuit simulator
- Simulation of Electrical network theorems in Applet circuit simulator.
- Simulation of simple AC and DC electrical circuit in Applet circuit simulator.
- Different DC Circuits analysis in PSPICE.
- Steady state Analysis of R-L, R-C and R-L-C Series circuits in PSPICE.
- Modelling of Active and Passive Elements in ATP
- Simulation and Verification of Electrical Circuits for Steady State and Transient Condition under the applications of DC and AC Supply of low, power and high frequency
- Simulation and Verification of Electronics Circuits for Steady state condition
- Simulation of Electrical Wiring Concepts using ATP
- LaTeX Programming : Documentation
- LaTeX Programming : Beamer
- Programming and Simulation using Scilab
- Introduction to Programming and Simulation
- Basic Mathematical operation – I : Inbuilt commands/functions for some standard mathematical functions. Arithmetic operations on numbers and vectors.
- Basic Mathematical operation – II : Input of matrix. Inbuilt commands/functions on matrices. Arithmetic operations on Matrices.
- Graphical representation of Data –I (2-D plotting)
- Graphical representation of Data –II(3-D plotting)
- Data Analysis –I : Measure of central tendency
- Data Analysis –II : Measure of dispersion
- Introduction of Block Programming / Simulation
- Block Programming / Simulation for system of ODE
- Block Programming / Simulation for electrical circuits.
- Libre office calc – I : Introduction, Data representation using various Charts.
- Libre office calc – II : Use of Mathematical and Statistical tools.

(4) Basic Electrical Engineering (Theory + Laboratory)

- Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.
- Review of magnetic materials. Flux density. Intensity of magnetization. MMF. Permeability. Reluctance. Their relationships. Comparison with electric circuits. Calculation of amp. turns for series, parallel and series-parallel magnetic circuits containing air gaps. Effect of magnetic leakage and fringing. Review of Faraday's and Lenz's laws. Concept of self and mutual induction and their coefficients. Calculation of self and mutual inductance. Energy stored in magnetic field. Lifting power of an electromagnetic. Magnetization curve. Reversal of magnetization. Hysteresis and Eddy current losses.
- Alternating Voltages and Currents. RMS and Average values, Form factor and peak factor, vector representation of AC quantities.

- AC through R, L and C circuits, Series and Parallel circuits, Resonance, Q-factor, concept of active, reactive, apparent power and power factor.
- Three phase balanced circuits, voltage and current relations in star and delta connections.

(5) Basic Electronics (Theory + Laboratory)

- Diodes and their applications: Various types of diodes and their characteristics. Clippers and Clampers. Different rectifier configurations and their analysis – with and without filters. Shunt and Series regulators. Voltage doubler/tripler/quadrupler circuits.
- BJT Transistors: BJT – Construction, operation, various biasing configurations and their characteristics. different methods of biasing. CE, CB and CC Amplifier Small signal analysis of transistor amplifiers. Equivalent circuit at low and high frequency operation of BJT – Ebers-Moll view. Hybrid π model, Multivibrators- Astable, Bistable and Monostable multivibrator
- Field Effect Transistors: Construction, operation, configurations and their characteristics, different methods of biasing, Small signal Analysis, equivalent circuit at low frequencies- r_d, g_m AND μ , Shockley's equation – I_{dss} –FET model – Common source Amplifier – MOSFET Construction, operation ,types –High Frequency FET model
- Large Signal Amplifiers: Power Amplifiers, Classifications, Class-A, Class-B, Class AB push–pull Amplifier Detailed Analysis, Conversion Efficiency and distortions
- Feedback Amplifiers: Various feedback amplifier topology configurations using BJT, FET – their analysis
- Oscillators: Oscillator principle, types R-C Phase shift, Wien Bridge and Tuned-circuit oscillators.

(6) Material Science (Theory)

- Introduction of Engineering Materials: Metalica Materials, Ceramic Material, Polymers, Composite and Nano-materials.
- Crystal Structure: Crystallography, Atomic structure and; Structure of crystalline solids; Lattices, unit cells; Crystal systems, Bravaislattices; Indexing of directions and planes, notations, Inter-planar spacings and angles, co-ordination number, packing factors stacking sequence in BCC, FCC and HCP.
- Mechanical Properties of Materials: Concepts of stress and strain, Stress- Strain diagrams; Properties obtained from the tensile test; Elastic deformation, Plastic deformation. Impact Testing & toughness behavior. Hardness of materials.
- Phase diagram: Gibbs phase rule, Binary phase diagram its types, solid solution – Hume Rothery Rules. Imperfections: Point defects, Line defects and surface defects – grain boundary, tilt boundary and twin boundary, Grain, Grain size number. Burgers vector and its representation.
- Ceramic Materials: Introduction, ceramic structures, silicate structures, Processing of ceramics; Properties, glasses; Composite Materials- Introduction, classification, metal-matrix, ceramic–matrix and polymer matrix composites.
- Corrosion: Types of corrosion – Dry and Wet corrosion, Electro chemical and oxidation (Chemical) corrosion. Corrosion prevention – anodic and cathodic protection & coatings

- Electrical & Electronic Materials: Intrinsic and Extrinsic Semi conductivity, Dielectric material, Piezo-electric materials. Magnetic Materials: Introduction, classification of magnetic materials, soft & hard magnetic materials.
- Advanced Materials: Nano Materials & its application, Metallic glasses, Super conducting material, optic fibers, smart materials.

First Semester of BE II

(1) Circuit Analysis & Synthesis (Theory + Laboratory)

- Two-port Networks: Network definitions, Principle of duality, Reduction of a complicated network, Conversions between T and π sections, The bridged- T network, The lattice network, Driving point impedance, transfer impedance, The parallel-T network. Definitions of different parameters and their equivalent circuits. Inter-conversion of parameters. Reciprocal and symmetrical networks. Different network structures (T, Pi, Ladder, Lattice, Bridged-T, Twin-T etc) and their parameters. Interconnection of two port Networks. Bartlett's Bisection theorem.
- Passive Filters: Impedance transformation-Transformation of impedances with tapped resonant circuits, Reactance L section for impedance transformation, Image impedances; reactance matching, Reactance T networks for impedance transformation. Fundamentals of filters. Various filter types and their responses – Constant-K, m-derived and Composite filters.
- Attenuators and Equalizers: Design and Analysis of symmetrical and asymmetrical attenuators. Equalizers- Inverse impedance, Constant resistance equalizers, Bridge T attenuation equalizers, Bridge T phase equalizer, Lattice attenuation equalizer, Lattice phase equalizer.
- Network Analysis using Laplace Transform: Application of LT to different RLC circuits and their responses for various excitations like dc, ac and exponential. LT of special signal waveforms – both periodic and non-periodic and their applications to obtaining different circuit responses.
- Network Functions: Network Functions of one port and two port network, Poles and Zeroes of network functions, Properties of driving point functions for RL, RC, LC networks and their Reactance Curves.
- Synthesis of One Port Network: Synthesis of RL, RC, LC networks using Foster and Cauer forms.
- Indefinite Admittance Matrix: Definitions, properties and reduction, applications of IAM.
- Graph Theory: Graph theory for networks – related definitions and matrices. Application of the same to solve different circuit examples.

(2) Data Structure & C Programming (Theory + Laboratory)

- Elements of C Language: Data types, variables, operators, expressions, flow control statement, Simple programs based on above statements and structures, functions, standard library functions - I/O, utility, time and date. Programs based on above.
- Advanced Features of C: Derived data type, pointers, and Library functions for string and Maths functions, Structures.

- Introduction to OOPS: Introduction to C++, Making sense of core object concepts (Encapsulation, Abstraction, Polymorphism, Classes, Inheritance), Constructors, Operator overloading, Virtual functions, Pointers, Stream and I/O functions
- Data structure: Representation of Stacks & queues using arrays & linked-list. Circular queues. Binary tree traversal methods. Sequential and binary searches. Insertion, Selection, Bubble, Quick, Shell, Heap Sorting.
- Numerical Methods: Development of computer programs in C language for Integration, Roots of Equations, simultaneous Equations, Matrix Inversion, Eigen value and Eigen vectors, First order differential equation. expansion coefficients; momentum Eigen functions.

(3) Signals & Systems (Theory + Laboratory)

- Introduction of Signals and Systems, Properties of Systems, Time-Domain Representations for Linear Time- Invariant Systems, correlation
- The Laplace transform, properties of Laplace transforms, Analysis and characterization of LTI systems using Laplace transforms
- Fourier Representations for periodic and aperiodic continuous time signals i.e. Fourier series and continuous time Fourier transforms, Sampling and reconstruction of signals, Energy Spectral Density, Power Spectral Density.
- The Z-transforms - ZT-IZT, Stability Criterion & ROC, Properties.
- Fourier Representations for Discrete-Time Periodic Signals and Discrete Time aperiodic signal - DTFT-IDTFT, DFT-IDFT, Filtering of Long data sequence, circular convolution, Radix-2 FFT

(4) Applied Mathematics III (Theory)

- Fourier Series and Fourier Transform: Fourier series of functions with arbitrary period, Fourier series of even and odd functions, Half range series. Fourier transform, Fourier sine and cosine transform.
- Multiple Integrals: Reorientation of concept of integrals, double and triple integrals, Evaluation techniques, Change of order of integration, Integrals in polar, cylindrical and spherical polar coordinates, transformation of multiple integrals.
- Vector Calculus: Line Integrals-Work done, Circulation, Surface integrals, Green's theorem, Stoke's theorem, Gauss divergence theorem.
- Second Order Partial Differential Equations: Formation and classification of PDE, Heat, wave, and Laplace equations & their solution by method of separation of variables and using Fourier series.
- Functions of Complex Variable: Limit, continuity and derivative of functions of a complex variable, C-R equations, analytic functions, and their applications: Harmonic, conjugate harmonic and potential functions, complex integration, line integrals, Cauchy integral theorem, and Cauchy integral formula.
- Power Series representation of $f(z)$: Taylor's series, Laurent's series, Singularities.

(5) Analog Electronic Circuits (Theory + Laboratory)

- Differential Amplifier: Single and dual stage differential amplifier, constant current source and current mirror circuits, level translator circuits, various parameters, CMRR

measurement, Introduction to OP-AMP, Internal stages of OP AMP difference amplifier. Different stages of OP AMP amplifier design.

- Practical OP-AMP: Input offset voltage and bias current. Thermal drift. CMRR. Open loop and closed loop frequency response- compensating networks. Op amp equivalent circuits, Linear applications of op-amp, Transient response, Bandwidth and slew rate.
- Analog Application-I: Non-linear application of OP AMPs. Schmitt triggers – characteristics, design and analysis. Different types of Ramp Generators. Bistable Multivibrators – design and analysis. Sample and Hold – characteristics and applications. Programmable Gain Data Amplifier (PGDA).
- Analog Application-II: Summing, Scaling and Averaging amplifier, V-I Converter and I-V converter, Integrator, Differentiator, Bridge Amplifier, Analog Electronic Computation, Logarithmic and Anti logarithmic Amplifier.
- Tuned Amplifiers: Wideband/narrowband amplifiers. Capacitively and inductively coupled single tuned amplifier, double tuned amplifier, staggered tuned amplifier
- Specialized IC applications: 555 Timer with applications. 565 PLL – applications. Phase detectors, Voltage Controlled Oscillator (VCO 566). Linear regulators (series and shunt types) – IC 723, 317, 78xx/79xx series. Dual power supplies, Switching and Buck/Boost type regulators.

(6) Electromagnetic Wave Theory (Theory)

- Basic laws of electromagnetism, Maxwell's equations, Wave equation, propagation of plane waves, Poynting's vector theorem.
- Reflection, refraction and transmission of plane waves at conductor, dielectric and dielectric-dielectric interface.
- Magnetic vector potential, retarded potentials, radiation from linear current incremental antenna, Quarter wave monopole and half wave dipole antenna, Radiation resistance and radiation patterns of various antennas, folded dipoles, Antenna theorems, gain effective area & effective length of antenna.
- Introduction, Distributed parameters and primary constants, Equivalent circuit in terms of primary constants, Characteristic impedance and propagation constant.
- Transmission line - General solution and physical significance, Waveform distortion, distortion-less line, Inductance loading of telephone cables, Reflection coefficient, reflection factor, reflection loss and insertion loss.
- T and Pi sections equivalent to lines, Distance to a line fault.
- RF transmission lines, Parameters of trans. line at high frequencies, Constants of lossless lines, V and I on lossless lines, Standing waves and SWR, Input impedance, power and impedance measurement on lossless lines, Reflection losses on unmatched lines, Impedance matching lines, Exponential line, Stub matching, transmission line chart (Smith's chart) and its applications.

Second Semester of BE II

(1) Modern Filter Design (Theory + Laboratory)

- Introduction of Active filters, Comparison of Active and Passive networks. Circuit terminology. VCVS, VCCS, C CVS, CCCS. Anteniou's and Riordan's gyrators. GIC. FDNR, FDNC, VNIC, CNIC, Capacitor multipliers

- Bilinear transfer functions and frequency response. Active realizations. Cascade design. Bode plots for all the types of filters.
- Design parameters Q and ω_0 . Frequency response of various types of second-order filters. Orthogonal tuning for designing different types of second-order filters. Other biquads like Sallen-Key circuits, Single Amplifier Biquad (SAB) and general impedance converter circuits (GIC circuits). Sensitivity analysis of Sallen-Key circuits and their comparisons.
- Stagger tuning; low-pass filters with maximally flat magnitude and equal ripple magnitude. Butterworth and Chebychev responses. Bessel, Elliptic and Inverse Chebychev filters. Switched-capacitor filters: First-order building blocks, second-order sections. Design of switched-capacitor cascaded and ladder filters
- Analog filters, Conditions for stability, Design of IIR filter using methods like (1) Design by approximation of Derivatives, (2) Impulse Invariance method and (3) Bilinear Transformation, Frequency transformations in Analog domain
- Window method (2) Frequency Sampling method and (3) Optimal method or CAD (Computer Aided Design) method, Alternation theorem, Remez Algorithm, Symmetric and Anti-symmetric FIR filters

(2) Electronic Measurements and Instruments (Theory + Laboratory)

- Measurement and errors: accuracy, precision, significant figures, types of error, statistical analysis, probability of error, Systems of units of measurement: fundamental and derived units, system of units, international system of units, other system of units, conversion of units, Standards of units: classification of standard and standards of current, voltage etc.
- Concept of Electromechanical indicating instruments including Suspension Galvanometer, PMMC Mechanism, DC Ammeter and Voltmeter, Ohmmeter millimeter-calibration of AC and DC voltmeters and ammeters. Study of A.C. indicating instruments. Study of electronic instruments for measuring basic parameters including A.C. Voltmeter using rectifiers, true R.M.S. reading voltmeters, Electronic millimeter. Digital voltmeters and Q Meter.
- Study of functionality of various signal generators including Sine wave generators, frequency synthesized generator, pulse & square Frequency generator, sweep frequency generator, function generators, wave Analyzer, Distortion analyzer.
- A.C. & D.C. bridges & potentiometers & their application to measure high & Low resistance capacitor, inductor, frequency etc.
- Transducers: classification, selection criteria, strain gauge, displacement, temperature etc. Data acquisition system, multiplexing and spatial encoders. FREQUENCY COUNTERS & TIME INTERVAL MEASUREMENT: Digital, Time, Phase & frequency measurement.

(3) Industrial Engineering (Theory)

- Introduction to Industrial Engineering: Concept of Industrial Engineering, role of industrial engineering, productivity and production, measurement of productivity, productivity index and its importance, means of measuring productivity
- Method Study: Introduction to work study, method study, steps in method study, Recording techniques, OPC, FPC, 2-handed process chart, man-machine chart.

- Work Measurement: Introduction, uses, Techniques, time study, recording, methods of timing and its example, allowances
- Ergonomics: Concept, Objectives, related science of ergonomics, man- machine system, design of controls, types of control
- Plant Location and Plant Layout: Nature of location, importance of plant location, choice of site for location, state regulations on location, government policies, comparison of locations, plant layout
- Material Handling: Introduction, Functions, Factors, Principle, material handling devices, Relationship to Plant Layout and material handling
- Industrial Safety: Introduction, personnel protective devices, accidents, definition, types, effect of accidents, accident causes, accident control or prevention
- Inventory Control: Introduction, classification, inventory control, inventory functions, determining inventory level, EOQ, ABC Analysis
- Industrial Psychology: Definition, Scope, Objectives, human behavior, group behavior, Mc Gregory theory, X Y theory

(4) Electrical Machines (Theory + Laboratory)

- DC Machines : Construction details, Principles of Operation, Characteristics of different types of DC generators and DC motors, Armature Reaction and Commutation, Testing, Performance evaluation and applications of DC machines, Starting and Speed control of DC Motors
- Transformers : Single phase transformer: Constructional features, working principle and types of transformers. Testing, performance evaluation and applications of various types of transformers, single phase auto- transformer. Parallel operation of transformers. Polyphase Transformer: Constructional features, working principle and types of polyphase transformers. Testing, performance evaluation and applications of various types of transformers, effect of saturation and harmonic analysis, three winding transformers, transformer connections, induction regulator.
- Synchronous Machines : ALTERNATORS: Constructional features, working principle, types of alternators. Testing and performance evaluation of alternators, synchronization of alternators with grid, capability curves. SYNCHRONOUS MOTORS: Constructional features, working principle, types of synchronous motors. Testing, performance evaluation and applications of synchronous motors, Methods of starting, effect of changing excitation, comparison between synchronous and induction motor.
- Induction Motors : Constructional features, working principle, types of induction motors. Production of rotating magnetic field, slip, frequency of rotor current, variation in rotor current. Equivalent circuit, torque-slip characteristics, starting, maximum and pullout torque, effect of change in supply voltage. Testing, performance evaluation and applications of induction motors. Circle Diagram, Starting and Speed control of Induction Motor, Double cage Induction Motor, Induction Motor as Induction Generator and Applications. Single Phase Induction Motors : Principle of working, types and applications of single phase induction motors.

(5) Digital Systems (Theory + Laboratory)

- Number system, codes and Boolean Algebra: Roman no. systems; weighted-positional systems and their conversions. Arithmetic operations. ASCII character set small

keyboard switch matrix. 4-bit and 5-bit codes like 8421-EX.3, Gray, parity bit and their conversions. Boolean theorems and identities, logic gates AND, OR, NOT, NAND, NOR, EX-OR. Boolean expression SOP & POS form. Minimization using Boolean rules. Minimization of logic expression using K-maps. Use of Don't care conditions. Minimization using prime implicant table.

- Combinational logic design using SSI: Design of HA, HS, FA, FS, carry look ahead adder; 4 bit 8 bit adder, 8421 Adder/Sub. Ex 3 Adder/Sub design of multiplexers, demultiplexers, Decoders, Encoders, Multiplier and division techniques and circuits.
- Implementing logic functions using MSI and Programmable device. Implementing Logic functions using multiplexers; using MSI decoders: using EX-OR and EX-NOR elements; using programmable devices: PROM, PAL, PLA, PLDs, programming PALs using PAL. Digital logic families- TTL, MOS & CMOS, I²L Logic, D/A and A/D conversion techniques
- Sequential Logic circuits: Sequential design using D, JK, T flip flops. Different types of flip flop, synchronous counter. Design e.g. shift counter, ring counter, twisted ring counter, Asynchronous counter, sequential design of fundamental mode circuits and pulse mode circuits.

(6) Universal Human Values-II (Theory + Laboratory)

- Introduction to Value Education
- Harmony in the Human Being
- Harmony in the Family and Society
- Harmony in the Nature/Existence
- Implications of the Holistic Understanding

First Semester of BE III

(1) Broadcast System Engineering (Theory + Laboratory)

- Introduction to modulation, Amplitude modulation, Types of AM, Generation of various forms of AM, Modulators, transmitters, Demodulation, Mixers, Detectors and Receivers.
- Angle modulation, Frequency and phase modulation, Narrow and wideband frequency modulation, Modulation techniques, modulators, transmitters, Demodulators, receivers.
- Ground wave propagation, Sky wave propagation, ionosphere and mechanism of reflection, Fading and MUF, Space wave propagation, Mobile Radio Propagation, Large scale Path loss, Small scale Fading and Multipath propagation.
- Principle of TV, Scanning, synchronization and blanking, TV standards, channel bandwidth allocation, basics of TV receiver, Fundamentals of Color TV, Color TV signals transmission and reception
- Flat panel displays like LCD, Plasma, LED; Progressive scanning, Digital TV, SDTV, HDTV, Cable TV, Satellite based digital broadcast and reception, Mpeg compression standard.

- Difference between Broadcast transmitter and Low Power transmitter, Mobile communication fundamentals, Grade of service, Advantages of Hexagonal cells, Frequency Reuse, Channel Assignment strategies, Cell sectoring, Cell splitting, Microcell zone concept, Co-channel and Inter-channel interference, Roaming and Handoff.

(2) Microprocessor & Microcontrollers (Theory + Laboratory)

- Microprocessors & Microcontrollers: Basics of Microprocessors and its architecture. Different types of microcontrollers, Relative merits and demerits of microcontrollers. Microcontroller architecture, pin-out and associated signals. Instruction timing and execution for 8-bit microcontrollers. Interrupts, Handling Multiple Interrupts, Vectored Interrupts, Non Vectored Interrupts and Polled Interrupts, Pending Interrupts. Interrupt structure of 8051.
- Software Concepts: Assembly language programming, software development tools for program testing and development. Instruction set of 8051: Data transfer group, Arithmetic and logic group of instructions and Branch group of instructions. Simple programs based on these instructions. Viz. programs for time delays, counters. Bitwise instructions and their applications.
- Advanced Software Concepts: Stack, Handling stack; stack and subroutine group of instructions, subroutines and Interrupts handling programs. Features of assemblers, assembler directive, Relocation features, Macros.
- Applications of Microcontroller: Interfacing and Assembly language programs of external Peripheral Devices such as: Relays, Switches, Keys, Keyboard, ADC, DAC, 7 segment displays, LCD displays, LED, Sensors, non-volatile memory elements with 8051 microcontroller. Introduction to various motors, serial printers etc and their interfacing with 8051 using various protocols viz.: I2C, SPI, RS232/UART, RS422/RS485, MODBUS etc.
- Introduction to 8051-F340: Microcontroller and its advanced peripherals. C-programs based on peripherals.

(3) Communication Theory (Theory + Laboratory)

- Random Variable and Processes: Probability density function, Theory of random signals, Discrete messages, Entropy, Information rate, coding to increase average information per bit
- Pulse Modulation System - Pulse modulation, Sampling, PAM, PPM, PWM modulators / demodulator, Digital modulation, PCM, Delta modulation and demodulation, DPCM, adaptive Delta modulation, multiplexing, transmission of digital signals, probabilities of error
- Mathematical Representation of Noise: Theory of noise, Noise temperature, noise bandwidth and noise figure and their calculation, S/N ratios. Noise in communication systems: Frequency domain representation of noise, effect of filtering, superposition of noise, linear filtering, Quadrature components, Noise in AM & FM systems, Threshold, effect of transmitter noise.
- Digital Modulation Techniques, M-ary modulation techniques - QASK, MSK, MPSK, MFSK, Signal recovery, synchronization, error probabilities, Matched filter, optimum filter, coherent reception, base band signal receiver

(4) Industrial Electronics (Theory + Laboratory)

- Study of different types of conventional and modern semiconductor power switches like Power diodes, Power transistors, SCR, GTO, IGBT, MOSFET, MCT, Triac, Diac etc – their Turn-on and Turn-off characteristics, triggering circuits, and protection
- Principle and types of Cyclo-converters. Single-phase step-up and step-down cycloconverter using midpoint and bridge converters of different types.
- Phase-controlled rectifiers – single-phase/three-phase/six-phase/poly-phase for midpoint converters with and without freewheeling diode for R-L-E loads. Fully and Half-controlled Bridge converters (1-ph and 3-ph) for R-L-E load with and without freewheeling diode. Effect of source impedance on different types of converters. Dual Converters.
- Thyristor Commutation techniques. Choppers-Principle of operation, circuits for different types, operation, analysis and commutation. Load-commutated and multi-phase choppers.
- Principle and classification of inverters. Single- and Three-phase bridge VSSingle phase CSI, Series and parallel Resonant Inverters.
- Principle of AC voltage controller and its types. Study of Phase-controlled AC voltage regulator with different loads
- SMPS, UPS, DC drives, Battery chargers, AC drives, DC-DC Converters: Buck, Boost, Buck-Boost, Cuck etc.

Second Semester of BE III

(1) Control Systems Engineering (Theory + Laboratory)

- Background: History, recent trends and applications. Systems, Control Systems and their classifications. Open-loop and closed loop control systems.
- Modeling: Mathematical modeling of electrical, mechanical, electromechanical, thermal and hydraulic systems. Differential equations, transfer functions and state-space models. Linearization. Systems with transport lag. Block diagrams and signal-flow graphs. Computer simulation of control systems.
- Components: AC and DC Servomotors, Synchros, Gyroscopes, Valves, Gear-trains, Potentiometers and their models. Motion control systems – Servomechanisms.
- Time-response analysis and Design: Time response, Transient response, Steady-state response. Responses of first- and second-order systems to standard test signals and related specifications. Error Constants and Generalized Error Series. Sensitivity and Robustness. Solution of homogeneous and non-homogeneous state equations. Controllability and Observability. Design of P, PD, PI and PID controllers in time domain.
- Stability and Root Locus: Concept and definition – BIBO and Zero-input stability. Routh-Hurwitz criterion. Analysis of control systems using root locus plots. Design of P, PD, PI and PID controllers and Lag and Lead compensators using root locus.
- Frequency domain analysis and design: Nyquist stability criterion – Gain and Phase margins. Bode plots. Frequency domain specifications and their correlations with time response. M-N circles and Nichols chart. Lag and Lead compensator design using frequency response plots.

(2) VLSI Design (Theory + Laboratory)

- Introduction about VLSI, Crystal growth and purification, epitaxy, oxidation, diffusion in implantation, diffusion, Metallization, IC fabrication process-monolithic, hybrid, thin film and thick film technology, interconnection, mask, fabrication encapsulation and testing. Fabrication process flow- basic steps, CMOS n-well process, layout design rules, full custom mask layout design, VLSI methodologies- VLSI design flow, design hierarchy, design for manufacturability and design for testability built in self-test techniques. MOS transistor- structure, enhance and depletion types critical voltage noise margin, logic levels of MOS inverters with resistive load/ depletion type/ enhanced MOSFET in saturation or linear mode of operation. Combinational and sequential logic
- DC analysis of inverters, basic gates, implementation of Boolean functions, structure and operation of MOS, scaling and small geometry effects, MOSFET capacitance. CMOS – circuit design process, basic circuit concepts latch up conditions and Protection, calculation of critical voltage and logic levels and threshold voltage, body effect, channel modulation, Ion implantation, tristate buffer, layout processes, design rules, various industry standard tools used for simulation and synthesis.
- VHDL : Introduction, Basic Terminology, Entity Declaration, Architecture Body, Configuration declaration, Package Declaration, Model Analysis, Simulation. Behavioural Modelling, Entity Declaration, Architecture body, Process statement, Variable assignment statement, Signal assignment statement, Wait statement, If Statement, Case Statement, Null statement, Loop, Exit, Next, Assertion, Report etc.. Simulation problems.
- Data Flow Modelling, Concurrent signal assignment statement, Sequential signalAssignment, Delta delay , Multiple drivers, etc. simulation problems, Structural Modelling, Component declaration, Component instantiation , simulation problems

(3) Embedded Systems (Theory + Laboratory)

- Introduction: Embedded systems overview, design challenge, processor technology, IC technology, Design Technology, Trade-offs. Custom single purpose processors: RT-level combinational logic, sequential logic (RT-level), custom single purpose processor design (RT-level) and optimization, Basic architecture, operation, Pipelining, Programmer's view, development environment. Finite state machines with data path model (FSMD), ASIPs, Selecting a microprocessor, General purpose processor design.
- Introduction to Advanced Microcontrollers: viz.8051-F340 microcontroller architecture and its advanced peripherals. Assembly/Embedded C-programs based on peripherals. Data types of 8051 C, Interrupts and re-entrant functions, Mix C and assembly code, header files, Debug and Test embedded C program with Keil.
- Cortex M0 architecture and programming: Features, Block Diagram & Pin Diagram. System Memory MAP, System Manager controller Register MAP, System Timer, Clock controller (System Clock, Sys_tick & Freq. divider). Basic configuration, Functional description & register map of General Purpose I/O. Introduction of Embedded C & programs on Led Interfacing & Stepper motor interfacing. Timer Controller: Block Diagram, Functional description, Modes of operation, register map and programs LCD Interfacing: Programs of String display& Scrolling message. ADC: Block Diagram Functional description, Modes of operation, register map & programs. NVIC: Timer Interrupts Programming, External Hardware Interrupts Programs of

keyboard Matrix Interfacing & 7-Segment Led display multiplexing. PWM Generator, UART Controller & I2c Serial Interface Controller & Programs.

- Introduction to Cortex M7 microcontroller STM32F746: Enhanced Features, Block Diagram & Basic functions. Interfacing with MEM sensors, Accelerometer, Gyro.

(4) Microcomputer Architecture (Theory)

- Register transfer logic, arithmetic and shift operations, instruction overflow, decimal and binary data, floating point data, instruction codes. Design of status register, Accumulator, Processor unit.
- Design of a control unit using hardwired & PLA methods. Design of control unit using micro program control, microprogram sequencer, Design of a small general purpose digital computer system configuration. Computer Instructions, timing & control, execution of instructions, design of computer registers, design control.
- RISC versus CISC characteristics, overlapped register windows, pipelining-general considerations, RISC pipeline, Instruction pipeline, parallel processing, vector processing, array processing, Superscalar processors – overview, design issues, power P C, Pentium, CISC scalar & RISC scalar processors. Linear and linear pipeline processors.
- Memory organization & multiprocessing – Memory Hierarchy, inclusion, Coherence and locally, virtual memory models – TLB, paging and segmentation, address space and memory space, address mapping using pages, associative memory page label, page replacement. Cache memory – Different types of mapping, cache initialization and writing. Segmented page mapping, multiprocessors, cache coherence
- ARM7TDMI: Introduction-Architectural overview, ARM7TDMI processor (LPC2378). System Control Block – PLL, Power control, Memory mapping, External Interrupts. Vectored Interrupt Controller – VIC register, Interrupt sources. External Memory Controller. Pin connect block, Port structure, ADC, DAC, UART, I2C interface, SPI interface, Timers, PWM, Watchdog, Real Time Clock. C-development – Programs on usage of above peripherals.
- DSP architecture and ASIC design: Basic architecture, operation, Pipelining, Application Specific Instruction-Set Processors (ASIPs) – Micro Controllers and Digital Signal Processors, FPGA architecture and its applications.

(5) Institute Elective (Theory)

1. Advance statistical Software (AMT1682IECS)
2. Nanotechnology and its Applications (APH1681IECS)
3. Space Technology (APH1682IECS)
4. Fundamentals of Sustainable Building Design (ARC1681IECS)
5. Innovative Product Design and Development (ARC1682IECS)
6. Green Fuels (CHL1681IECS)
7. Plastic Waste Management (CHL1682IECS)

8. Python Programming (CSE1682IECS)
9. Circular Economy and Sustainable Development (CVL1681IECS)
10. Electrical Safety and Energy Management (ELE1681IECS)
11. Robotics Engineering (MEC1682IECS)
12. Natural Resources for Textiles (TXC1681IECS)
13. Textile Materials and Sustainability (TXE1681IECS)
14. Functional Textiles (TXE1682IECS)
15. Water Conservation Concepts (WRE1681IECS)
16. Perspectives of Climate Change (WRE1682IECS)

(6) Electronics Workshop (Laboratory)

First Semester of BE IV

(1) Project Part I (Project)

(2) Digital Communications (Theory, Department Elective I)

- Signal design for band limited channels, Inter symbol interference, Base-band shaping for signal transmission, Binary Data formats, Duo binary and partial response signaling, correlative coding
- Information Theory & coding, discrete messages, average information, entropy, source coding information rate, Shannon's theorem, Channel capacity
- Galois field algebra, Channel Coding, linear block codes, convolution codes, Error control, ARQ and coding techniques. , Cyclic Codes, Convolutional Codes, Maximum Likelihood Decoding of Convolutional Codes, Trellis-Coded Modulation, Turbo Codes
- Passband Digital Transmission, Adaptive equalization for data transmission, digital comm through fading multipath channels Equalization
- Detection and Estimation: Wiener filter for waveform estimation, Principle of orthogonality, Linear Prediction, Prediction-error filter, Adaptive filters using Least Mean Square algorithm
- Optimum receiver for AWGN channel, performance of optimum receiver for memoryless modulation
- Spread spectrum modulation -Direct sequence & frequency hopping SS, Probabilities of error, applications.

(3) Digital Control and Distributed Control System (Laboratory, Department Elective I)

- Computer-controlled Systems: Basic concepts of sampled-data systems. Sampling rate selection – various practical considerations. Modeling (transfer functions & state-space) and analysis of sampled-data control systems.
- Industrial Controllers: Basic principles of industrial controllers – Process load, Process lag, parameter range, control modes etc. Basic control actions – Proportional (P), Integral (I) and derivative (D), PI, PD and PID.
- Design of Digital Controllers: The design approaches – translation of analog design (digital redesign) and Direct Digital control (DDD). Direct and Indirect synthesis for DDD. Obtaining digital PID controllers by redesign and Lag/Lead compensators by DDD using Indirect synthesis. Design of Digital controllers using state-space formulations.
- Artificial neural networks - Basic models of ANN – Connections, Learning, Activation Functions, Multilayer Perceptron and Back Propagation Algorithm. Supervised learning as an optimization problem. System identification and control using ANNs.
- Intelligent controllers using soft computing techniques like Fuzzy Logic, Genetic Algorithms, Meta-heuristics and Swarm Intelligence techniques.

(4) Microwave Theory (Theory + Laboratory, Department Elective II)

- Introduction: Microwave frequencies, advantages and general applications of microwaves, Microwave devices and Systems, Guided waves, Parallel plane wave guides.
- Microwave waveguides and components rectangular waveguide, circular waveguide, MW cavities, MW Hybrid circuits, Directional couplers, circulators, isolators Gyrator etc.
- MW Transistors and diodes, MW bipolar transistors, Hetero-junction bipolar transistors and MW diodes, MW field effect transistors, Junction FET, Metal- semiconductor FET (MESFETs).
- Transferred Electron Devices (TEDs), Gunn Effect diodes - GaAs diode, Ridley Watkins-Hilsum (RWH) Theory, Modes of operation of LSA diodes, InP diodes, MW generation and amplification. Avalanche Transit-time devices: Read diode, IMPATT diode, TRAPATT diode, BARITT diode, Parametric devices.
- MW linear beam tubes (O type) Conventional tubes and its limitations, Klystrons, Multi-cavity Klystrons, Reflex Klystrons, Helix TWTs, Coupled cavity TWTs, High power and Gridded control TWTs, Microwave filters
- MW Cross field devices: Magnetrons, Forward wave crossed field amplifier, Backward wave cross field amplifier and oscillator, Strip lines: Microstrip lines, parallel strip lines, coplanar strip lines, shielded strip lines etc.

(5) Digital Instrumentation (Theory + Laboratory, Department Elective II)

- Transducers in Instrumentation: Transducer characteristics, step-response, second order model, Errors, feedback transducers. Transducer bridge, Signal conditioning. Interfacing transducers to electronic control and measuring; Digital processing in Instrumentation: S/H circuits, MUX and DMUX, system sampling and quantization, Data converters - A/D, D/A conversion.
- Measuring Physical Variables: Transducers for measuring: Displacement, strain, Velocity, acceleration, pressure, flow, temperature, humidity etc.

- Programmable Logic Controller: PLC and their applications: Hardware and field connections. Input and Output modules of PLC, Physical and logical ladder diagrams – elements like Motors, Solenoids, Relays, Lights, Switches etc. in PLC. PLC Instructions like: Timers and counters, Comparison, arithmetic, data manipulation, logical etc. Advanced programmable controllers
- Data acquisition systems (DAS): Analog, Digital; Data acquisition using serial interface: serial communication, serial interface like RS 232, RS 422, RS 485, GPIB (IEEE 488).

(6) Mobile Communication (Theory, Department Elective III)

- Mobile Radio Propagation: Characterization of wireless channels, Multipath, reflection, scattering, fading, shadowing, Doppler effects, large scale effects, small scale effects.
- Introduction to Cellular Mobile Systems: Hexagonal cell and concept of frequency reuse, Distance to frequency reuse ratio, channel & co channel interference reduction factor, hand off mechanisms ,Hard, Soft & forced handoffs, Cell splitting, Umbrella Cell Concept, Cell Sectoring, S/I ratio consideration, Minimum Co-channel and Adjacent interference.
- Frequency and Access Management: Spectrum utilization, setup channel, access channel, fixed Channel assignment, Intra system hand off mechanisms, Integration with landline systems, Digital modulation methods.
- Channel Capacity and Interference: TDMA, FDMA, SDMA, CDMA, OFDM; Modulation techniques: Constant envelope modulation MSK, GMSK, combined and linear modulation techniques-MPSK, QAM.
- Digital Cellular Systems: GSM cellular standard, service aspects, reference architecture and functioning partitioning, typical call flow sequence. CDMA based standard IS95 and its specifications, frame structure and channels in IS95, Walsh code and PN codes in 1595, channel coding and scrambling in 1895.
- Multimedia and Data Communication Over Mobile Networks: Packet radio service ,GPRS, EDGE, 3G and 4G features, IMT-2000 service aspects, network reference model, radio aspects and distinctive features, PCS , Wireless LAN, Satellite Mobile

(7) Embedded Software and Administration (Theory, Department Elective III)

- Introduction to Operating Systems, Characteristics of RTOS.
- Operating Systems for Embedded Environments.
- The VxWorks real-time operating system, Tasks – Multitasking, State Transitions, Scheduling, POSIX Scheduling Interface, VxWorks System Tasks.
- Inter task Communications, Shared memory, Semaphores, Message queues and pipes, Sockets and remote procedure calls, Signals, Interrupt Service Code, Watchdog Timer; POSIX Clocks and Timers.
- Embedded Linux: Linux history and Linux Architecture Overview, Thread and Process Context, Context switching, Process Management, Memory Management–Paging, process address space, page fault handling File Systems – Virtual file system, Linux Proc File System, Kernel module.

- Basics for writing Device Driver, System calls handler and service routines, Implementation of system call, Making Embedded Linux by reconfiguration of Linux kernel.

(8) AI & Soft Computing (Theory, Department Elective III)

- Machine Intelligence: Overview of different definitions of AI. History of AI - classical AI. Relationship of AI with computer science, Logic, power system, Robotics and Cybernetics.
- Modern AI: Agent based conception – Agents and Environments. Classification of various agent types and their characteristics – Goal-based, Model-based and Learning agents. Classification of environments and their properties. PEAS description.
- Problem-solving agents: Problem solving through searching – Uninformed and Informed search strategies. Constraint satisfaction problems
- Knowledge and Reasoning: Knowledge-based agents using Propositional and First order logics. Knowledge Engineering in FOL. Introduction to Rule-based and knowledge-based reasoning.
- Fuzzy Logic: Concepts of Fuzzy sets, Fuzzy Membership functions, Defuzzification. Fuzzy rule-based systems. Basic FLC and its applications.
- Artificial Neural Networks: Basic concepts - model of an artificial neuron. Neural Network architectures – Single and Multi-layered Feed forward networks, Recurrent Networks. Back propagation Networks –Perceptron. Back propagation Learning
- Genetic Algorithm: Basic concepts – Canonical Genetic Algorithm (CGA). Comparison with other Optimization and search methods. Various aspects of CGA – Encoding, Fitness function, reproduction, Crossover, Mutation. Application of GA to optimization and search problems.

(9) Wireless Sensor Network and IoT (Theory, Department Elective III)

- Basics of Networking, Introduction to Wireless Ad Hoc Networks; MANET: Self-organizing Behaviour, Cooperation, MAC Protocols, Routing, Multicasting, Mobility Models, Transport Protocols; Opportunistic Mobile Networks, UAV Networks.
- Introduction to Wireless Sensor Networks, Coverage & Placement, Topology, Mobile WSN , Medium Access Control, Routing, Congestion and Flow Control; Underwater Sensor Networks, Security, Hardware Design of Sensor Node, Real Life node Deployment.
- Machine-to-Machine Communications, Cyber Physical Systems, Internet of Things: Introduction, Sensing and Actuation, Processing Topologies and Types, Connectivity Technologies, Communication Technologies, Protocols, Interoperability.
- ASSOCIATED IOT TECHNOLOGIES: Cloud Computing, Fog Computing, Applications: Smart Cities and Smart Homes, Smart Grid, Industrial IoT, Agricultural IoT , Vehicular IoT , Healthcare IoT.

(10) Multicopter Design and Control (Theory, Department Elective III)

- Coordinate System and Attitude Representation: Coordinate Frame, Right-Hand Rule, Earth-Fixed Coordinate Frame, Aircraft-Body Coordinate Frame, Attitude Representation, Euler Angles, Rotation Matrix , Quaternions.

- Dynamic Model and Parameter Measurement : Multicopter Control Model, Multicopter Flight Control Rigid Model , Control Effectiveness Model, Propulsor Model Multicopter Aerodynamic Drag Model , Blade Flapping, Multicopter Aerodynamic Drag Model , Multicopter Model Parameter Measurement , Position of the Center of Gravity , Weight , Moment of Inertia, Propulsor Model's Parameter Measurement
- Sensor Calibration and Measurement Model : Fundamental Principle, Calibration & Measurement Model of various sensors like : Three Axis Accelerometer, Three-Axis gyroscope, Three-Axis Magnetometer, Ultrasonic range finder, Barometer, 2D Laser Range Finder, Global Positioning system, Camera
- Low-Level Flight Control , Framework of Low-Level Flight Control of Multicopters, Linear Model Simplification, Horizontal Position Channel Model ,Altitude Channel Model, Attitude Model,Position Control, Euler Angles as Output, Rotation Matrix as Output, , Attitude Control , Euler Angles Based Attitude Control ,Rotation Matrix Based Attitude Control, Robust Attitude Control , Control , Implementation of Control Allocation in Autopilots.
- Motor Control, Closed-Loop Control,Open-Loop Control, Comprehensive Simulation, Control Objective and System Parameter Setting, Euler Angles Based Attitude Control Combined with Euler Angles Based Position Control,Rotation Matrix Based Attitude Control Combined with Rotation Matrix Based Position Control , Robust Attitude Control . Position Controller Design
- PID Controller, Additive-Output-Decomposition-Based Dynamic Inversion Control, System Identification, Control Design, Comparison of Tracking Performance Proportional –Integral-Derivative control, Effects of Proportional –Integral-Derivative action, Noise filtering and high frequency roll-off, Set point weighting and 2 DOF, Windup, Tuning, Computer implementation

Second Semester of BE IV

(1) Applied Signal Processing (Theory + Laboratory)

- Structures for Discrete Time Systems, Representation of numbers and Quantization of filter coefficients, Round off effects, Sampling and reconstruction of signals, sampling of bandpass signals, A to D conversion
- LTI as FREQUENCY SELECTIVE FILTERS: Ideal Filter characteristics, Low-pass Filter, Band-pass Filter, Band-stop Filter, High-pass Filter, Low-pass to High-pass Filter transformation, Digital Resonators, Notch filters, Comb Filters, All Pass Filter, Digital Oscillator, Minimum Phase, Maximum Phase and Mixed Phase systems, Decomposition of Non-minimum Phase into Minimum phase and Allpass filter. Filtering and Signal Distortion: Linear Distortion and Equalization, Ideal Low-Pass Filters, Band-Pass Transmission, Phase Delay and Group Delay, Nonlinear Distortion, Spectral analysis of sinusoidal signals, spectral analysis of nonstationary signals, spectral analysis of random signal
- Multirate filter banks and wavelets, Multirate digital signal processing: interpolator, Decimator, multistage implementation of sampling rate conversion, sampling rate conversion by an arbitrary factor, Application of multi rate signal processing, Uniform and tree structured filter banks and its application

- Digital music processing and synthesis, signal compression, digital speech coding, speech signal analysis and modeling, Methods of speech coding, Transform coding, Subband coding, Frequency domain coding, Linear Predictive coding of Speech and Audio Compression
- Introduction to Multimedia systems, Compression: Lossy compression, Lossless compression, Transform Coding, Text Compression, Image Compression & standards, Video compression, CD, VCD, DVD

(2) Communication Engineering (Theory + Laboratory, Department Elective IV)

- Basic Antenna Parameters, Antenna Family, Antenna terminal impedance, Loop antenna, Slot antenna, Horn antenna, Helical antenna, Reflector antenna, Microstrip antenna, Rumsey's Principle, Log antenna, Spiral antenna, Spot band antenna
- Parametric Amplifier- Parametric Diode, Manley-Rowe relations, Linearized Equations for Parametric Amplifiers, Parametric Up Converter, Negative Resistance Parametric Amplifier
- Secondary sources – Images of Electric and Magnetic Current, Electric and Magnetic current sheet as a source, Impressed and induced current source, Induction and equivalence current theorem, Field of a secondary or Huygen's source.
- Principles of Satellite Communications: Orbital Mechanics, Look Angle Determination and Calculation, Orbital Perturbations and determination, Launches and Launch Vehicles, LEO, MEO, GEO, Transponder
- Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Downlinks, Satellite systems using small earth stations, Uplink design, Design for specified C/N, Spade System, Multiple Access: TDMA, FDMA, CDMA, SSTDMA, Demand Assign FDMA
- Radar and Navigational Systems: Basic Principles, Pulsed Systems, CW Doppler radar, Frequency modulated CW radar, Phased array radars, planar array radars Conventional and satellite based navigation systems (like VOR, ILS, GPS etc)

(3) Industrial Instrumentation (Theory + Laboratory, Department Elective IV)

- Noise and noise reducing techniques in measuring systems. MTBF, MTTR, probabilities of non-function and availability. Telemetry system.
- Gas chromatography, Gas analysers: hydrogen, oxygen, carbon dioxide, carbon monoxide. Control valves: valve sizing, rangeability, types, flow characteristics, actuators, and positioners. Signal Converting Elements: Pneumatic to electrical convertors, Electric to Pneumatic convertors, Voltage to Current convertor, Current to Voltage convertor, Frequency to voltage & Voltage to Frequency convertor.
- HART communication, fieldbuses like MODBUS, PROFIBUS, DeviceNet and ControNet, FOUNDATION fieldbus, Industrial Ethernet, IEEE1394 for industrial automation. Microcontroller serial interface: UART interface, I2C, SPI bus. Virtual Instrumentation, Smart transmitters. SCADA (Supervisory Control and Data Acquisition) system: block diagram, working and applications etc., USB interface, PAC (Programmable Automation Control).

- Measurement, Monitoring and controlling of different Parameters: level and mass flow, Ultrasonic, Photoelectric, Thermoelectric and optical transducers. NDT (Nondestructive testing), Automotive sensors.

(4) Project Part II (Project)

(5) Data Communication Network (Theory + Laboratory, Department Elective V)

- Overview of Communication Methods: Serial and parallel communication, Asynchronous and synchronous transmission, Network architecture and the OSI model. Physical layer: Introduction, Circuit and packet switching, X.25, Frame Relay, Modems, RS232C, RS449, PBX, ISDN, ATM
- Multiple Access Techniques: Controlled Access: Polling, token passing, Reservation; Random access protocols: ALOHA, CSMA; Channelization: TDMA, FDMA, CDMA, LAN: IEEE 802.n procedures.
- Data-link layer design issues, error handling and flow control, CRC, checksum, ARQ, sliding window protocols, HDLC, SDLC, PPP.
- Network layer routing algorithms, Congestion control, Inter networking and routers, servers, repeaters, gateways, bridges etc., Network layer protocols, Internet protocols.
- QoS- Quality of Service (Integrated Services & Differentiated Services). Transport layer : TCP & UDP, Application Layer: DNS Domain Name System, E-mail, FTP, Network Security: Cryptography, Symmetric key Algorithms
- Introduction to Optical Network, FDDI, Optical packet switching, client layers of Optical Layers (SONET/ATM/IP), WDM network elements, WDM network design

(6) Biomedical Instrumentation (Theory + Laboratory, Department Elective V)

- Basic electrophysiology – Bioelectric potentials and their propagation. Action potentials and extracellular waveforms. Cell membrane models and volume conductor. Biopotential electrodes.
- Principles, techniques and applications of neurological measurements, electroencephalography and electromyography. Different types of ECG monitoring equipment. Photo vector & echocardiography.
- Bioelectric amplifiers & signal processing. Basic requirements. Transient's protection. Interference reduction. Radiology and Nuclear medicine equipment- X rays, CAT scans, PET. Ultrasonic scanners. Endoscopes. Sonography & MRI.
- Cardiovascular measurements & instrumentation. Blood pressure direct & indirect measurement & processing. Blood flow & volume measurements. Blood gas analyzers, blood cell counters and blood pumps. Audiometry. Lifesaving, Devices: Pacemakers, Defibrillators, Heart, Lung machine.