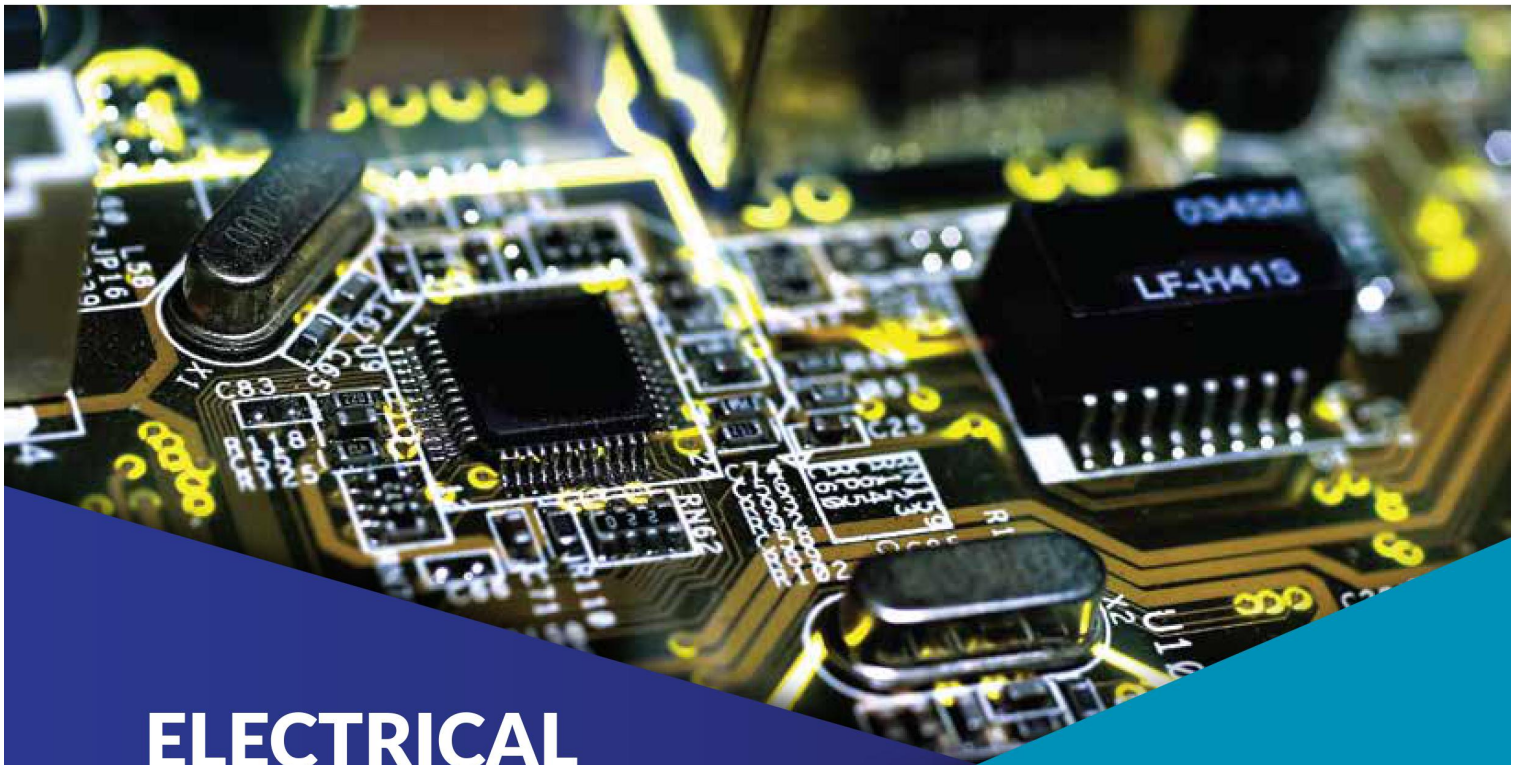


ELECTRICAL ENGINEERING

Electrical engineering is one of the oldest disciplines of engineering. Initially it was confined to few areas such as power generation, transmission and distribution, radio communication and wireless telephony. However, in the last half of the century it has seen tremendous growth and expansion. The diversification and expansion in some areas of Electrical Engineering has been of such a large magnitude that they seem to be independent disciplines in their own. However, in a large part of the world electrical engineering is still considered to be the parent discipline. This curriculum has been developed on this rationale. It facilitates the teaching of common core courses and selection of courses of a particular area depending upon the need and availability of the resources.

- Bachelor of Electrical Engineering BEE

Bachelor of Electrical Engineering BEE

Department of Electrical Engineering

Campuses
Islamabad, Karachi

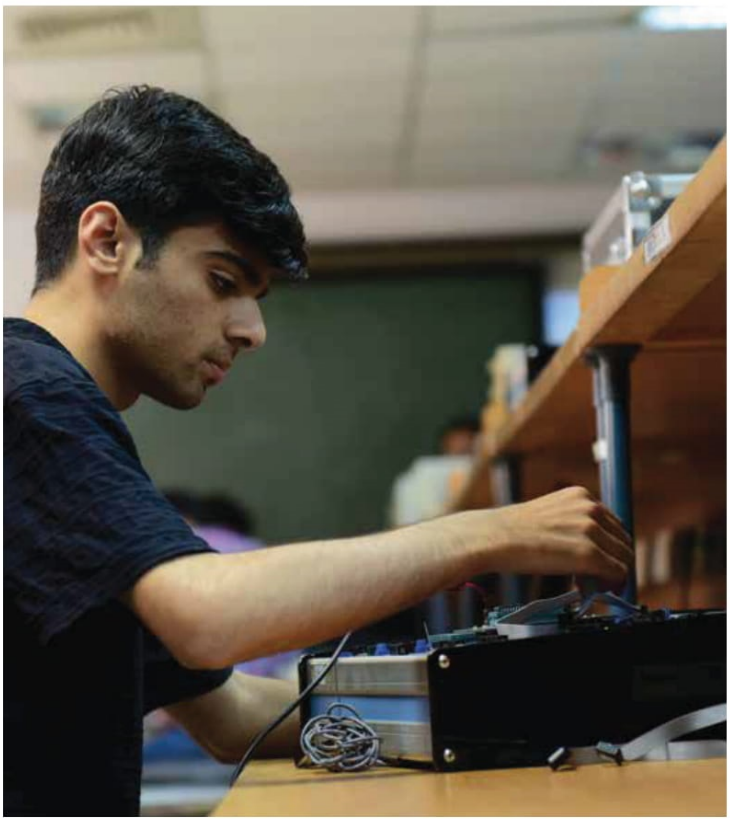
Programme Duration
4 Years
8 Semesters

Available Specialization
Electronics / Telecommunication / Power Systems

Programme Timing
Morning

Entry Requirements

F.sc Pre Engineering/ Equivalent with minimum 60% marks.



Objectives of the Degree Program

PEO 1: To exhibit the expertise in the field of electrical engineering to compete with technical challenges and find the solutions of complex engineering problems.

PEO 2: To be skillful employable graduates in different domains of design, development, operation and maintenance, as well as explore opportunities for entrepreneurship.

PEO 3: To pursue professional growth by taking up higher studies, ascertain technologies, develop proficiency in the usage of new tools.

PEO 4: To work in multicultural environment and communities, providing leadership in their domain, and responsive to ethical, moral, and societal issues.

Learning outcome of the Degree Program

- **Engineering Knowledge:** An ability to apply knowledge of Engineering fundamentals and Electrical Engineering specialization to the solution of complex Engineering problems.
- **Problem Analysis:** An ability to identify, formulate, review, and analyze complex Electrical Engineering problems reaching substantiated conclusions using principles of natural sciences and Electrical Engineering.
- **Design/Development of Solutions:** An ability to design solutions for complex Electrical engineering problems and design Electrical systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
- **Investigation:** An ability to investigate complex Electrical engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
- **Modern Tool Usage:** An ability to 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.
- **The Engineer and Society:** An ability to apply reasoning informed by contextual knowledge of Electrical engineering to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.
- **Environment and Sustainability:** An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
- **Individual and Team Work:** An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
- **Communication:** An ability to communicate effectively, orally as well as in writing, on complex Electrical 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.
- **Project Management:** An ability to demonstrate management skills and apply Electrical engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
- **Lifelong Learning:** An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

Why choose BU for the stated Degree Program?

Bahria University is focused and committed to develop highly qualified engineers for improving human condition. The Electrical Engineering Department (EED) is devoted to enhance student's academic portfolio by emphatically injecting the "5I" features namely, Intellect, Innovation, Integration, Information technology and Industrial partnership.

Bachelor of Electrical Energy curriculum is designed to keep in view the diversification and expansion in the field of Electrical Engineering and is fully compliance with Higher Education Commission of Pakistan and Pakistan Engineering Council.

One of the most invoking attribute of EE department is its highly qualified and distinguished PhD & MS faculty presently involved in educating students, monitor and guide them to build their future. University has acquired top talents from diverse disciplines into the university's academic and research enterprise. Strengthening its learning community and provides support and overall management of the department as well. Our faculty's research interests span the full spectrum Electrical Engineering topics and domains related to the programs we are offering.

Labs at Bahria University provide students to do hands-on work in testing, simulations, and research. Electrical engineering labs at BU offer wide range equipment and devices in particularly Electrical Machines, Microprocessor, Control & Instruments, Computer Networks, Digital Logic Design, and Analog and Digital Lab. Physics, and Research & Development Lab.

Road Map

Campus	Islamabad/Karachi
Department	Department of Electrical Engineering
Program Title	BEE
Program Level	Bachelors
Total Duration of Program	4 years
Total Number of semesters	8 semesters
Total Number of Credit Hours	136
Number of Credit Hours per Semester	16-18
Engineering Courses	28 Courses, 95 Cr Hrs, 69.9 % of total
Non-Engineering Courses	15 Courses, 41 Cr Hrs, 30.1 % of total

Courses of Non-Engineering Domain

Knowledge Area	Sub Area	Name of Course	Lec. Cr. Hrs	Lab Cr. Hrs	Total Cr. Hrs.	Total Cou-rses	Total Cre-dits	% Area	% Overall
Humanities and Social Sciences	English	Functional English	2	0	2	3	7	17	5.1
		Comm. Skills	2	0	2				
		Technical Report Writing & Present. Skills	3	0	3				
	Culture	Islamic Studies	2	0	2	2	4	9.7	2.9
		Pakistan Studies	2	0	2				
	Social Sciences	Social Sciences Elective 1	3	0	3	2	6	14.6	4.4
		Social Sciences Elective 2	3	0	3				

Management Sciences		Management Sciences Elective 1	2	0	2	2	5	12.2	3.7
		Management Sciences Elective 2	3	0	3				
Natural Sciences	Math	Applied Calculus and Analytical Geometry	3	0	3	4	12	29.2	8.8
		Linear Algebra	3	0	3				
		Differential Equations	3	0	3				
		Complex Variable and Transform	3	0	3				
	Physics	Applied	3	1	4	1	4	9.8	2.9
Total			39/ 40	2/1	41	15	41	100%	30.1%

Courses of Engineering Domain

Knowledge Area	Name of Course	Lec. Cr. Hrs.	Lab Cr. Hrs.	Total Cr. Hrs.	Total Cou-rses	Total Cr. Hrs.	% Area	% Overall
Computing	Introduction to Computing	1	1	2	3	9	9.5	6.6
	Programming Fundamentals	2	1	3				
	Computing Elective	3	1	4				
Electrical Engineering Foundation	Linear Circuit Analysis	3	1	4	9	28	29.5	20.6
	Electrical Network Analysis	3	1	4				
	Workshop Practice	0	1	1				
	Signals and Systems	3	1	4				
	Electronic Devices & Circuits	3	1	4				
	Digital Logic Design	3	1	4				
	Electromagnetic field theory	3	0	3				
	Probability Methods in Engineering	3	0	3				
	Engineering Drawing & CAD	0	1	1				

Electrical Engineering Core (Breadth)	Communication Systems	3	1	4	7	28	29.5	20.6
	Embedded system design	3	1	4				
	Electrical Machines	3	1	4				
	Linear Control Systems	3	1	4				
	Electronic Circuit Design	3	1	4				
	Breadth Core 1	3	1	4				
	Breadth Core 2	3	1	4				
Electrical Engineering Core (Depth)	Depth Elective 1	3	1	4	5	19	20	13.9
	Depth Elective 2	3	1	4				
	Depth Elective 3	3	1	4				
	Depth Elective 4	3	1	4				
	Depth Elective 5	3	0	3				
IDEE	IDEE-1	2	0	2	2	5	5.2	3.8
	IDEE-2	3	0	3				
Senior Design Project	Project 1	0	3	3	2	6	6.3	4.4
	Project 2	0	3	3				
Internship (Summer)		0	0	0	0	0	0	0
Total					28	95	100	69.9%

Semester-1

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	GSC 110	Applied Calculus and Analytical Geometry	3+0	3	0
2	None	CSC 111	Introduction to Computing	1+1	1	1
3	None	ENG 104	Functional English	2+0	2	0
4	None	ISL 101	Islamic Studies	2+0	2	0
5	None	XXXX	IDEE-1	2+0	2	0
6	None	GSC 113	Applied Physics	3+1	3	1
7	None	EEL 112	Workshop Practice	0+1	0	1
Total Credit Hours in Semester-1				16	13	3

Semester-2

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	EEL 121	Engineering Drawing & CAD	0+1	0	1
2	GSC 110	GSC 210	Differential Equations	3+0	3	0
3	CSC 111	CSC 112	Programming Fundamentals	2+1	2	1
4	None	EEN 110	Linear Circuit Analysis	3+1	3	1
5	None	CEN 120	Digital Logic Design	3+1	3	1
6	None	PAK 101	Pakistan Studies	2+0	2	0
Total Credit Hours in Semester-2				17	13	4

Semester-3

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	HSS 118	Communication Skills	2+0	2	0
2	EEN 110	EEN 224	Electronic Devices and Circuits	3+1	3	1
3	EEN 110	EEN 211	Electrical Network Analysis	3+1	3	1
4	CSC 112	CSC XXX	Computing Elective	3+1	3	1
5	GSC 110	GSC 220	Complex Variables and Transforms	3+0	3	0
			Total Credit Hours in Semester-3	17	14	3

Semester-4

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	GSC 121	Linear algebra	3+0	3	0
2	None	HSS XXX	Humanities & Social Sciences Elective -1	3+0	3	0
3	GSC 220	EEN 313	Signals and Systems	3+1	3	1
4	EEN 224	EEN 225	Electronic Circuit Design	3+1	3	1
5	GSC 110	EEN 226	Probability Methods in Engineering	3+0	3	0
			Total Credit Hours in Semester-4	17	15	2

Semester-5

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	GSC 110	EEN 311	Electromagnetic Field Theory	3+0	3	0
2	CEN 120	CEN 440	Embedded systems Design	3+1	3	1
3	XXXX	XXXX	Natural Science Elective	3+0/2+1	3/2	0/1
4	EEN 313	EET 321	Communication Systems	3+1	3	1
5	EEN 211	EEN 312	Electrical Machines	3+1	3	1
Total Credit Hours in Semester-5				18	15/14	3/4

Semester-6

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	XXXX	EEXXXX	Breadth Core- 1	3+1	3	1
2	EEN 313	EEN 412	Linear Control Systems	3+1	3	1
3	None	MGT XXX /HSS XXX	Management Science Elective 1	2+0	2	0
4	XXXX	EEXXXX	Depth Elective 1	3+1	3	1
5	XXXX	EEXXXX	Breadth Core-2	3+1	3	1
Total Credit Hours in Semester-6				18	14	4

Semester-7

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	ESC 498	Project – 1	0+3	0	3
2	None	HSS 320	Tech. Writing & Presentation Skills	3+0	3	0
3	XXXX	EEXXX	Depth Elective 2	3+1	3	1
4	XXXX	EEXXX	Depth Elective 3	3+1	3	1
5	XXXX	XXXX	IDEE-2	3+0	3	0
Total Credit Hours in Semester-7				17	12	5

Semester-8

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	XXXX	ESC 499	Project-2	0+3	0	3
2	None	HSS XXX	Humanities & SS Elective-2	3+0	3	0
3	None	MGT XXX	Management sciences Elective - 2	3+0	3	0
4	XXXX	EEXXXX	Depth Elective 4	3+1	3	1
5	XXXX	EEXXXX	Depth Elective 5	3+0	3	0
Total Credit Hours in Semester-8				16	12	4

List of Elective Courses
Non-Engineering Domain Electives

A. Humanities and Social Sciences Electives

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	HSS 422	Engineering Ethics	3+0	3	0
2	None	HSS 202	Introduction to Sociology	3+0	3	0
3	None	BES 103	Critical Thinking	3+0	3	0
4	None	HSS 456	Organizational Behavior	3+0	3	0
5	None	PSY 401	Professional Psychology	3+0	3	0
6	None	HSS 111	Introduction to International Relations	3+0	3	0

B. Management Science Electives

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	HSS 423	Entrepreneurship	2+0	2	0
2	None	MGT 421	Leadership	2+0	2	0
3	None	MGT 422	Personal Grooming	2+0	2	0
4	None	MGT 111	Principles of Management	3+0	3	0
5	None	MGT 423	Engineering Management	3+0	3	0
6	None	MGT 424	Engineering Economics	3+0	3	0
7	None	MGT 425	Project Management in Engineering	3+0	3	0

C. Natural Sciences Electives

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	GSC 110	GSC 211	Multivariable Calculus	3+0	3	0
2	GSC 210	GSC 320	Numerical Analysis	3+0	3	0
3	None	GSC 221	Discrete Mathematics	3+0	3	0
4	None	GSC 340	Chemistry	2+1	2	1

Engineering Domain Electives

A. Computing Electives

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	CSC 112	CSC 210	Object Oriented Programming	3+1	3	1
2	CSC 112	CSC 221	Data structure and Algorithm	3+1	3	1

B. Breadth Core Electives

1. Power Engineering

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	EEN 211	EEP 331	Power System Analysis (Breadth Core 1)	3+1	3	1
2	EEN 219	EEN 433	Power Distribution and Utilization (Breadth Core 2)	3+1	3	1

2. Electronics Engineering

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	EEN 224	EEP 468	Power Electronics (Breadth Core 1)	3+1	3	1
2	EEN 313	EEN 325	Digital Signal Processing (Breadth Core 2)	3+1	3	1

3. Telecommunication Engineering

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	CEN 223	Computer Communication & Networks (Breadth Core 1)	3+1	3	1
2	EEN 313	EEN 325	Digital Signal Processing (Breadth Core 2)	3+1	3	1

C. Depth Electives

1. Communication/ Telecommunication Engineering

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	EEN 311	EEN 431	RF and Microwave Engineering	3+1	3	1
2	None	EET 463	Optical Fiber Communication	3+1	3	1
3	EEN 311	EET 447	Radar Systems	3+1	3	1
4	EET 321	EEN 436	Wireless and Mobile Communication	3+1	3	1
5	EET 321	EET 449	Satellite Communications	3+1	3	1
6	EEN 311	EET 451	Wave Propagation and Antennas	3+1	3	1
7	CEN 223	EET 452	Multimedia Communications	3+1	3	1
8	None	CSC 453	Information Theory	3+1	3	1
9	CEN 223	EEN 434	Computer Networks	3+1	3	1
10	EET 321	EET 411	Digital Communications	3+1	3	1
11	None	EET 456	Telecom Transmission and Switching Systems	3+0	3	0
12	CEN 223	CEN 444	Digital Image Processing	3+0	3	0
13	EEN 325	CEN 441	FPGA- Based System Design	3+1	3	1

14	CEN 120 CEN 440	EEN 469	Linear Integrated Circuits and Applications	3+1	3	1
15	EEN 224	EEN 316	Instrumentation and measurement	3+1	3	1
16	None	EET 471	Emerging Wireless Technologies and RF planning	3+0	3	0
17	None	EET 472	Telecommunication policies and standards	3+0	3	0

2. Electronic Engineering

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	EEN 224	EEN 316	Instrumentation and measurement	3+1	3	1
2	EEN 224	EEN 462	Integrated Electronics	3+1	3	1
3		EEN 441	Industrial Process Control	3+1	3	1
4	EEN 224	EEN 442	Digital Electronics	3+1	3	1
5	EEN 224	EEN 444	Opto Electronics	3+1	3	1
6	EEN 224	CEN 452	VLSI Design	3+1	3	1
7	EEN 224	EEN 445	Industrial Electronics	3+1	3	1
8	CEN 120	CEN 442	Digital System Design	3+1	3	1

9	EEN 224	EEN 469	Linear Integrated Circuits & Applications	3+1	3	1
10	EEN 224	EEN 466	Introduction to Nano Technology	3+0	3	0
11	EEN 311	EET 451	Wave Propagation and Antennas	3+1	3	1
12	EEN 325	CEN 444	Digital Image Processing	3+0	3	0
13	EEN 224	EEN 435	Solid State Devices	3+1	3	1
14	EEN 412	EEN 437	Digital Control Systems	3+1	3	1
15	EEN 219	EEN 433	Power Distribution and Utilization	3+1	3	1
16	CEN 120	CEN 441	FPGA- Based System Design	3+1	3	1
17	EEN 219	EEN 420	Industrial Automation	3+1	3	1
18	EEN 224	EEN 471	Microelectronics Technology	3+0	3	0
19	EEN 311	EEN 431	RF and Microwave Engineering	3+1	3	1
20	EEN 325	ESC 471	Biomedical Instrumentation	3+0	3	0
21	None	CEN 223	Computer Communication & Networking	3+1	3	1
22	None	ESC 472	Medical Robots	3+0	3	0

3. Power Engineering

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	EEN 224	EEN 316	Instrumentation and Measurements	3+1	3	1
2	EEN 219	EEP 441	Advanced Electrical Machines	3+1	3	1
3	EEN 219	EEP 442	Power Generation	3+1	3	1
4	EEN 433	EEP 443	Electrical Power Transmission	3+1	3	1
5	EEN 224	EEP 468	Power Electronics	3+1	3	1
6	EEP 331	EEP 444	Power System Protection	3+1	3	1
7	EEP 331	EEP 445	Power System Stability & Control	3+0	3	0
8	EEN 219	EEP 471	Electrical Machine Design and Maintenance	3+1	3	1
9	EEN 211	EEP 446	High Voltage Engineering	3+1	3	1
10		EEP 448	Renewable Energy Systems	3+0	3	0
11	EEN 313	EEN 325	Digital Signal Processing	3+1	3	1
12	EEN 224	EEP 472	Industrial Drives	3+1	3	1
13	EEP 331	EEP 475	FACTS and HVDC Transmission	3+0	3	0
14	None	CEN 223	Computer Communication & Networking	3+1	3	1

15	None	EEP 474	Smart Grid	3+0	3	0
16	EEN 412	EEN 437	Digital Control System	3+1	3	1
17	EET 321	EET 474	Digital Communication System	3+1	3	1
18	EEN 224	EEN 469	Linear Integrated Circuits and Applications	3+1	3	1
19	EEN 224	EEP 474	PLC and Industrial Drives	3+1	3	1
20	EEN 224	EEN 445	Industrial Electronics	3+1	3	1
21	None	EEN 434	Computer Networks	3+1	3	1

D. IDEE Electives

Sr. No.	Pre-requisite course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	ESC111	Basic Mechanical Engineering	2+0	2	0
2	None	GSC104	Surveying and Leveling	2+0	2	0
3	None	GSC486	Geographical Information System	2+0	2	0
4	None	ENV 440	Energy and Environment	2+0	2	0
5	None	EEA 430	Introduction to Mechatronics	3+0	3	0
6	None	EEN 438	Introduction to Biomedical Engineering	3+0	3	0
7	None	CSC 320	Operating Systems	3+0	3	0
8	None	CSC 419	Introduction to Machine Learning	3+0	3	0

Electrical Engineering Course Description

Calculus and Analytical Geometry
Course Code: GSC110
Prerequisite: None

Objectives: Teach the concepts of calculus and analytic geometry and the applications of these concepts to the solution of engineering problems.
Course Outline: Complex Numbers, DeMoivre's Theorem and its Applications, Simple Cartesian Curves, Functions and Graphs, Symmetrical Properties, Curve Tracing, Graphs, Symmetrical Properties, Curve Tracing Limit and Continuity, Differentiation of Functions. Derivative as Slope of Tangent to a Curve and as Rate of Change, Application to Tangent and Normal, Linearization, Maxima/ Minima and Point of Inflexion, Taylor and Maclaurin Expansions and their convergence. Integral as Anti-derivative, Indefinite Integration of Simple Functions. Methods of Integration: Integration by Substitution, by parts and by partial fractions, Definite Integral as Limit of a Sum, Application to Area, Arc Length, Volume and Surface of Revolution.

Linear Algebra
Course Code: GSC121
Prerequisite: None

Objectives: Introduce the matrix theory and the use of matrices in the solution of engineering problems.
Course Outline: Vectors, Vector Spaces, Matrices & Determinants, Cofactor and Inverse, Rank, Linear Independence, Solution of system of Linear systems, Positive Definite matrix, Linear Transformations, Operations on matrices, Inner products, orthgonality and least squares, Eigenvalue & Eigenvectors. Applications to Systems of Equations and to Geometry, Singular Value Decomposition.

Differential Equations
Course Code: GSC210
Prerequisite: Calculus and Analytical Geometry

Objectives: Develop fundamental skills of solvin ordinary differential equations, and developing differential equations for realworld problems.
Course Outline: Ordinary Differential Equations of the First Order: Geometrical Considerations, Isoclines, Separable Equations, Equations Reducible to Separable Form, Exact Differential Equations, Integrating Factors, Linear First-Order Differential Equations, Variation of Parameters. Ordinary Linear Differential Equations; Homogeneous Linear Equations of the Second Order, Homogeneous Second-Order Equations with Constant Coefficients, General Solution, Real Roots, Complex Roots, Double Root of the Characteristic Equation, Differential Operators, Cauchy Equation, Homogeneous Linear Equations of Arbitrary Order, Homogeneous Linear Equations of Arbitrary Order with Constant Coefficients, Non-homogeneous Linear Equations. Modeling of Electrical Circuits. Systems of Differential Equations. Series Solutions of Differential Equations. Partial Differential Equations: Method of Separation of variables, wave, Heat & Laplace equations and their solutions by Fourier series method.

Complex Variables and Transforms
Course Code: GSC220
Prerequisite: Calculus and Analytical Geometry

Objectives: Develop fundamental skills complex variable analysis and apply it in solving differential equations through Laplace transform.
Course Outline: Complex numbers and functions. Complex integration. Power series, Taylor series. Laurent series, residue integration. Laplace Transform. Use of Laplace transform in solving differential equations.

Numerical Analysis
Course Code: GSC320
Prerequisite Differential Equation,
Multivariable Calculus

Objectives: Teach the use of computers for the numerical solution of engineering problems.
Course Outline: Floating point number system error analysis, solutions of equations, interpolation, splines, numerical differentiation and integration, numerical methods in linear algebra, systems of linear equations, method of least squares, eigenvalues, eigenvectors, solution of ordinary and partial differential equations. This subject is to be supplemented with extensive computer exercises.

Introduction to Computing
Course Code: CSC111
Prerequisite: None

Objectives: To acquaint the students with the structure, operation, programming, and applications of computers.
Course Outline: History, classification, basic components, CPU, memory, peripheral devices, storage media and devices, peripheral devices, storage media and devices, physical and logical storage, data organization, file storage, programs and software, application software, operating systems, problem specification, flow chart, variables and constants, arrays, input/output, termination, social impact of computer age, computers in office, industry and education.
Lab Work Outline: Basic computer organization including motherboard, memory, I/O cards, networking devices, use of flow charts introduction to office tools including spreadsheet, word processing and presentation, introduction to mathematical software such as MATLAB, overview of different browsers, introduction to various operating systems, coding, executing and debugging simple programmes.

Programming Fundamentals
Course Code: CSC112
Prerequisite: Introduction to Computing

Objectives: To acquaint the students with the fundamental concepts of structured and object oriented computer program-ming language such as C++ OR Java.
Course Outline: Fundamental data types, abstract data types, arrays and matrices, records and pointers, linked lists, Introduction to Object oriented programming and software development, defining classes, selection statements, repetition statements, exceptions and assertions, arrays and collections, file I/O, inheritance and polymorphism, GUI and Event driven programming.
Lab Work Outline: Programming in C++ OR Java using simple programs for basic file I/O, single dimensional arrays, two-dimensional arrays, sorting algorithm, problem solving in object oriented paradigm, object oriented program design process and tools, implementation of classes and derived classes, objects and encapsulation, operator and functions overloading, inheritance and polymorphism, GUI development.

Object Oriented Programming
Course Code: CSC210
Prerequisite: Programming Fundamentals

Objectives: To introduce objects, class hierarchy, operations on objects and use them in solving real life problems.
Course Outline: Procedural versus object oriented programming languages, UML modeling, object oriented design strategy and problem solving, objects and classes, member functions, public and private members, dynamic memory management, constructors and destructors, templates, object encapsulation, derived classes, class hierarchies, inheritance and polymor-phism, operator

overloading, stream class, practical design through Object Oriented Programming
Lab Work Outline: Introduction to functions, introduction to arrays, structures, structures and pointers, structure with functions, strings, introduction to classes, introduction to classeswith constructors, operator overloading, friend class and friend function, strings class, inheritance file handling, polymorphism and abstract class.

Linear Circuit Analysis
Course Code: EEN110
Prerequisites: None

Objective: Introduce basic electrical engineering concepts and to acquaint students with the knowledge and the tools to analyze liner electric circuits.
Course Outline: Electric quantities, electric signals, electric circuits, Kirchhoff's laws, circuit elements. Resistance, series parallel combination, voltage and current dividers, resistive bridges and ladders, practical sources and loading, instrumentation and measurement. Nodal analysis, loop analysis, linearity and superposition, source transformation, one ports, circuit theorems, power calculations. Dependent sources, ideal transformer, amplifiers. The operational amplifier, basic op-amp configurations, ideal
op-amp circuit analysis, summing and difference amplifiers, amplifier types. Capacitance, inductance, natural response of RC and RL circuits. Response to DC forcing function. Transient response of first order circuits, step, pulse and pulse train responses, first order op-amp circuits. Transient response and step. response of second order circuits. AC fundamentals; RMS or effective, average and maximum values of current & voltage for sinusoidal signal wave forms.
Lab Work Outline: Learn the use of basic instruments in electrical engineering such as function generators, power supplies, oscilloscopes. Design and implement circuits using R, RL and RC and verify the node voltages and loop currents using instruments. Verify Circuit-theorems using lab instruments. Verify circuit transformations using lab instruments.

Workshop Practice
Course Code: EEL112
Prerequisite: None

Objectives: To develop practical skills in the use of workshop tools and equipment.
Course Outline: Introduction to various technical facilities in the workshop including mechanical and electrical equipment. Concepts
in electrical safety, safety regulations, earthing
concepts, electric shocks and treatment. Use of tools used by electricians, wiring regulations, types of cables and electric accessories including switches, plugs, circuit breakers, fuses etc., symbols for electrical wiring schematics e.g. switches, lamps, sockets etc., drawing and practice in simple house wring and testing methods, wiring schemes of two-way and three-way circuits and ringing circuits, voltage and current measurements. Electric soldering and soldering tools; soldering methods and skills, PCB designing, transferring a circuit to PCB, etching, drilling and soldering component on PCB testing.

Electrical Network Analysis
Course Code: EEN211
Prerequisite: Linear Circuit Analysis

Objectives: To equip the students with the knowledge and techniques of analyzing electrical networks.
Course Outline: Current and voltage transients, RLC circuits with DC and AC excitation, resonant circuit: series and parallel resonance in AC circuit, Q-Factor, mutual inductance and transformers, introduction to phasor

representation of alternating voltage and current, single-phase circuit analysis, star-delta transformation for DC and AC circuits, poly phase generators, sphase sequence, vector diagrams for balance and unbalanced three phase networks, power in three phase circuits and different methods of its measurements. Two-port networks and their interconnections. Application of Laplace transform in circuit analysis.
Lab Work Outline: Design and implement RLC circuits and observe resonance and impedance characteristics. Verify the node voltages and loop currents in RLC circuits using instruments Verify Circuit-theorems using lab instruments. Verify circuit transformations using lab instruments. Learn the use of Circuit Simulation computer package such as SPICE. Observe transient and steady state response in RL, RC and RLC circuits using SPICE.

Electronic Devices & Circuits
Course Code: EEN224
Prerequisite: Linear Circuit Analysis

Objectives: The objective of this course is to teach the principle, operation and characistrics of various electronic devices and their applications in electronic circuirts.
Course Outline: PN Junction, device physics, diode circuits, clampers and rectifiers. Zener diodes, LED, laser diode, photo diode, tunnel diode, BJTd, FETs and MOSFETS. Biasing circuits for BJT and FET. Small signal transistor models. Single transistor amplifiers. Operational amplifiers.
Lab Work Outline: Observe electrical characteristics of Diodes, BJT and FET. Design, implementation and measurements of electronic circuits for rectifiers, zener diode regulators, Biasing in BJT and FET, Small-signal amplifiers in BJT and FET. Use of Operational amplifiers.

Digital Logic Design
Course Code: CEN120
Prerequisite: None

Objectives: To introduce the concepts for the design of digital electronic circuits and systems.
Course Outline: Number Systems, Boolean Algebra, Logic Simplification, Combinational Logic, Sequential Logic, Tri-state logic, Counters, Shift Registers, Computer Buses, Memory, Storage, Adders, Multiplexers and simple arithmetic logic unit (ALU) design.
Lab Work Outline: Basic logic gates, hardware implementation of combinational logic circuits such as multiplexers and de-multiplexers, encoders/decoders, ALU; implementation of sequential circuits such as flip-flops, registers, shift registers, counters and other digital circuits.

Engineering Drawing & CAD
Course Code: EEL121
Prerequisite: None

Objectives: To equip the students with the basic knowledge and skills of engineering drawing and its application in practical scenarios. The students will also be introduced to a CAD package. Course Outline: Types of lines and usage, dimensioning, lettering, orthographic first angle projection, sheet planning, orthographic third angle projection, introduction to computer aided drawing, isometric projection, sectional drawing and assembly drawing. Drawing sheets will be prepared on drawing board as well as CAD package.
Course Outline: Types of lines and usage, dimensioning, lettering, orthographic first angle projection, sheet planning, orthographic third angle projection, introduction to computer aided drawing, isometric projection, sectional drawing and assembly drawing. Drawing sheets will be prepared on drawing board as well as CAD package.

Probability Methods in Engineering
Course Code: EEN226
Prerequisites: Calculus and Analytical Geometry

Objective: To introduce the basic concepts and engineering applications of probability and statistics. Course Outline: Set theory, basic concepts of probability, conditional probability, independent events, Baye's Theorem, discrete and continuous random variables, distributions and density functions, probability distributions (binomial, Poisson, hyper geometric, normal, uniform and exponential), mean, variance, standard deviations, moments and moment generating functions, linear regression and curve fitting, limits theorems and applications.

Signals and Systems
Course Code: EEN313
Prerequisite: Complex Variables and Transforms

Objectives: To provide understanding of signals, systems and transforms.
Course Outline: Continuous time and discrete time signals, periodic signals, even and odd signals, exponential and sinusoidal signals, the unit impulse and unit step functions, continues time and discrete time systems, linear time invariant (LTI) systems, difference equation, causality, BIBO stability, convolution and correlation, discrete time Fourier transforms, time and frequency characterization of signals and systems, the sampling theorem, aliasing, sampling the discrete time signals, z-transform, analysis and characterization of LTI systems using z-transform, case studies: communication systems and linear feedback systems. Introduction to analog filter design.
Lab Work Outline: Develop and understanding of signal systems and transforms using MATLAB.

Electromagnetic Field Theory
Course Code: EEN311
Prerequisite: Calculus and Analytical Geometry

Objectives: Introduce the concepts and mathematical methods to understand and analyze electromagnetic fields and waves.
Course Outline: Vector algebra, coordinate systems and transformations, Vector calculus, electrostatic fields in materials, electrostatic boundary value problems, resistance and capacitance calculation. Magneto-static fields magneto-static fields and materials, inductance calculation. Faraday's Law, displacement current and Maxwell's equation.

Communications Systems
Course Code: EET321
Prerequisite: Signals and Systems.

Objectives: This course is structured as a senior-level design course emphasizing fundamental communication principles and the application of these principles to Contemporary analogue and digital communication systems. Students learn basic concepts (both digital and analogue) associated with information, coding, modulation, detection, and signal processing in the presence of noise. They apply these concepts to the design of contemporary communications, and digital telephony such as television, radio, wireless, mobile, and satellite communications.
Course Outline: Amplitude Modulation: Baseband and carrier communications, Double Sideband (DSB), Single Sideband (SSB), Vestigial Sideband (VSB), Superhetrodyne AM Receiver, Carrier Acquisition, Television Angle Modulation: Instantaneous frequency, Bandwidth of FM/PM, Generation of FM/PM, Demodulation of FM/PM. Noise: Mathematical representation, Signal to Noise Ratio, Noise in AM, FM, and PM systems. Pulse Modulation: Sampling and Quantization, Pulse Amplitude Modulation, Pulse Position and Pulse width Modulation, Quantization Noise, Signal to Quantization Noise Ratio, Pulse code Modulation, Delta Modulation, Frequency Shift Keying, Phase Shift Keying.
Lab Work Outline: Introduction to function generators and powering of trainers, RFoscillators, 2nd order active BPF filters, TDM multiplexing-De multiplexing, FDM multiplexing –De multiplexing, AM by balanced modulators, AM demodulation by diode detector, DSB-SC and SSC modulation, DSB-SC and SSC demodulation, Frequency modulation by PLL, Frequency demodulation by PLL, PCM modulator, PCM demodulator, Delta modulator, Delta demodulator, BPSK modulator-demodulator

Electrical Machines
Course Code: EEN312
Prerequisite: Linear Circuit Analysis

Objectives: Covers fundamental aspects of Electrical Machines.
Course Outline: Introduction to Electrical Machinery Principles: Magnetic Field and Circuits, Magnetization curves Characteristics of hard and soft magnetic materials, losses. Transformers: Ideal Transformer, Single Phase transformer: Operation and Equivalent Circuit, auto-transformer. DC Machinery fundamentals: Basics, loop rotating between pole faces, Commutation, Windings, Armature reaction, Induced Voltage and torque equation. Power flow and losses, Types of DC motors, Permanent magnet DC motors. AC Machinery fundamentals: Rotating Magnetic Field, Magneto motive force and flux distribution, Induced Voltage and Torque, Windings, Power Flow and Losses, Introduction to Induction Machines. Special Purpose Motors: Introduction to Single phase Induction Motors Switched Reluctance motors, Hysteresis motors, Stepper, brushless DC motors. Lab Work Outline:Electric machinery fundamentals, transformers, alternating current machines, direct current machines, single phase motors and three phase circuits

Linear Control Systems
Course Code: EEN412
Pre-Requisite: Signals and Systems

Objectives: This course is aimed to build a comprehensive foundation in the analysis and design of control systems using classical and modern techniques.
Course Outline: Modeling of electrical, mechanical and biological control systems, Open and closed-loop systems, Block diagrams. Second order systems. Step and impulse response. Performance criteria. Steady state

error. Sensitivity, s-plane system stability. Analysis and design with the root loci method. Frequency domain analysis, Bode plots, Nyquist criterion, gain and phase margins, Nichols charts. The State-space method, state equations, flow graphs, stability, compensation techniques. Simulation and Controller design using MATLAB.
Lab Work Outline: Control system tool box in Matlab,stability using laplace transform, block diagrams and feedback, state space response of systems, frequency response of LTI system, stability of LTI system, transient response & implementation of PID controller, controller design using root locus method, design of state space feedback controller using pole adjustment method. Introduction to easy motion studio, motor PID parameters adjustment, PID parameters tuning under different moment of inertia, effect of interference upon position controller and speed controller. time-domain analysis of second-order system.

Power Distribution and Utilization
Course Code: EEN433
Prerequisite: Electric Machines

Objectives: Students are introduced to the basics of power distribution systems and effective utilization of power in heating and illumination applications.
Course Outline: Introduction to distribution system. Urban, suburban and rural distribution systems. Primary, secondary and tertiary voltages. Radial and ring main systems, application of distribution transformers, estimation of load, load characteristics, substation switch gears and bus bar arrangements, calculation of voltage drop and regulation in distribution feeders. Grounding and earthing, distribution transformer neutral, earthing resistance, earthing practice in L.V. networks. Power Factor: Disadvantages and causes of low power factor, methods for improvement, application of shunt capacitors in distribution network. Batteries & Electrochemical Processes: Main types of batteries and their working, battery charging, electroplating, electrolysis and electro metallurgical process. Cathodic protection of poles, gas pipes, oil pipes and water structures. Heating and Welding: Electric heating, resistance, induction and dielectric heating, electric furnaces, microwave heating, electric welding, resistance welding and its types. Fundamentals of Illumination Engineering: Laws, units and terms used, requirements for good lighting, illumination schemes for various situations (street lighting, commercial/ industrial lighting, stadium/ flood/stage/spot lighting etc.), types of lamps, their working and relative merit.

Instrumentation and Measurements
Course Code: EEN316
Prerequisite: Electrical Network Analysis

Objectives: Introduce the concepts and the methods and instruments for the measurement of electrical and non-electrical quantities.
Course Outline: Precision measurements terminologies principles of different measurement techniques; instruments for measurement of electrical and non-electrical quantities; systems for signal processing and signal transmission; modern instrumentation techniques; static and dynamic responses of instrumentation and signal conditioning; data acquisition systems; principles of operation, construction and working of different analog and digital meters, Advanced Testing & Measuring instruments recording instruments, signal generators, Input and output transducers; types of bridges for measurement of resistance, inductance, and capacitance; power and energy meters; high-voltage measurements.
Lab Work Outline: Design, contruction, and analysis of measurement circuits, data acquisition circuits, instrumentation devices, and automatic testing;

measurement of electrical parameters using different lab instruments; calibration of measurement instruments; use of data acquisition systems for presentation and interpretation of data; use of microcomputers to acquire and process data; use of simulation and instrumentation languages (LabVIEW)

Electronic Circuit Design
Course Code: EEN225
Prerequisite: Basic Electronics

Objectives: Introduce DC and AC analysis and design of single stage, capacitor coupled and direct coupled amplifiers, classification and types of amplifiers, feedback and oscillators. BJT and FETs (MOSFETSs) are covered.
Course Outline: The transistor at low frequencies, biasing. The transistor at high frequencies. Multistage amplificers. Feedback amplifiers analysis and design. Stability concepts and oscillators. Signal generators and wave shaping circuits. Power amplifiers.
Lab Work Outline: Characteristics and Analysis of BJTs, FET and MOSFETs. Multistage Amplifiers, Feedback in amplifiers, Oscillators.

Computer Communication & Networking
Course Code: CEN223
Prerequisite: Introduction to Computing

Objectives: Tounderstand the concepts related to data communication and networking and to apply this knowledge of data communications to wireless and other emerging networks.
Course Outline: Data communication and protocol architecture, data transmission fundamentals, data link control protocols, transmission systems, local area network (LAN) architecture, medium access control protocols, packet switching network, TCP/IP networking protocol suite and emerging trends in data communication.
Lab Work Outline:Basic cable construction and testing,Introduction to IP addressing, Building and testing a Peer-to-Peer network, Building and testing a Hub and Switch based network, Router and switch command line interface (CLI) fundamentals, Introduction to Router and establishing a console session Using Hyper Terminal, Building and testing a Router based network, Retrieving configuration from NVRAM and TFTP server, Building and Testing VLAN, Configuring VTP in switch domain network, Configuring RIP routing protocol between two routers, Configuring OSPF routing protocol between two routers, Learning packet motion through DHCP server in a network using packet tracer and Learning packet motion through DNS server in a network using packet tracer.

Computer Networks
Course Code: EEN434
Prerequisite: Introduction to Computing

Objectives: To help the students gain an understanding of the terminology and standards in modern day computer networks. To make the students understand communication basics, etworking and network technologies; with emphasis on data and computer communication within the framework of the OSI and TCP/IP protocol architectures, internet and internet working and how to apply these in the design and analysis of network.
Course Outline: Network architectures and switching techniques, characteristics of transmission media. Channel access protocols and their efficiency. Link control protocols, and their efficiency. Routing algorithms and protocols. Interconnection of network at the link level and at the network level, the Internet Protocol (IP) and associated control protocols. End-to-end protocols, with TCP and UDP as examples; congestion control and

flow control. Cursory view of application- level protocols, including electronic mail, HTTP and DNS. Introduction to network calculus (Optional).
Lab Work Outline: Introduction of Ns-2 and Ubuntu OS, Performance Evaluation of TCP on a communication link, Performance Evaluation of User Datagram Protocol on a communication link, Simulating a Multiple-node Network having several TCP connections, Using Ns-2 for simulating a Unicast Routing Protocol, Using Ns-2 for simulating a Multicast Routing Protocol: Distance Vector Multicast Routing Protocol, Using Ns-2 for simulating a Multicast Routing Protocol: Protocol Independent Multicast (Dense Mode), Using Ns-2 for simulating a Multicast Routing Protocol: Bi- directional Shared Tree, Using Ns-2 to simulate a Diffserv (QoS) Model, Implementing a
Collision Sense Multiple Access (CSMA) protocol in Ns-2, Simulating Transmission Control Protocol over a 3 node Ad-hoc network with Ad-hoc On Demand Distance Vector (AODV)routing protocol, Simulating Transmission Control Protocol over a 3 node Ad-hoc network with Destination Sequenced Distance Vector (DSDV) routing protocol, Simulating Transmission Control Protocol over a 3 node Ad-hoc network with Dynamic Source Routing (DST) protocol, Implementing a classical Queuing Model (M/M/1) using Ns-2

Digital Image Processing
Course Code: CEN444
Prerequisites: Signals and Systems

Objectives: To understand the concepts of digital image acquisition, perception and processing in order to use them in computer vision, image enhancement and compression.
Course Outline: Concept of digital image, Type of images, Visual Perception, Light & Electromagnetic Perception, Image sensing &acquisition, : Spatial and luminance resolution parameters, Image Sampling and quantization, Imaging defects, Noise, Histogram Processing, Spatial Filtering Convolution & Correlation, Smoothing & Sharpening, Fourier Transform, DFT, Frequency based filtering, Contrast enhancement & adjustment, Noise elimination: smoothing, Histogram manipulation (equalization,
compression & Stretching, Image Restoration & Reconstruction, Edge detection, Image segmentation, Segmentation, Feature extraction, Image Coding & Compression, Applications
Lab Work Outline: Image Sampling and quantization, Image Transform, Spatial Domain Filtering, Convolution & Correlation, Smoothing & Sharpening, Frequency Domain Filtering, Fourier Transform, DFT, Contrast enhancement & adjustment, Noise elimination: smoothing, Histogram equalization, compression & Stretching, Image Restoration & Reconstruction, Filtering, low pass (smoothing), high-pass (edge-enhancement). Edge detection techniques. Image segmentation, Feature extraction, Image Coding& Compression.

Wireless & Mobile Communication
Course Code: EEN436
Prerequisite: Communication Systems

Objectives: To provide an overview of the fundamental concepts and technologies involved in wireless and mobile communication systems.
Course Outline: Wireless channel models: path ,loss, shadowing, multipath fading, wideband channel models. Capacity of wireless channels, digital modulation, performance in wireless fading channels. Diversity (time, frequency, space), equalization. Multicarrier modulation (OFDM), spread spectrum (CDMA), cellular concept, frequency reuse. Multiuser

systems, wireless networks.
Lab Work Outline: Introduction to antenna trainer, folded dipole λ/2 antenna, simple dipole (λ/2) antenna, log periodic antenna, rhombus antenna, Yagi-Uda 3 element antenna, Yagi-Uda 5 element simple dipole antenna, Yagi-Uda 7 element simple dipole antenna, slot antenna, combined collinear antenna, helical antenna, introduction to high frequency structure simulator (HFSS). simulation of dipole antenna on HFSS, simulation of rectangular antenna on HFSS.

Digital Communications
Course Code: EET411
Prerequisite: Communication Systems

Objectives: The objective of the course is to prepare students for engineering work and research in the telecommunication industry. The course covers concepts and useful tools for the design and performance analysis of a digital transmitter and receiver at the physical layer of a communication system.
Course Outline: Significance of digital communication, overview of signals, spectra, probability and random variables, SNR and Eb/No, Sampling and quantization (uniform & non-uniform), Signal to quantization noise ratio (SQNR). Detection of a binary signal in Gaussian noise, Matched filters and correlators, Baye's decision criterion, Maximum likelihood detector, Error performance, Inter-symbol interference (ISI), Root raised cosine pulse, Eye-patterns,
Equalization techniques. Vectorial representation of signals, Gram- schmidtorthogonality principle, Performance analysis of M-ary signaling techniques. Error correcting codes: block codes, design and analysis of convolutional codes, Advanced techniques for digital communication (e.g. DS-CDMA, FH-CDMA, OFDM, MIMO techniques).
Lab Work Outline: MATLAB introduction, line coding & decoding, sampling, PCM encoding and decoding, block encoding and decoding, ask generation & demodulation, signal constellations, QAM generation & demodulation, QPSK generation & demodulation, noisy channel and SNR, eye pattern, zero forcing equalizer, BER measurement, DSSS – spread spectrum, superhetrodyne.

Radar Systems
Course Code: EET447
Prerequisite: Electromagnetic Field Theory

Objectives: This course is intended to give an overview of optical fiber, optical fiber communication and different devices used in optical communication. Important theoretical and mathematical problems will be discussed to understand the in-depth functionality of optical networks.
Course Outline: Basic Radar, The simple form of the Radar Equation, Radar block diagram, Radar frequencies, Application of the Radar, Origin of the Radar. Introduction to Radar equations, detection of signals in noise, receiver noise and signal to noise ratio, Probability density function, Probability of detection and false alarm, Integration of the Radar pulses, Radar cross section of targets, Transmitter power pulse repetition frequency. Introduction to Doppler and MTI radar, Delay line cancellors, Staggered pulse repetition frequencies, Limitation to MTI performance. Tracking with Radar, Monopulse tracking, Conical scan and sequential lobing. Linear beam power tubes, Solid state RF power sources, Magnetron, Cross field amplifiers, Other RF power sources, Other aspects of Radar transmitters. The Radar receiver, The receiver noise figure, Super Heterodyne receiver, Duplexers and receiver protectors, Radar displays. Introduction, Forward Scattering from a flat earth, Scattering from the round earth surface, Atmospheric Refraction, Standard propagation, Non-standard propagation, Diffraction, Attenuation by

atmospheric gases, External environmental noise, Other propagation effects. Terminology used in navigational Systems, Direction finding, GPS, Laser Gyro, Decca, Loran, Beacon system, GIS, GNSS.

Optical Fiber Communication
Course Code: EET463
Prerequisites: Communication Systems

Objectives: To acquaint the students with the devices and techniques used in optical fiber communication

Course Outline: Comparison between optical and electrical mediums, basic optical communication system, Snell's law, refractive index, line width, optical and electrical bandwidth. Step index fibre, graded index fiber, refractive index profiles, meridional and skew rays, acceptance angle and acceptance con, numerical aperture for meridional and skew rays. EM waves, modes, modes in planar wave guides, wave guide condition, evanescent waves, phase velocity, group velocity, group index, modes in cylindrical fibres, Parameters for single mode fiber (cutoff wavelength, mode field diameter, effective refractive index, group delay). Attenuation due to: (i) absorption, (ii) scattering (iii) bending losses Dispersion, Reflectance and optical return losses, special types of fibers. Optical sources, modulators and modulating schemes, line coding, optical detectors, demodulator and demodulation methods, couplers, connectors, switches, splicing, optical amplifiers and repeaters, Optical time division multiplexing, wavelength division multiplexing (techniques and devices) link budgeting w.r.t time and power. LAN system, FDDI, SONETS and SDH, Wavelength routing based optical networks, Optical burst switching.

Lab Work Outline: Basic structure and types of the optical fiber, optical power measurements, optical power emitted by the led, the HENE laser intensity profile, light polarization and focal length of thin lenses, determination of the acceptance angle and numerical aperture of optical fibers, light coupling to multimode graded index fibers, fiber misalignment loss measurement, fiber splicing and introduction to the OTDR, OTDR measurement of fiber length, attenuation and splice loss, characteristics of the light-emitting diode and characteristics of the photodiode.

Satellite Communications
Course Code: EET449
Prerequisites: Communication Systems

Objectives: The objective of this course is to get comprehensive knowledge of satellite technology and communication.

Course Outline: Introduction to Satellite Communication, Satellite Link Design, Propagation Characteristics of Satellite Links, Satellite systems: Space-segment and ground segment, Channel Modeling, Access Control Schemes, System Performance Analysis, System Design, Space standards, Satellite Applications such as earth observation, weather, and communication.

Lab Work Outline :To study uplink transmitter, down link receiver and transponder, establish a direct communication link between Uplink transmitter and Downlink receiver using tone signal, setup an Active satellite link and demonstrate link fail operation, establish an AUDIO-VIDEO satellite link between Transmitter and Receiver, communicate VOICE- signal through satellite link, change different combinations of uplink and downlink frequencies and to check the communication link, transmit and receive three separate signals (Audio, Video, Tone) simultaneously through satellite link, transmit and receive function generator waveforms through satellite link, transmit and receive PC data through satellite link, TDMA and TDMA frame structure.

Wave Propagation and Antennas
Course Code: EET451
Prerequisite: Electromagnetic Field Theory

Objectives: To make the students understand different aspects of electromagnetic wave propagation and the role of antenna as transducer. Different characteristics of antennas are also explained.
Course Outline: Transmission lines, micro strip transmission lines, transient waves. The wave equation and waveguides. Traveling and standing waves. EM plane waves. EM radiation. Properties of antennas. Measurement of antenna characteristics. Computer aided design and testing. Propagation of radio waves.
Lab Work Outline: Introduction to the use of wave-guides and finding the cut-off frequency, finding the wavelength of a radio wave, measurement of small voltage standing wave ratio, measurement of large voltage standing wave ratio, measurement of microwave power, detector characteristic, learning how to read a smith chart, measurement of impedance, microwave tuner (method1), microwave tuner (method2), directional coupler, series and shunt t coupler, horn antenna, Doppler radar, use of coaxial cable.

Satellite Communications
Course Code: EET449
Prerequisites: Communication Systems

Objectives: This course aims to develop mathematical and analytical skills necessary to analyze digital signals both in time and frequency domains. From the system's perspective, the objective is to incorporate extensive design skills in the students enabling them to develop relevant prototypes with the desired level of accuracy.
Course Outline: Overview of Discrete-time systems. Application of z-transform for analysis of Linear Shift Invariant systems, Circular Convolution, Discrete Fourier Transform, Fast fourier Transform, Butterworth and Chebyshev approximation of analogue filters, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters, Design of FIR filter, Design of IIR Filter.
Lab Work Outline: Two Dimensional Graphics plotting in Matlab, time domain Representation of discrete Signals and Digital Processing of Continuous Signals, Discrete time LTI systems and its properties, Frequency domain Analysis, Z-transform, Poles and Zeros analysis in Z Domain, sampling, A/D conversion and D/A conversion, Decimation and interpolation, Design of FIR filters using MATLAB commands, Designing of IIR filters by MATLAB commands, Filter designing by MATLAB FDA and FVtools, Introduction of DSP kit 6713, Implementation of basic program of DSP kit 6713, LED & DIP Switch using DSK6713

RF and Microwave Engineering
Course Code: EEN431
Prerequisite: Communication Systems

Objectives: To introduce basic concepts of Radio Frequency (RF) components and circuits especially in the range of microwaves.
Course Outline: RF behavior of Passive Components and RF models, Chip components, Distributed Circuit elements, Strip Lines, Microstrip Lines, Coupled Striplines/Coupled microstriplines, Smith Chart, Impedance and Admittance Transformation, Parallel and series connection, Impedance Matching Networks, Analysis of Single and Multiport Networks using Network Parameters, Microwave Filter Design, Microwave Amplifier design, Mixers and Detectors, Oscillators, Power dividers, Directional Couplers, Circulators, Microwave Systems.

Information Theory
Course Code: CSC453
Prerequisite: Communication Systems

Objectives: The course aims at representing information in a format so that it is able to be transmitted successfully by removing/omitting any errors introduced by the channel.
Course Outline: Information, Entropy, Relative & mutual Entropy, Chain rules for entropy and mutual information, Source coding, Data compression, Examples of compression codes, Huffman codes, Lempel-ziv codes, Types of channels: discrete memory-less, Binary Symmetric, Binary Erasure, Gaussian channel capacity, Shannon's Theorem, Prefix and Block codes (fixed and variable length), binary fields and vectors spaces, linear block codes, Hamming codes, error rate, performance bounds, cyclic, polynomial representation, generation and decoding of cyclic codes, BCH codes, Reed-Solomon codes, convolutional codes, structural properties, Viterbi algorithm (Hard and soft decision decoding), concatenated codes, Turbo Codes, LDPC codes.

Telecom Transmission and Switching Systems
Course Code: EET456
Prerequisites: Communication Systems

Objectives: The course has been designed to equip the students with skills and knowledge of the current and future telecommunication networks. Course Outline: Transmission Systems
including PDH and SDH, Synchronization, routing techniques, Line Encoding Techniques (HDB3, 2B1Q), Types of Switching Review of switching technologies Circuit, Message and Packet Switching, Telecommunication Network (PSTN, PLMN), Exchanges Hierarchy, Basic Functions of a Typical Digital Switching Exchanges (examples taken from EWSD, AXE, SYSTEM12 etc), SPC, Software Structure of SPC Digital Switches, Software Life Cycle, Telecommunications Traffic and models including characterization of PABX and Public exchange traffic, GOS, BHCA, Network Traffic Load and Parameters, Blocking Probabilities, Modelling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay Systems, Time and Space Switching, T-S-T and S-T-S Systems and its variations, Numbering Plans, Routing Tables, Charging Plans, Call detail recording (CDR), numbering plans, Classifications of Signalling Systems, Channel Associated Signalling (CAS) and Common Channel Signalling (CCS) ITU's Common Channel Signalling System # 7 (CCS7 Or SS7), – protocol Architecture mapping with OSI model, MSU, LSSU, and FISU, Global title translation, ISUP and TUP protocol maps, Case Study of FMM on Call Scenarios such as prefix Analysis and task element definition(PATED), isolation of condensed prefix(CPX), DNEU and Index LSIF, TRA and Private Access Resource Management. ISDN Implementation in Commercial Exchange.

Multimedia Communication
Course Code: EET452
Prerequisite: Communication Systems

Objectives: To develop familiarity with the science and technology of multimedia communication.
Course Outline: Overview of multimedia systems, Audio/Video fundamentals (representation, human perception, equipment and applications). Audio and video compression (e.g., JPEG, MPEG, H.26X, etc.), scalable coding, perceptual audio encoders. Performance comparison of coding algorithms, Algorithms for image and video processing, multimedia programming.

Power Electronics
Course Code: EEP468
Prerequisite: Electronic Circuit Design

Objectives: The course discusses Power Devices, Power Rectifiers, Power Inverters and Choppers in detail.
Course Outline: Principles of power electronics, converters and applications, circuit components and their effects, control aspects. Power Electronic Devices: Power diode, power BJT, power MOSFET, IGBT and SCR, GTO and TRIAC and DIAC. Construction, characteristics, operations, losses, ratings, control and protection of thyristors. Halfwave and full-wave rectifiers with resistive and inductive loads, un-controlled, semi controlled and fully controlled rectifiers, three-phase rectifiers: un-controlled semi controlled and full controlled, six-pulse, twelve-pulse and 24-pulse rectification, PWM converters, DC to AC converters, three-phase inverter, six-pulse, twelve-pulse inverters, PWM inverters, switching mode power supplies, DC to DC conversation, buck converter, boost converter and buck-boost converters, isolated converters, forward converters, flyback converters.
Lab Work Outline: FET charcteristics, MOSFET characteristics and speed control, IGBT characteristics, SRC and RC phase control, DIAC characteristics, TRIAC characteristics, UJT characteristics, UJT oscillator and timer circuits, PUT charateristics, PUT oscillator and timer circuits, study of three phase rectifier, study of single phase inverter, Dc to DC, converter circuits, closed loop control of power converters.

Digital System Design
Course Code: CEN442
Prerequisite: Computer Architecture and Organization

Objectives: To introduce the skills to write VHDL/ Verilog code that can be synthesized to efficient logic circuits.
Course Outline: High-level digital design methodology using VHDL/verilog, design, implementation, and verification, application requiring HW implementation, floating-point to fixed-point conversion, architectures for basic building blocks, adder, compression trees, and multipliers, transformation for high speed using pipelining, retiming, and parallel processing , dedicated fully parallel architecture, time shared architecture, hardwired state machine based design, micro program state machine based design, FPGA-based design and logic synthesis. Lab Work Outline:Introduction to verilogHDL gate level modeling in verilog, dataflow modeling in verilog, behavioral modeling in verilog, tasks and functions in verilog, implementing FSM/ASM and ASMD based complex digital systems in verilog, introduction to SYSTEMC and XILINXVIVADO, SYSTEMC basics: data types, modules, processes, threads, channels, implementing digital circuits using SYSTEMC, hardware FIFO and LIFO based memories, conversion of RTLbased digital system from HDL to SYSTEMC

Linear Integrated Circuits& Applications
Course Code: EEN469
Prerequisite: Electronic Circuit Design

Objectives: Teach the analysis and design of digital electronic circuits and operational amplifier, and introduce the fabrication of electronic devices.
Course Outline: Detailed design of pulse and switching circuits; mono-stable, a-stable and bi-stable circuits; Schmitt trigger; logic families (DTL, TTL, ECL, I2L, CMOS); Introduction to the fabrication of digital microelectronic pMOS, nMOS, CMOS, and BiCMOS circuits; epitaxy, ion implantation and oxidation; differential amplifiers: DC and AC analysis of differential amplifier; design of simple differential amplifier; level translator; current sources (simple current mirror,

Widler and Wilson current source): output stage design; use of op- amp as a circuit element, offset and offset compensation, op-amp with negative feedback, frequency response of an op-amp, DC and AC analysis of op-amp ICs; amplifier; linear and non-linear applications. Analogue and digital circuit interface with applications. Lab Work Outline: Comparator analysis, inverting and non-inverting amplifiers, analog- to digital and digital-to-analog converters, dual regulator, switched capacitor voltage regulator, switched capacitor voltage measurement, op-amp speed, single-supply op-amp, function generator, phase locked-loop, frequency synthesizer.

Opto Electronics
Course Code: EEN444
Prerequisite: Electronic Circuit Design

Objectives: Teach the electronic devices and techniques used in optical communication.
Course Outline: Nature of light, basic laws of light, optical fibre, types of optical fiber, fibre material, fabrication and components, laser, threshold condition, laser losses, population inversion and threshold conditions, laser modes, classes of lasers, semiconductor light sources, light emitting diodes, iconductor
laser diodes (SLDs), optical transmitter, optical receivers, wavelength division multiplexing (WDM), FDM versus WDM, WDM multiplexer, benefits of WDM, dense wavelength division multiplexing, optical networks.
Lab Work Outline: Optical sources, optical detectors, optical amplifiers, optical transmitters, optical receivers, optical transceivers, optical fibers, propagation of light through an optical fiber, losses in fiber optic elements, optical modulation, multiplexing optical systems.

FPGA-Based System Design
Course Code: CEN441
Prerequisite: Digital Logic Design

Objectives: Teach the design of digital electronic circuits with field programmable gate arrays.
Course Outline: Introduction to digital design and FPGA, FPGA architectures, SRAM-based FPGAs, permanently-programmed FPGAs, circuit FPGA-based system design, logic design process, combinational network delay, power and energy optimization, arithmetic logic elements, logic implementation using FPGAs, FSM design, ASM design. Physical design (PnR) for FPGAs, synthesis process. Sequential design using FPGAs, sequential machine design process, sequential design style.
process, sequential design style.
Lab Work Outline: Introduction to Verilog HDL, gate-level modeling, data flow modeling, behaviouralmodelling, design, simulation, synthesis and fitting of combinational circuits,design and implementation of an FSM and memory. Industrial drives: Speed control of DC, AC, and servo motors. Process control Systems, Measurement of non-electrical quantities: Temperature, displacement, pressure, time, frequency; digital industrial measuring systems. Ultrasonic generation and applications. Photo-electric devices. Industrial control using PLCs. Data acquisition for industrial processes. Distributed control system in process industries. Basic concepts of SCADA.
Lab Work Outline: Experiments related to the service and manufacturing automation using PLCs; speed control of DC, AC, and servo motors.

Digital Control Systems
Course Code: EEN437
Prerequisite: Linear Control Systems

Objectives: Teach the theory and methods for the analysis and design of digital control systems including theory of sampling, discrete transfer functions, z transform analysis, and stability.
Course Outline: Basics of digital control, theory of sampling, sampled data systems, discrete signals and sampling, difference equation, discrete transfer functions, z transform analysis, frequency response methods, state equations, time-discrete representation of time-continuous systems, discrete control algorithms, design methods of digital controllers, stability of digital control systems, discrete equivalents for continuous controllers, pulse transfer functions of feedback systems, digital-to analog conversion, digital filtering of systems.
Lab Work Outline: Control system identification; controller design, experimentation,
computer simulation, and analysis of control systems. All experiments are conducted with
real-time process interface cards of PC for experimental data display and storage. Stored files are analyzed further using MATLAB. Lab assignments include computer-based control system simulation and design using MATLAB.

Introduction to Nanotechnology
Course Code: EEN466
Prerequisite: Applied Physics

Objectives: The course goal is to discuss interesting emerging nanotechnologies by providing interdisciplinary scientific and engineering knowledge necessary to understand fundamental physical differences at the nanoscale.

Course Outline: Introduction, nanoscale phenomena, nanoparticles, carbon nanost- ructures, nanowires, nanostructured, materials, self assembly, surface probe microscopy, other nanoscale characteri-zation, nanolithography, nanoscale devices and systems, applications of nan-otechnology.

Industrial Process Control
Course Code: EEN441
Prerequisite: Linear Control Systems

Objectives: The course objective is to give knowledge to students to draw a block diagram of process-control loop, read and draw P&ID drawings, perform analog and digital signal conditioning, analyze discrete-time models and apply computer control techniques.
Course Outline: Development of discrete-time dynamic models, Analysis of discrete transfer functions, Estimation and Analysis of transfer functions using experimental data, design and tuning of digital computer controllers, design of advanced model predictive controllers, Impleme-ntation of computer control systems on realistic processes.

Introduction to Biomedical Engineering
Course Code: EEN438
Prerequisite: Signal & Systems

Objectives: This course will introduce the terminologies of the medical profession; anatomy and physiology of the human body from overall system and functional perspective, and consideration of those areas in which engineering may be applied advantageously to medicine.

Course Outline: Introduce the concepts of medical and clinical instrumentation and teach the tests and test equipment used in medical care and research. Basic concepts of medical and clinical instrumentation; basic concepts of medical diagnosis and statistical analysis; introduction to techniques for the design of biomedical instrumentation including sensors and associated electronics: bio potentials, bio sensors, and amplifiers; electro-cardiography (ECG), electro-encephalography (EEG), electro- myography (EMG), electro Retino Graphy (ERG); basic concepts of diagnostic ultrasound; plain x-ray; CT, MRI, PET, and SPECT; supporting instrumentation such as incubator, respirator, anesthesia machine and dialysis machine; tests used in medical care and research: cardio vascular, imaging, and blood analysis; electrical safety in hospitals.

Introduction to Mechatronics
Course Code: EEA430
Prerequisite: Linear Control Systems

Objectives: This objective is to introduce students to the fundamental principles that underlie the study of mechatronic engineering.
Course Outline: Introduction To The Mechatronics Systems; Dynamic Systems; Modeling And Simulation Of Dynamic Systems; Measurement Systems, Sensors And Actuators ; Introduction To Software And Data Acquisition; , basic sensing, and basic mechanical design (machine elements and mechanical CAD). Sensors. Stepper motors. Actuators. Motor sizing. Power transmission: gears (rack and pinion, spur, planetary, worm, bevel, crown, harmonic) and belt drives; torque, speed, and power equations, efficiency, inertia, reflected inertia, inertia matching.

Functional English
Course Code: ENG104
Prerequisite: None

Objectives: Enhance language skills and develop critical thinking.
Course Outline: Basics of Grammar. Parts of speech and use of articles. Sentence structure active and passive voice. Practice in unified sentence. Analysis of phrase, clause and sentence structure. Transitive and intransitive verbs. Punctuation and spelling. Comprehension: Answers to questions on a given text. Discussion: General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students). Listening: To be improved by showing documentaries/ films carefully selected by subject teachers. Translation skills: Urdu to English. Paragraph writing: Topics to be chosen at the discretion of the teacher. Presentation skills.

Communication Skills
Course Code: HSS118
Prerequisite: None

Objectives: Enable the students to meet their real life communication needs.
Course Outline: Business communications; planning messages, writing concise but with impact. Letter formats, mechanics of business letter writing, letters, memo and applications, summaries, proposals, writing resumes, styles and formats, oral communications, verbal and alnon- verbal communication, conducting meetings, small group communication, taking minutes. Presentation skills; presentation strategies, defining objective, scope and audience of presentation, material

gathering and organization strategies, time management opening and concluding, use of audio-visual aids.

Technical Writing and Presentation Skills
Course Code: HSS320
Prerequisite: None

Objectives: Enhance language skills and develop critical thinking
Course Outline: Presentation skills. Essay writing: Descriptive, narrative, discursive, argumentative. Academic writing: How to write a proposal for research paper/term paper. How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency). Technical Report writing. Progress report writing.

Islamic Studies
Course Code: ISL101
Prerequisite: None

Objectives: The objectives of this course are: to provide basic information about Islamic studies to enhance understanding of the students regarding Islamic civilization, to improve students skill to perform prayers and other worships, to enhance the skill of the students for understanding of issues related to faith and religious life.

Pakistan Studies
Course Code: PAK101
Prerequisite: None

Objectives: Develop vision of historical Prespective, government, politics, contemporary Pakistan, ideological background of Pakistan. Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Organizational Behavior
Course Code: HSS456
Prerequisite: None

Course Outline: Introduction to organizational behavior. Structure and control in organization. Individual and work learning. Stress. Individual differences. Motivation and job satisfaction. Group and work. Group and inter-group behavior. Leadership. Patterns of work. Conflict and consent in work. Organizational culture.

Introduction to Sociology
Course Code: HSS202
Prerequisite: None

Course Outline: The Nature of sociology: The study of social life. Exploring the global village. Sociology as a science. The sociological imagination. The development of sociology. Pioneers of sociology. Nature, scope and subject matter of sociology. Brief historical development of sociology. Society and community. Relationship with other social sciences. Social interaction processes. Social groups: Definition and functions. Types of social groups. Social institutions: Definition. Structure and function of social institutions. Inter-relationships among various social institutions. Culture and related concepts: Definition and aspects of culture. Elements of culture. Organization of culture. Other concepts, cultural relativism, sub cultures, ethnocentrism, culture lag. Socialization and personality: Role and status. Socialization. Culture and personality. Deviance and social control: Definition and types of deviance. Juvenile delinquency. Formal and information methods of social control. Social stratification: Approach to study social stratification. Caste class and race as basics of social stratification. Major perspectives in sociology: Functionalist perspective. Confilict perspective.

Interactionstic perspective. Social control and deviance: Agencies of social control. Social stratification: Determinants of social stratification. Social mobility, types and definition. Dynamics of social mobility. Concept of social movement: Theories of social movement. Social and cultural change. Social and cultural change: Definition of social change: Dynamics of social change: Impact of globalization on society and culture: Resistance to change. Collective behaviour: Definition. Characteristics. Causes. Types. Social movements. Mob and crowd behavior

Entrepreneurship
Course Code: HSS423
Prerequisite: None

Objectives: Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyze the theories of entrepreneurship and to go for case studies of successful. entrepreneurs.

Principles of Management
Course Code: MGT111
Prerequisite: None

Objectives: This is a rudimentary course for the students of business administration. The focus of attention will be given to learning fundamental principles of management and of managing people and organization in a historical as well as contemporary world. Students are expected to develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international orgnizations.

Professional Psychology
Course Code: PSY 401
Pre-Requisite: None

Objectives: This course will help increase in self-awareness, set and pursue meaningful goals, and develop positive personal qualities such as self-esteem, a positive attitude, self-discipline, and self-motivation. Furthermore, exploring personality, interests and values to increase self-understanding and select an appropriate major and career. Examine adult stages of development and develop a plan for wellness and living a long and healthy life. Learn strategies for motivation and stress management. The History and Methods of Psychology, The Nature and Nurture of Behavior, Sensation, Perception, and Consciousness, Learning and Memory, Development, Social Psychology, Psychopathology

Leadership
Course Code: MGT 421
Pre-Requisite: None

Objectives: In this course our purpose in learning about leaders and leadership would be to enable each one of us to become a better leader. The focus of the course is on leadership, and not on management. The thesis of the course is that all of us have the potential to be an authentic leader and all of us should commence the journey of leadership. The purpose is to explore who each individual is as a leader and on how they use different set of tools or techniques to develop leadership skills. Basics of Leadership, Trait Approach, Skills Approach, Leadership Philosophies, Team Leadership, Advanced Leadership Skills, Supporting Skills.

Personal Grooming
Course Code: MGT 422
Pre-Requisite: None

Objectives: The personal grooming course is a holistic approach to living a successful and composed life. Self-grooming is a broad term but encompasses some quite complex skills and understandings that only come with guidance, training, opportunity and experience. Introduction to Personal-Grooming and Life Skills, Developing Self Awareness, Introduce Emotional Intelligence. Habits of Highly Effective People, Principles of self-management.

Course Title: Engineering Economics
Course Code: MGT 424
Pre-Requisite: None

Objectives: This course emphasizes the strong correlation between engineering design and manufacturing of products/systems and the economic issues they involve. The basic concepts of the time value of money and economic equivalence is applied throughout the course. Each engineering problem/project progressively incorporates different cash flows, the cost of funds, capital, operational and maintenance costs, salvage value, depreciation, amortization, and taxation. Engineering Economic Decisions, Interest Rate and Economic Equivalence, Understanding Money and Its Management, Present Worth Analysis, Annual Equivalent-Worth Analysis, Rate of Return Analysis, Cost Concepts Relevant to Decision Making, Depreciation and Corporate Taxes, Developing Project Cash Flows, Project Risk and Uncertainty.

Course Title: Project Management in Engineering
Course Code: MGT 425
Pre-Requisite: None

Objectives: This course provides engineering students with a comprehensive understanding of how to plan, optimize and efficiently manage projects (or tasks) to implement products, services or developments. This includes building the structure, processes, components and linkages with a team for successful project delivery within schedule, budget and quality requirements. Introduction to Project Management, Project Quality Management, Project Stakeholder Management, Project Cost Management, Project HRM and Communication Management, Project Integration, Time Management, Cost Management, Risk Management and Project Closure Management.

Course Title: Engineering Management
Course Code: MGT 423
Pre-Requisite: None

Objectives: This course includes group decision-making, the development of the individual, and the importance of communication and interpersonal skills in the engineering environment. Students gain an understanding of work preferences and personal interactions through self-analysis, experience and reflection. In addition students are introduced to a range of business management topics including, but not limited to, contract law, competition law and professional ethics.Teamwork Sessions, Organization strategy and project selection, Strategy and Long-Term Planning, Financial Reporting.

Course Title: Introduction to Machine Learning
Course Code: CSC 419
Pre-Requisite: None

Objectives: This course will provide a basic introduction to machine learning and statistical pattern recognition. Algorithms based on machine learning will be discussed in this course. In this course recent applications of machine learning, such as to robotic control, data mining, etc. will also be discussed. Supervised learning (parametric/non-parametric algorithms, support vector machines, kernels, neural networks). Unsupervised learning (clustering, dimensionality reduction, recommender systems, deep learning). Best practices in machine learning (bias/variance theory; innovation process in machine learning and AI).

Embedded System Design

Course Code: CEN 440

Pre-Requisite: Digital Logic Design

Objectives: This course will introduce students to the design and implementation of embedded systems. This course provides students the basis for basic skills in embedded systems design. Those skills are usable in designing digital control units for consumer electronics, industrial automation, telecommunication systems, etc. Course Outline: Scope and ubiquitous presence of embedded systems. Microprocessor and Microcontroller (AVR) Architecture. Internal Registers, Machine code, Addressing modes and Instruction Set, C and the Compiler, Debugging Software and Hardware, Threads, Tasks and Simple Scheduling, Branching, Interrupt handling, I/O and Communication Ports programming, Digital and Analog I/O Peripherals, A/D and D/A interfacing, Simulation design and debugging. Application using PWM.