

**ACADEMIC CURRICULA 2021 - 2025**

**BACHELOR'S DEGREE PROGRAMME**  
**B. Tech in**  
**Electronics & Electrical Engineering**  
**Curricula & Syllabi**



**Kalinga Institute of Industrial Technology (KIIT)**  
Deemed to be University U/S 3 of UGC Act, 1956  
Bhubaneswar, Odisha, India

# **ACADEMIC CURRICULA**

## **2021 - 2025**

### **BACHELOR'S DEGREE PROGRAMME**

#### **B. Tech in**

#### **Electronics & Electrical Engineering**

**Course Structure and Detailed Syllabi**  
**for students admitted in**  
**2021 - 25**  
**Academic Session**



**Kalinga Institute of Industrial Technology (KIIT)**  
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## **B. TECH IN ELECTRONICS AND ELECTRICAL ENGINEERING**

### **Programme Educational Objectives (PEOs):**

The B. Tech Programme in Electronics and Electrical Engineering aims to prepare the graduates with the following objectives:

1. Graduates will be able to lead a successful career in industry, pursue higher study or entrepreneurial endeavor through application of domain specific knowledge in the areas of embedded system design, signal processing, instrumentation and control, electrical machines, power engineering and allied fields of Electronics and Electrical Engineering.
2. Graduates will be able to perceive feasibility and impact of engineering solutions in social, legal, environmental, economic and multi-disciplinary context.
3. Graduates will be able to demonstrate professional and ethical responsibility and engage in life-long learning.

### **Programme Outcomes (POs):**

The programme outcomes are:

- a) Engineering knowledge: Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) Problem analysis: Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) Design/Development of solutions: Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) Conduct investigations on complex problems: Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) Modern tool usage: 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.
- f) The engineer and society: Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) Environment and sustainability: Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) Ethics: Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) Individual and team: Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j) Communication: Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- k) Project management and finance: Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) Life-long learning: Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**Programme Specific Outcomes (PSOs)**

The programme specific outcomes are:

- m) Ability to design and implement electronic circuits, electrical machine, drives and different power systems in industry.
- n) Ability to carry out research in the fields of embedded systems, renewable energy, machine design and smart grids.
- o) Ability to utilize the knowledge in solving practical problems for electronics and electrical systems.

**Abbreviations used in describing the category in all the courses are as follows:**

BSC:	Basic Science Course
BSLC:	Basic Science Laboratory Course
ESC:	Engineering Science Course
ESLC:	Engineering Science Laboratory Course
HSMC:	Humanities, Social Science & Management Course
PCC:	Professional Core Course
PCLC:	Professional Core Laboratory Course
PEC:	Professional Elective Course
OEC:	Open Elective Course
PROJ:	Project
IEC:	Industry Elective Course

COURSE STRUCTURE FOR B. TECH IN ELECTRONICS AND ELECTRICAL  
ENGINEERING

SCHEME-I  
SEMESTER – I

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA 1003	Mathematics – I	3	1	0	4	4
2.	PH 1007	Physics	3	1	0	4	4
3.	EE 1003	Basic Electrical Engineering	3	0	0	3	3
4.	ME 1003	Engineering Mechanics	3	0	0	3	3
Total of Theory						14	14
Practical							
1.	PH 1097	Physics Lab	0	0	3	3	1.5
2.	EE 1093	Basic Electrical Engineering Lab	0	0	2	2	1
Sessional							
1.	ME 1083	Basic Manufacturing Systems	0	1	2	3	2
2.	CH 1081	Environmental Science	0	0	2	2	1
Total of Practical & Sessional						10	5.5
Semester Total						24	19.5

SCHEME-I  
SEMESTER – II

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA 1004	Mathematics – II	3	1	0	4	4
2.	CH 1007	Chemistry	3	0	0	3	3
3.	HS 1005	Professional Communication	2	0	0	2	2
4.	LS 1001	Biology	2	0	0	2	2
Total of Theory						11	11
Practical							
1.	CS 1093	Computer Programming	0	2	4	6	4
2.	CH 1097	Chemistry Lab	0	0	3	3	1.5
Sessional							
1.	HS 1085	Language Lab	0	0	2	2	1
2.	CE 1083	Engg. Graphics	0	1	2	3	2
Total of Practical & Sessional						14	8.5
Semester Total						25	19.5
	EAA- 1	Extra Academic Activity					P/NP

SEMESTER – III

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	MA 2007	Mathematics-III (Electrical)	3	1	0	4	4
2	EC 2027	Analog Electronics	3	1	0	4	4
3	EE 2015	Electrical Circuits Analysis	3	0	0	3	3
4	EC 2023	Principle of Signals and Systems	2	0	0	2	2
5	EE 2017	Transformers and Induction Motors	3	0	0	3	3
6	EI 2003	Electrical & Electronic Measurement Techniques	3	0	0	3	3
Total of Theory						19	19
Practical							
1	EC 2091	Electronic Circuits & Network Lab	0	0	3	3	1.5
2	EI 2095	Electrical & Electronic Measurements Lab	0	0	2	2	1
Sessional							
1	HS 2081	Business Communication	0	0	2	2	1
Total of Practical & Sesssional						7	3.5
Semester Total						26	22.5



SEMESTER – IV

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	EC 2011	Digital Electronics	3	0	0	3	3
2	CS 2001	Data Structure and Algorithms	3	1	0	4	4
3	EE 2020	DC Machines & Synchronous Machines	3	0	0	3	3
4	EC 2014	Electromagnetic Theory	3	0	0	3	3
5	EE 2028	Linear Control System	3	0	0	3	3
6		HS Elective-I	3	0	0	3	3
Total of Theory						19	19
Practical							
1	EC 2096	Digital & Linear IC Lab	0	0	2	2	1
2	EE 2096	Electrical Machines Lab	0	0	3	3	1.5
3	CS 2091	Data Structures Lab	0	0	2	2	1
4	EC 2098	Simulation Lab	0	0	2	2	1
Total of Practical						9	4.5
Semester Total						28	23.5

SEMESTER – V

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	EC 2016	Communication Engineering	3	1	0	4	4
2	EE 2024	Generation, Transmission & Distribution of Electric Power	3	1	0	4	4
3	EE 3028	Power Electronics Circuits	3	0	0	3	3
4	EC 2020	Microprocessors, Microcontrollers & Interfacing	3	1	0	4	4
5		Department Elective-I	3	0	0	3	3
6		Department Elective-II	3	0	0	3	3
Total of Theory						21	21
Practical							
1	EC 2090	Microprocessor and Microcontroller Lab	0	0	2	2	1
2	EE 3098	Control Lab	0	0	2	2	1
3	EE 2098	Power Electronics Lab	0	0	3	3	1.5
Total of Practical						7	3.5
Semester Total						28	24.5

SEMESTER –VI

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1	EC 3007	Digital Signal Processing	3	1	0	4	4
2	EE 3002	Power System Operation and Control	3	1	0	4	4
3		Department Elective-III	3	0	0	3	3
4		Department Elective-IV	3	0	0	3	3
5		Department Elective-V	3	0	0	3	3
6		Open Elective-I / (MI-1)	3	0	0	3	3
Total of Theory						20	20
Practical							
1	EE 3092	Power System Lab	0	0	3	3	1.5
2	EC 3096	DSP Lab	0	0	2	2	1
Sessional							
1	EL 3082	Minor Project	0	0	4	4	2
Total of Practical & Sesssional						9	4.5
Semester Total						29	24.5

SEMESTER – VII

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1		HS Elective-II	3	0	0	3	3
2	HS 4001	Professional Practice, Law & Ethics	2	0	0	2	2
3		Open Elective-II / (MI-2)	3	0	0	3	3
(4)		(MI-3)	(3)	(0)	(0)	(3)	(3)
(5)		(MI-4)	(3)	(0)	(0)	(3)	(3)
(6)		(HO-1)	(3)	(0)	(0)	(3)	(3)
Total of Theory						8	8
Sessional							
1	EL 4081	Project-I / Internship					3
2	EL 4083	Practical Training	-	-	-	-	2
(3)		(Project – Minor / Lab)	(0)	(0)	(4)	(4)	(2)
Semester Total							13

SEMESTER-VIII

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
(1)		(MI-5)	(3)	(0)	(0)	(3)	(3)
(2)		(MI-6)	(3)	(0)	(0)	(3)	(3)
(3)		(HO-2)	(3)	(0)	(0)	(3)	(3)
(4)		(HO-3)	(3)	(0)	(0)	(3)	(3)
Sessional							
1	EL 4082	Project - II / Internship					10
Semester Total							10

MI – Minor

HO - Honors

## LIST OF HS ELECTIVES

### HS Elective – I

Sl. No	Course Code	Course Title	Credit
1.	HS 2002	Engineering Economics	3
2.	HS 2008	Economic Environment of India	3
3.	HS 2010	Financial Institutions, Markets and Regulations	3
4.	HS 2012	Development Economics	3

### HS Elective – II

1.	HS 3006	Entrepreneurship	3
2.	HS 3008	Management Concepts & Practices	3
3.	HS 3002	Organizational Behaviour	3
4.	HS 3004	Human Resource Management	3

## LIST OF DEPARTMENT ELECTIVES

### Dept. Elective – I

1.	EE 3038	Utilization of Electric Power	3
2.	EE 3017	Renewable Energy Sources	3
3.	EI 3027	Industrial Instrumentation	3
4.	EL 3024	Industrial Automation & Control	3

### Dept. Elective - II

1.	EL 3022	Advanced Control System	3
2.	EC 3021	Neural Network & Machine Learning	3
3.	EE 3035	Energy Storage Technology	3
4.	EC 3011	VLSI Design	3

### Dept. Elective - III

1.	EE 3006	Electric Drives & Control	3
2.	EE 3068	Power Converter Analysis & Design	3
3.	EC 3023	Optimization Techniques in Engineering	3
4.	EC 3060	Mobile Communication Engineering	3

### Dept. Elective – IV

1.	EE 3008	Power System Protection	3
2.	EE 3048	HVDC & FACTS	3
3.	EC 3028	Data Communication & Networking	3
4.	EI 3032	Principle of Sensors & Data Acquisition	3

### Dept. Elective – V

1.	EE 3058	Energy Audit and Accounting	3
2.	EE 3072	Computer Aided Power Systems	3
3.	EC 3033	Embedded System Design and Applications	3
4.	EI 3022	Biomedical Instrumentation	3

LIST OF OPEN ELECTIVES OFFERED BY SCHOOL OF ELECTRONICS ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2011	Digital Electronics	NIL
2	EC 2021	Signals & Networks	Math-II (MA 1004)
3	EC 3044	Introduction to Communication Engineering	NIL
4	EC 3066	Principles of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EI 3027	Industrial Instrumentation	Basic Electrical Engineering (EE 1003)
6	EC 3013	Principle of Digital Signal Processing	Math-II (MA 1004)
7	EL 2002	Principle of Control System	Signals & Networks (EC 2021)
8	EC 3011	VLSI Design	Digital Electronics (EC 2011)
9	EC 3033	Embedded system Design and Applications	Microprocessors and Microcontrollers (EC 2020) /Principles of Microprocessors and Microcontrollers (EC 3066)
10	EL 3024	Industrial Automation & Control	Principle of Control Systems (EL 2002) /Linear Control System (EL 2028)
11	EC 6108	Digital Image Processing	Principle of Digital Signal Processing (EC 3013) / Digital Signal Processing (EC 3007)
12	EC 3060	Mobile Communication Engineering	Communication Engineering (EC 2016) /Introduction to Communication Engineering (EC 3044) / Principle of Digital Communication (EC 2004)
13	EC 3050	Internet of Things and its applications	Microprocessors and Microcontrollers (EC 2020) / Principles of Microprocessors and Microcontrollers (EC 3066)

MINOR IN ELECTRONICS & TELECOMMUNICATION ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC2011)
4	EC 2021	Signals and Networks	Mathematics-II (MA1004)
5	EC 2014	Electromagnetic Theory	Mathematics-II (MA1004)
6	EC 3011	VLSI Design	Analog Electronic Circuits
7	EC 3031	ARM and Advanced Processors	Principle of Microprocessors and Microcontrollers (EC3066)
8	EC 3035	High speed Digital system Design	Digital Electronics (EC2011)
9	EC 3044	Introduction to Communication Engineering	Nil
10	EC 3015	Microwave Engineering	Nil
11	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC3044)
12	EC 3060	Mobile communication Engineering	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication Engineering (EC2016)
13	EC 3050	Internet of Things and its Applications	Principle of Microprocessors and Microcontrollers (EC3066)
14	EC 6122	Satellite Communication Systems	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication Engineering (EC2016)
15	EC 3029	Optical Communication and Networking	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication



			Engineering (EC2016)
16	EC 3021	Neural Networks and Machine Learning	Mathematics-I &II (MA1003 and MA1004)
17	EC 1094	Analog Electronic Circuits Lab	
18	EC 2093	Digital Electronics Lab	
19	EC 3095	VLSI Lab	

MINOR IN ELECTRONICS & INSTRUMENTATION ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EI 2003	Electrical & Electronic Measurement Techniques	Basic Electrical Engineering (EE 1003)
3	EC 2021	Signals and Networks	Mathematics-II (MA 1004)
4	EL 2002	Principle of Control System	Signals and Networks (EC 2021)
5	EI 2012	Sensors and Signal Conditioning	Electrical and Electronic Measurement Techniques (EI 2003)
6	EI 3009	Instrumentation Measurement Techniques	Electrical & Electronic Measurement Techniques (EI 2003)
7	EI 3029	Process Dynamics and Control	Principle of Control System (EL 2002)
8	EI 3025	Principle of Analytical Instrumentation	Chemistry (CH 1007)
9	EI 3030	Power Plant Instrumentation	Instrumentation Measurement Techniques (EI 3009)
10	EI 3032	Principle of Sensors and Data Acquisition	Electrical and Electronic Measurement Techniques (EI 2003)
11	EI 3023	Neural Network & Fuzzy Logic Control	Mathematics-I (MA 1003), Mathematics-II (MA 1004) and Principle of Control System (EL 2002)
12	EI 2095	Electrical & Electronic Measurements Lab	
13	EI 3091	Instrumentation Lab	
14	EI 3092	Process Control Lab	

**MINOR IN VLSI AND EMBEDDED SYSTEM**

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Principles of Electronics Engineering (EC 2025)
3	EC 2005	Semiconductor Devices	Principles of Electronics Engineering (EC 2025)
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3011	VLSI Design	Digital Electronics (EC2011)
6	EC 3035	High Speed Digital System Design	Digital Electronics (EC2011)
7	EC3033	Embedded System Design and Applications	Digital Electronics (EC2011)
8	EC 3031	ARM and Advanced Processors	Microprocessors, Microcontrollers & Interfacing (EC 2020) / Principle of Microprocessors and Microcontrollers (EC 3066)
9	EC 3068	Real Time Systems and Application	Digital Electronics (EC 2011)
10	EC 6224	Low Power VLSI Design	VLSI design (EC 3011)
11	EC 3058	Nanoelectronics	Principles of Electronics Engineering (EC 2025)
12	EC 2093	Digital Electronics Lab	
13	EC 2090	Microprocessor and Microcontroller Lab	
14	EC 3095	VLSI Lab	

MINOR IN SENSORS & SIGNALS

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 2021	Signals and Networks	Mathematics-II (MA1004)
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EI 2003	Electrical & Electronic Measurement Techniques	Basic Electrical Engineering (EE 1003)
6	EI 2012	Sensors & Signal Conditioning	Electrical and Electronic Measurement Techniques (EI 2003)
7	EC 3013	Principle of Digital Signal Processing	Signals and Network (EC 2021)
8	EI 3032	Principle of Sensors & Data Acquisition	Electrical & Electronic Measurement Techniques (EI 2003)
9	EC 3021	Neural Networks & Machine Learning	Mathematics-I and Mathematics-II (MA1003 and MA1004)
10	EC 3050	Internet of Things and its applications	Principle of Microprocessors and Microcontrollers (EC3066)
11	EC 6108	Digital Image Processing	Principle of Digital Signal Processing (EC 3013)
12	EI 3024	Virtual Instrumentation	Sensors and Signal Conditioning (EI 2012), Digital Electronics (EC 2011)
13	EC 3056	Speech and Audio Signal Processing	Principle of Digital Signal Processing (EC 3013)
14	EC 2093	Digital Electronics Lab	-
15	EI 2095	Measurements and Instrumentation Lab	-
16	EC 3099	DSP Lab	-

MINOR IN “COMMUNICATION NETWORKS, INTELLIGENT IOT & CYBER PHYSICAL SYSTEMS”

Sl No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3044	Introduction to Communication Engineering	Nil
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3033	Embedded System Design and Applications	Principles of Microprocessors and Microcontrollers (EC 3066)
6	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC 3044)
7	EC3050	Internet of Things and its applications	Principles of Microprocessors and Microcontrollers (EC 3066)
8	EC 3070	MANET AND WSN	Data Communication and Networking (EC 3028)
9	EC 6112	Communication & Network Security	Data Communication and Networking (EC 3028)
10	EC 3072	Introduction to machine learning	Mathematics-I & II (MA1003 and MA1004)
11	EC 3074	Internet Technologies for cloud & Edge computing	Computer Programming (CS 1093)
12	EC 3076	IoT & Cyber-Physical System Design	Internet of Things and its applications (EC3050)
13	EC 4061	AI and Machine Learning for IoT	Mathematics-I & II (MA1003 and MA1004) & Internet of Things and its applications (EC3050)
14	EC 2093	Digital Electronics lab	

15	EC 2090	Microprocessor and Microcontroller Lab	
14	EC 4099	Internet of Things & connected intelligent systems Lab	
15	EC XXXX	Project	

MINOR IN “APPLIED MACHINE LEARNING”

Sl No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3044	Introduction to Communication Engineering	Nil
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3033	Embedded System Design and Applications	Principles of Microprocessors and Microcontrollers (EC 3066)
6	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC 3044)
7	EC3007	Digital Signal Processing	
8	EC 6108	Digital Image Processing	Digital Signal Processing
9	EC 3072	Introduction to Machine learning	Computer Programming (CS 1093)
10	EC 3078	Signal Understanding Using Machine Learning	Signal and Network
	EC 3080	Deep Learning	
11	EC 4059	Computer Vision and Pattern Recognition	Digital Image Processing
12	EC 2093	Digital Electronics lab	
13	EC 2090	Microprocessor and Microcontroller Lab	
12	EC 4097	Machine learning Lab	
13	EC XXXX	Project	

## COURSES OF FIRST YEAR

MA 1003      Mathematics-I

Credit:            4  
Category:        BSC  
Prerequisite(s): Nil

### Course Description:

The laws of nature are expressed as differential equations. The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of science. This course is designed to familiarize the prospective engineers with techniques in ordinary differential equations, multivariate calculus and solution for ODEs numerically. This course also focuses on Linear algebra that covers system of linear equations and properties of matrices. The objective of the course is to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced levels of mathematics and applications that they would find useful in their disciplines.

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

- CO1: model and formulate differential equation of Physical problems
- CO2: apply different methods to solve 1st and 2nd order ODEs
- CO3: apply numerical methods to solve ODEs
- CO4: study differential calculus in engineering problems
- CO5: use the essential tool of matrices and linear algebra
- CO6: analyze Eigenvalue problems

### Topics:

- Ordinary Differential Equations.
- Linear differential equations of 2<sup>nd</sup> order.
- Differential calculus and Numerical methods to solve ODEs
- Vector space and system linear of equations
- Matrix-eigenvalue Problems

### Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, (online) 10<sup>th</sup> Edition.
2. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand, reprint 2009.

### Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand & Co Ltd, 11<sup>th</sup> edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & Partial Differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.



PH 1007          Physics

Credit:            4  
Category:         BSC  
Prerequisite(s): Nil

Course Description:

This course includes the fundamentals of different types of oscillations and its applications; mathematical expression of waves and its physical interpretation; the concept of interference, diffraction and their applications; the principle, construction and working of different Lasers. The course also gives a flavour of Quantum mechanics, which is the founding stone to the state of the art in modern techniques and paves the way towards the world of nano devices. It covers the formulation of Maxwell's electromagnetic equations, and verification of different properties of electromagnetic waves. Mechanical and magnetic properties of different materials and their applications are also covered in this course.

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

CO1: utilize the concept of waves and intensity modulation in day to day life through various applications

CO2: apply the mechanism of LASER technology in different fields

CO3: formulate and solve engineering problems of electricity and magnetism using Maxwell's electromagnetic equations

CO4: apply the principles of quantum mechanics to related problems

CO5: apply the knowledge of magnetic materials in related applications

CO6: analyze the macroscopic behavior of solids and utilize them in future applications

Topics:

- Oscillation and wave
- Interference and diffraction
- LASER
- Quantum mechanics
- Electromagnetism
- Properties of matter (mechanical)
- Magnetism

Textbook (s):

1. Engineering Physics, B. K. Pandey and S. Chaturvedi, Cengage Publication, New Delhi

Reference Book(s):

1. Introduction to Electrodynamics, D J Griffiths, Pearson Education
2. Quantum Mechanics, L. I. Schiff, Tata McGraw-Hill Publications
3. Optics, A K Ghatak, Tata McGraw-Hill Publications
4. Concepts of Modern Physics, A. Beiser, Tata McGraw-Hill Publications
5. Engineering Physics, R K Gaur and S. L. Gupta, Dhanpat Rai Publications, New Delhi.

ME 1003      Engineering Mechanics

Credit:            2  
Category:        ESC  
Prerequisite(s): Nil

Course Description:

The course on Engineering Mechanics is a specialized need-based extension of applied physics which is aimed at developing an understanding of the principle of statics and dynamics. The course focuses on learning methodical and logical idealization and subsequent implementation of corresponding procedures for analysis of rigid body, frame and machine under the action of force system which is highly essential for effective design. The course intends to develop the ability of drawing and analyzing the free body diagram of a system when at rest or motion using scalar/vector techniques. Further, the course serves as a prerequisite to fundamental machine design courses such as mechanics of solids and design of machine elements.

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

- CO1: draw complete and correct free-body diagrams and write the appropriate equilibrium equations from the free-body diagram
- CO2: use scalar analytical techniques for analyzing forces and moments in mechanical systems
- CO3: analyzing forces in statically determinate structures such as trusses, frames and problems related to friction
- CO4: determine the centroid and second moment of area
- CO5: apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems
- CO6: solve real-life problems by using mathematics, physical laws and theorems

Topics:

- Concurrent Forces in a Plane
- Friction
- Parallel Forces in a Plane
- Moment of Inertia
- Force analysis of Plane Trusses
- Principle of Virtual Work
- Kinematics of Rectilinear Motion
- Kinematics of Curvilinear Motion
- Rotation of a rigid body

Textbook(s):

1. Engineering Mechanics (Revised 5th edition), TMH by S. Timoshenko, D.H. Young, J.V Rao and S. Pati.

Reference Book (s):

1. Engineering Mechanics (Statics and Dynamics) - Bear and Johnson, TMH
2. Engineering Mechanics (Statics and Dynamics) by I.H. Shames, Prentice Hall
3. Engineering Mechanics –S.S. Bhavikatti, New Age International
4. Engineering Mechanics (Statics and Dynamics)-S. Rajasekaran & G Sankarasubramanian, Vikas Publishing House.

PH 1097          Physics Laboratory

Credit:            1.5  
Category:        BSLC  
Prerequisite(s): Nil

Course Description:

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, Screw gauge, vernier calliper, microscope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

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

- CO1: calculate appropriate structural members using the fundamental concepts of the elastic behavior of materials
- CO2: use the principles of interference and diffraction to find out the wavelength of an unknown monochromatic source of light
- CO3: apply the concept of photoelectric emission to calculate the Planck's constant and analyze some aspects of electron-photon interaction through characteristic curves
- CO4: explore the efficiency in terms of power output of a green energy source i.e. solar cell
- CO5: calculate the acceleration due to gravity 'g' by using the concept of a compound pendulum

Topics:

- Estimation of elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio
- Determination of wavelength of unknown source using Newton's rings and Michelson's interferometer
- Precision length measurement up to the order of  $6 \text{ \AA}$  (distance between sodium D-lines) using Michelson interferometer
- Determination of grating element using a diffraction grating
- Study of photo cell and solar cell by analyzing their characteristic curves
- Determination of acceleration due to gravity using a bar pendulum

EE 1093            Basic Electrical Engineering Laboratory

Credit:            1  
Category:        ESLC  
Prerequisite(s): Nil

Course Description:

Basic Electrical Engineering lab comprises of various equipments and loads i.e voltmeters,ammeters, wattmeters, single phase and three phase transformer, induction motors etc. It is a specialized practical oriented course which intends to develop and understand various principles like Ohm's law and Kirchoff's law. The course focused on learning methodical and logical idealization of various theorems which is highly essential for solving a network. The course intends to make the students familiar with various parts of DC machines and AC machines. The course intends to develop the ability of problem solving by analyzing RL and RLC series circuits. This lab helps the students to understand the principle of operation of a single phase transformer with its no load calculation.

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

- CO1: recall the safety practices in the laboratory and the associated work areas
- CO2: comprehend the skills for working in a team with common objective
- CO3: apply different theorems to find the parameters in DC and AC circuit
- CO4: analyse the different parts of DC and AC machines to describe operational features thereof
- CO5: apprise the experimental results in systematic manner
- CO6: discuss about determination of resistance in incandescent lamp and power factor in fluorescent lamp

Topics:

- measurement of resistance of tungsten filament lamp
- measurement of inductance of a choke coil
- study and use of megger
- study of different parts of dc machine and three phase induction motor
- layout of power system analysis
- determination of voltage ratio of a single phase transformer
- measurement of no load current and core loss of a single phase transformer
- verification of KCL and KVL
- verification of voltage and current ratio of star and delta connection
- study & determine the power factor of the RLC series circuit
- study, connection & determine the power factor of fluorescent tube
- verification of the superposition theorem
- transient analysis of series RL and RC circuit using matlab-simulink with dc excitation

Textbook(s):

1. Basic Electrical Engineering by D.C. Kulshreshtha, Tata Mcgraw publication, 1st Edition 2011.
2. Basic Electrical Engineering, T.K. Nagasarkar and M.S. Sukhija, Oxford University press, 2nd Edition 2011.

Reference Book(s):

1. Basics Electrical Engineering Sanjeev Sharma, I.K. International, New Delhi.(Third Reprint 2010).

ME 1083      Basic Manufacturing Systems

Credit:            2  
Category:        ESLC  
Prerequisite(s): Nil

Course Description:

This laboratory practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which covers both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC and 3D printing.

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

- CO1: practice different operations related to fitting shop
- CO2: use different welding tools to prepare a given type of joint
- CO3: demonstrate various turning operations including taper turning and knurling using a conventional lathe machine
- CO4: design a tray and prepare it using sheet metal equipment involving soldering
- CO5: appraise different operations using a CNC machine
- CO6: interpret different advanced machines such as 3D printing/additive manufacturing

Topics:

- Turning operations
- Sheet metal operations
- Fitting
- Welding

CH 1081      Environmental Science

Credit:            1  
Category:        BSLC  
Prerequisite(s): Nil

Course Description:

The course is designed to make the students aware of different environmental components and their composition. It will make the students understand different pollutants, their sources and management. It will also help students to apply the principles of Green Chemistry and implement them in synthesis of advanced materials required for engineering applications. It also outlines the basic steps for developing the EIA statements

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

- CO1: understand the different components and composition of the environment
- CO2: rationalize the different pollutants, their sources, effects and controlling measures
- CO3: quantify water quality parameters
- CO4: apply the systematic environmental impact assessment (EIA) requirements before setup of any project
- CO5: understand and implement the principles of solid waste management
- CO6: conceptualize the principles of green chemistry and implement them in synthesis of advanced material, so as to reduce the pollution

Topics:

- Overview on environment
- Environmental pollution: air pollution, water pollution
- Pollution management

Textbook(s):

1. Environmental Chemistry, A. K. De, New Age International Publishers.

Reference Book(s):

1. Environmental Chemistry- S. Chakroborty, D. Dave, S.S. Katewa, Cengage Publishers
2. Environment Science and Engineering, Aloka Debi. Second Edition ;Universities Press
3. Text Book of Environment studies for under graduate courses, Erach Bharucha : 2<sup>nd</sup> Edition, Universities Press
4. Fundamentals of Environment and Ecology, D. De, D. De; 2013, S. Chand Group
5. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publishing Company

MA 1004            Mathematics-II

Credit:            4  
Category:         BSC  
Prerequisite(s): Nil

Course Description:

The course is to familiarize the students with series solutions of ODEs, Laplace Transforms, Fourier series, vector calculus, and numerical integration. For the ODEs with variable coefficients, the situation is more complicated to get their solutions in elementary functions. Legendre and Bessel's equations are important ODEs of this kind and their solutions, the Legendre polynomials and Bessel functions play an important role in engineering applications. Laplace transforms can be used as a mathematical toolbox for engineers to solve linear ODEs and related initial value problems. The Fourier series and vector calculus play a very important role in many engineering areas such as solid mechanics, aerodynamics, fluid flow, heat flow, quantum physics. The applied mathematician, engineer, physicist, or scientist must become familiar with the essentials of numerics and its ideas, such as interpolation and numerical integration.

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

- CO1: understand application of Power series and solution of ODEs
- CO2: use Power series solutions to Legendre and Bessel's equations
- CO3: comprehend Laplace transform and IVPs
- CO4: study periodic and non-periodic functions and their Fourier series expansion
- CO5: develop vector differential and integral calculus and the applications of Green's theorem, Gauss Divergence Theorem & Stokes Theorem
- CO6: apply numerical techniques in interpolation and evaluation of the definite integral

Topics:

- Series Solution of Differential Equations
- Laplace Transforms
- Fourier Series
- Vector Differential and Integral Calculus
- Interpolation and Numerical Integration

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10<sup>th</sup> Edition.

Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand & Co Ltd, 11<sup>th</sup> edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & partial differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.

CH 1007            Chemistry

Credit:            3  
Category:        BSC  
Prerequisite(s):   Nil

Course Description:

The course is designed to enrich the students with basic concepts in Chemistry to strengthen their fundamentals which will support them for pursuing education and research in engineering. It will help them to develop the idea on feasibility and mechanism of different chemical processes, conceptualize alternative sources of energy, give an exposure for handling instrumental techniques to explore structure of organic molecules and an idea of different methods for synthesis of advanced materials.

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

- CO1: rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process
- CO2: analyze the kinetics of simple and multistep reactions as well as theories of reaction rates
- CO3: evaluate some properties such as pH, solubility product etc. by using electrochemical cell and understand the working of modern batteries
- CO4: able to understand the mechanism of corrosion and its different controlling measures
- CO5: distinguish the different electromagnetic radiations used for exciting different molecular energy levels in various spectroscopic techniques to evaluate the structure of molecules
- CO6: get an exposure to different methods used for synthesis of nanostructured materials

Topics:

- Chemical Equilibrium and Thermodynamics
- Chemical Kinetics
- Electrochemistry
- Spectroscopy
- Chemistry of Nano Materials

Textbook(s):

1. Engineering Chemistry: Fundamentals and Applications- Shikha Agarwal, Cambridge University Press, 2016

Reference Book(s):

1. Textbook of Engineering Chemistry: Sashi Chawala, Dhanpat Rai and Co, 2016
2. Principles of Physical Chemistry- B.R. Puri, L.R Sharma, M.S. Pathania; 42nd Edition, Vishal Publishing Co.
3. Spectrometric Identification of Organic compounds, 7th Edition -Robert M. Silverstein, Francis, Webster, David J. Kiemle; Jhon Wiley & Sons, INC.
4. Nanostructures & Nanomaterials: Synthesis, Properties and Applications- G. Cao and Y. Wang, World Scientific Pvt. Ltd.; 2nd Edition



HS 1005          Professional Communication

Credit:            2  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

Professional Communication is more emphasized on enhancing the four LSRW skills like Listening, Speaking, Reading and Writing in order to improve students' professional communication. It is basically designed to enhance speaking skills through pronunciation, stress and tone. This course is prepared to improve reading skills through reading, comprehending and retaining information. This course is basically expected to provide the learner an approach to communicate using all the four skills

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

- CO1: understand the communication process and practical implementations in the workplace
- CO2: apply verbal and non-verbal modes of communication effectively in practical situations
- CO3: apply effective conflict management strategies
- CO4: use English grammar correctly and unambiguously in technical writing
- CO5: bridge the gap between native language and target language i.e. English
- CO6: retain a logical flow while drafting reports and other technical pieces of writing

Topics:

- Communication: Process and Methods of Communication
- Basics of Grammar: Time & Tense, Subject-Verb Agreement, Analogy, Active & Passive Voice, Error Detection in Sentences
- Writing Skills: Paragraph Writing-Techniques & Skills, Use of Punctuation, Business Letter-Enquiry, Claim/ Complaint, Order
- Basic Sounds of English: Hearing & Listening, Introduction to Basic Sounds of IPA, Problem Sounds & MTI

Textbook(s):

1. Technical Communication Principles & Practices. Meenakshi Raman and Sangeeta Sharma OUP. Second Edition-2011

Reference Book(s):

1. A Communicative English Grammar. Geoffrey Leech and Jan Svartvik. Third Edition. Routledge Publication. New York. 2013.
2. Effective Technical Communication. M Ashraf Rizvi TMH 2005
3. The Oxford Grammar (English ) Sidney Greenbaum, Oxford University Press India. 1<sup>st</sup> Edition. 2005
4. Verbal Ability and Reading Comprehension for the CAT. Arun Sharma and Meenakshi Upadhyay, TMH, New Delhi, 2007
5. Better English Pronunciation, Cambridge University Press, J D O'Connor, 2<sup>nd</sup> Edition (Paper Back) 2013

LS 1001      Biology

Credit:        2

Category:     BSC

Prerequisite(s): Nil

Course Description:

Biology is important to everyday life because it allows humans to better understand their bodies, their resources and the potential threats existing in the environment. The engineering undergraduates need to be suitably exposed to the biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

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

CO1: comprehend the typical characteristics which distinguish life forms and analyze life process at cellular level

CO2: apply concepts on structure and function of simple biomolecules in life processes

CO3: comprehend different biological process involved in life and to analyze their effect

CO4: understand different biological phenomenon and then relate it with engineering application domains

CO5: comprehend different physiological functions and then relate it to computer based techniques

CO6: understand biology and its relevance to engineering and technology

Topics:

- The Cellular organization of a living Organism
- The molecular and biochemical basis of an organism
- Enzymes, photosynthesis, metabolism and bioenergetics
- Molecular machines, biosensor and bioremediation
- Nervous system, immune system and cell signaling

Textbook(s):

1. Biology for Engineers. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi, M.K. Jaganathan. McGraw Hill Education (India) Ed., 2012

Reference Book(s):

1. Biology (Indian Edition), P.H. Raven and G.B. Johnson. McGraw Hill Education (India) Private Limited.
2. Concepts of Biology, Eldon D. Enger, Feederick C, Ross and David B. Bailey. TMH Publications.
3. Biology. Neil A. Campbell and Jane B. Reece, Pearson Education.
4. Biology Concepts and Application, Cecie Starr, Thomson Books.

CS 1093          Computer Programming Laboratory

Credit:            4  
Category:        ESLC  
Prerequisite(s): Nil

Course Description:

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

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

- CO1: have fundamental knowledge on basics of computers hardware and number systems with concept on basics commands in Linux
- CO2: write, compile and debug programs in C language
- CO3: design programs involving decision structures, loops, and functions
- CO4: understand the dynamics of memory by the use of pointers
- CO5: use different data structures and create/update basic data files

Topics:

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

CH 1097      Chemistry Laboratory

Credit:            1.5  
Category:        BSLC  
Prerequisite(s): Nil

Course Description:

The Chemistry laboratory course is designed to develop basic concepts of quantitative analysis by using volumetric as well as instrumental methods. It includes classical titrations to estimate hardness, alkalinity, dissolved oxygen, ferrous ion content, chloride content in water/solution samples. It also gives hands on training to use advanced titration techniques such as potentiometric, pH metric and conductometric titrations which can be used with turbid and colored solutions in incredibly low concentrations. The course also gives an exposure to extensive use of UV-Vis spectroscopy for estimation of different ions in solution phase.

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

- CO1: understand the significance of quantitative chemical analysis
- CO2: prepare solutions of different concentrations and do their standardization
- CO3: get an exposure to different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry
- CO4: evaluate the rate constant of pseudo first order reactions
- CO5: analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, ferrous iron contents
- CO6: rationalize chemical handling and chemical safety in an advanced modern laboratory

Topics:

- Hardness of water sample
- Alkalinity of water
- Estimation of  $\text{Fe}^{2+}$  iron
- Dissolved Oxygen
- Potentiometric Titration
- Kinetics of Ester Hydrolysis
- Chloride Estimation
- pH metric Titration
- Conductometric Titration
- Concentration of  $\text{KMnO}_4$  by Visible spectroscopy

HS 1085          Language Laboratory

Credit:            1  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

Language Lab is more practical oriented which is designed with an objective to make the learner practice the skills which he/she has learnt in the theory I.e Listening, Speaking, Reading and Writing in order to improve their communication skills. It is basically designed to engage the students to learn to perform group activity or an individual activity. This course is prepared to improve the listening reading, speaking and writing skills . It is expected to orient the students with vocabulary, analogy, sentence completion and sentence correction.

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

- CO1: use English grammar correctly and unambiguously in technical writing
- CO2: apply verbal and non-verbal modes of communication effectively in practical situations
- CO3: have a basic understanding of the communication process and to know the practical implementations in the workplace
- CO4: retain a logical flow while drafting reports and other technical pieces of writing
- CO5: develop competence in reading and comprehension
- CO6: be familiar with English pronunciation and use neutral accent successfully

Topics:

- Reading & Comprehension
- Skit/ Role-Play Practice
- Listening Comprehension
- Time & Tense
- Business Letter
- Business Report
- Subject-Verb Agreement
- Visual Elements in Writing:
- Gadget-Supported Textual Formatting
- Attendance + Lab Record Checking
- Viva Voce

CE 1083          Engineering Graphics

Credit:            2  
Category:        ESLC  
Prerequisite(s): Nil

Course Description:

The course of Engineering Graphics comprises of basics of drafting, projection of points & lines, line inclined to both the planes, projection of planes, Computer Aided Drafting, projection of solids and development of surfaces.

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

- CO1: use common drafting tools properly
- CO2: select, construct and interpret appropriate drawing scale as per the situation
- CO3: draw orthographic projections of points, lines and planes
- CO4: draw orthographic projection of solids like cylinders, cones, prisms and pyramids including sections
- CO5: develop the sections of solids for practical situations
- CO6: communicate ideas effectively using Computer Aided Drafting

Topics:

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Textbook(s):

1. Engineering Drawing + AutoCAD by K. Venugopal, New Age Publishers, 1st edition, 2011

Reference Book(s):

2. Engineering Drawing with an Introduction to AutoCAD by S. N. Lal, Cengage India Private Limited, 1st edition, 2017

## COURSES OF THE PROGRAMME

EC 2005          Semiconductor Devices

Credit:            3

Category:        PCC

Prerequisite(s): Analog Electronics Circuit (EC 1004)

Course Description:

This course will give the fundamental concepts of electronics devices that are backbone of all electronics circuits. In this course students will be able to understand the basic semiconductor device physics and how the concepts are used in PN junction, metal semiconductor contacts, BJT, MOSFET, Optoelectronics devices. The course will give in-depth knowledge about the operating principle of the devices with characteristics and how these are related to modern technologies. This course will also helps the students to explore various other domains of electronics like VLSI design, Digital electronics etc.

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

CO1: understand and explain the fundamental semiconductor physics concepts like Fermi level, carrier concentration etc. and analyze them to solve different problems

CO2: analyze and explain different conduction techniques in semiconductor materials and solve relevant problems

CO3: comprehend and analyze the operation of different diodes, metal semiconductor contacts and solve different diode problems

CO4: explain the operation and solve problems associated with of BJT

CO5: analyze and explain the operation of MOS Transistors and solve relevant problems

CO6: comprehend and analyze operating principle of different optoelectronic devices and their applications

Topics:

- Energy bands & Current Carriers in Semiconductors
- P-N Junction
- BJT (Bipolar Junction Transistor)
- Metal-Oxide Field Effect Transistor (MOSFET)
- Optoelectronics devices

Textbook(s):

1. Solid State Electronic Devices: Streetman & Banerjee, 7th Edition, Pearson.

Reference Book(s):

1. Semiconductor Devices: Basic Principles, Jasprit Singh John Wiley & Sons, 2000
2. Integrated Electronics: Analog And Digital Circuit Systems, Jacob Millman, Christos Halkias, Chetan D Parikh, 2nd Edition, TMH 2010.
3. Semiconductor Physics And Devices: Donald Neaman and Drubesh Biswas, 2012, 4th Edition, TMH 2012.

EC 2011          Digital Electronics

Credit:            3  
Category:        PCC  
Prerequisite(s): Nil

Course Description:

This course covers all basic concepts in digital systems. The course starts with fundamentals of Boolean Algebra-different number systems and inter-conversions, binary codes and K-maps. This will be followed by designing of various combinational circuits such as adders, subtractors, decoders, encoders, magnitude comparators, multiplexer and de-multiplexers. Detail concept about memory elements (flip-flops) will be provided that will help the students to learn about various design techniques of sequential circuits like shift registers, counters and FSMs. Fundamentals of digital logic families, ADC and DAC will also be covered that will help the students to learn digital electronics principles comprehensively in today's perspective.

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

- CO1: comprehend, simplify and realize Boolean expression
- CO2: comprehend and analyze combinational circuits using logic gates
- CO3: design various asynchronous & synchronous sequential circuits using Flip-Flops
- CO4: design & implement Mealy and Moore model FSMs for different synchronous sequential circuits
- CO5: analyze and differentiate between different logic families such as TTL & CMOS chips
- CO6: comprehend and analyze the concept of different types of Analog-to-Digital converters and Digital-to-Analog converters

Topics:

- Introduction to Boolean Algebra
- Combinational Circuits
- Sequential Logic
- Finite State Machine (FSM)
- Logic Families
- A/D and D/A

Textbook(s):

1. Fundamentals of Digital Logic – Anand Kumar - PHI, 2nd Edition, 2011
2. Digital Logic and Computer Design – M. Morris Mano – PHI,2011

Reference Book(s):

1. Digital Principles and Applications – Malvino & Leach –TMH, 7th edition, 2011
2. Digital Fundamentals – T. L. Floyd & Jain – Pearson Education, 10th edition, 2011



EC 2014          Electromagnetic Theory

Credit:            3

Category:        PCC

Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

The course provides a basic understanding of electrostatics and magnetostatics using the already known knowledge of vector calculus. This course will also cover different aspects of time varying fields and provide insight to Maxwells equations. Concepts on the propagation of the EM waves in different media and under boundary conditions will lead to the understanding of transmission line behaviour and impedance matching circuits.

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

CO1: apply the appropriate coordinate system for a particular vector based problem, and the laws of vector calculus

CO2: analyze and solve numerical problems involving static charges

CO3: analyze and solve numerical problems involving constant currents

CO4: analyze and apply Maxwell's equations for electromagnetism

CO5: analyze and apply wave behavior during its propagation through multiple media in presence of different boundary conditions

CO6: design transmission line sections (Length propagation constant and characteristic impedance) along with feeding mechanism for realizing impedance matched conditions

Topics:

- Orthogonal coordinate systems
- Static electric and Static magnetic fields
- Time varying fields and Maxwell's equations
- Plane Electromagnetic waves
- Transmission Lines

Textbook(s):

1. Elements of Electromagnetics (Fourth Edition) by Matthew N.O Sadiku, Oxford University Press, 2009.
2. Field and Wave Electromagnetics (Second Edition) By David K. Cheng, Pearson Education, 1989.

Reference Book(s):

1. Engineering Electromagnetics (Seventh Edition) by William H. Hayt, Jr and John A. Buck, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.
2. Electromagnetic Waves and Radiating Systems by Edward C. Jordan and Keith G. Balmain, Prentice Hall of India, New Delhi, 2nd Edition.

EC 2016          Communication Engineering

Credit:          4

Category:        PCC

Prerequisite(s): Principles of Signals and Systems (EC 2023)

Course Description:

The course deals with analog and digital communication techniques that includes AM, FM, sampling, pulse modulation techniques, and multiplexing techniques. It also covers fundamentals of modern communication systems such as optical communication, satellite communication and mobile communication.

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

CO1: understand the basic of signal and systems, Fourier transform and their properties, random process, random variable, PSD & ESD of a signal

CO2: explain the need of communication, its definition & understand the block diagram of different types of communication system

CO3: classify amplitude modulation, angle modulation, Pulse modulation, Types of digital modulation

CO4: applying Fourier transform for analysis of radio spectrum, sketch the waveform and interpret the information present

CO5: design simple systems for generating and demodulating amplitude modulated signals, frequency modulated signal, pulse modulated signal and digital modulation

CO6: design a communication system and select an appropriate modulation technique for a particular application

Topics:

- Introduction
- Signals
- Amplitude Modulation
- AM Radio Receiver
- Angle Modulation
- FM Radio Receiver
- Pulse Modulation and Demodulation
- Digital Modulation
- Modern Communication Systems

Textbook(s):

1. Introduction to Analog & Digital Communication System, Simon Haykins, 2011, John Wiley.
2. Modern Digital and Analog Communications Systems, B. P. Lathi, Oxford University Press, 4th edition.

Reference Book(s):

1. Principles of Communication System, H. Taub & D. L. Schilling, TMH, 3rd edition

EC 2020          Microprocessors, Microcontrollers & Interfacing

Credit:            4

Category:        PCC

Prerequisite(s): Digital Electronics (EC 2011)

#### Course Description:

The objective of this course is to teach the fundamentals of Microprocessor (like 8085, 8086) and Microcontroller (like 8051) systems to the students. In this course, the students learn about assembly language to program the Microprocessors, Microcontrollers and develop programs to solve simple applications.

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

CO1: comprehend the basic concept of Bus structure, a basic 8-bit Microprocessor (like 8085) system, its architecture, concept of stack, Addressing modes etc.

CO2: explain the architecture of a 16-bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation

CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems

CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor

CO5: explain the features of the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16-bit processor

CO6: explain and analyze memory organization of a 8-bit Microcontroller (like 8051), its addressing modes, instructions, timers & counters and its serial communication

#### Topics:

- 8085 (8-bit Microprocessor)
- 8086 (16-bit Microprocessor)
- Interfacing Chips
- 8051 Family of Microcontrollers

#### Textbook(s):

1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall, McGraw Hill Education Pvt Ltd., 3rd edition.

#### Reference Book(s):

1. Microprocessor Architecture, Programming and Applications with the 8085 - Ramesh S. Goankar, Penram International Publishing (India).
2. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd edition.
3. Microcontroller Theory & Applications - Deshmukh, McGraw Hill Education Pvt Ltd.

EC 2021          Signals & Networks

Credit:            3

Category:        PCC

Prerequisite(s): Mathematics-II (MA 1004)

#### Course Description:

This course is designed to establish a strong foundation for communication and signal processing. It will enable students to classify various analog and discrete time signals and visualize the signals after various operations. The course will enable the students to represent various signals in terms of singularity functions and find relationships between signals. It will provide the knowledge of various classifications of systems as well as time and frequency domain analysis of signals and systems using in-depth knowledge of Fourier and Laplace transforms. It will provide the knowledge of linear circuit analysis using Laplace transform to find dynamic and steady state responses. It is designed to provide the concepts of fundamental network theorems and network parameters to analyze linear electrical circuits.

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

CO1: understand and classify various continuous and discrete signals, understand sampling process and visualize signals after various operations

CO2: classify and analyze system characteristics and determine output of LTI system in time domain

CO3: analyze continuous time signals and systems in frequency domain using continuous time Fourier series and continuous time Fourier transform

CO4: determine the Laplace Transform of various signals and analyze analog systems characteristics using Laplace transform and its properties

CO5: analyze RLC circuits for AC/DC excitation using Laplace transform

CO6: analyze and apply network theorems and network parameters to various electrical circuits

#### Topics:

- Introduction to signal classification and operation and sampling process
- Introduction to system classification and time domain analysis of systems
- Analysis of signals and systems in frequency domain using Fourier analysis
- Analysis of signals and system using Laplace transform
- Linear circuit analysis using Laplace transforms
- Network theorems and network parameters and their applications for analyzing linear circuits

#### Textbook(s):

1. Signals and Systems by Alan V. Oppenheim, Alan S. Willsky, PHI, edition
2. Circuit Theory, Analysis and Synthesis A, Chakrabarti, Dhanpat Rai Publishing Company (P) Limited 5th edition, 2008.

#### Reference Book(s):

1. Signals & Systems – P. Ramesh Babu –Scitec,4th edition
2. Network Analysis 3rd edition, by M. E. Van Valkenburg, Pearson Education, 2006

EC 2023      Principle of Signals and Systems

Credit:      2

Category:    PCC

Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

The course presents basic concepts for both continuous-time and discrete-time signals and systems. This course also covers Fourier transform, Laplace transform basics of signal and systems.

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

CO1: comprehend and plot continuous and discrete signals and determine respective characteristics.

CO2: analyze the concept of vector space and orthogonality

CO3: classify various types of systems and analyze system characteristics in time domain

CO4: determine the frequency domain representations of periodic and aperiodic signals using Fourier analysis and its properties

CO5: analyze LTI systems in frequency domain using Fourier analysis for periodic as well as aperiodic signals

CO6: determine the Laplace Transform of various signals and analyze analog systems characteristics using Laplace transform and its properties

Topics:

- Introduction to signals and Classification of signals
- Introduction to continuous and discrete time signals and sampling theorem
- Decomposition of signals, Representation of signals in terms of impulses
- Introduction&classification to systems with examples
- Characteristics of LTI systems and derivation of system response
- Causality and stability criteria of discrete and analog LTI IIR, FIR
- Introduction to Fourier Analysis and their need in LTI
- Properties of CTFS with examples & Approximation of Fourier Series to Transform for aperiodic signals
- Properties of Fourier transform with examples
- Analysis of LTI Systems using FT, Establishment of Laplace transform as modification of FT
- Laplace transform. Convergence of Laplace Transform, Properties of Laplace Transform
- Transfer function, Pole-Zero plot and ROC properties

Textbook(s):

1. Signals & Systems, Alan V Oppenheim and Alan S Willsky, PHI publication, 2nd edition.

Reference Book(s):

1. Signals and systems, Ramesh Babu, Scitech Publication, 4th edition.

EC 2025      Principle of Electronics Engineering

Credit:            3  
Category:        PCC  
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the efficacy of Electronic principles which are pervasive in engineering applications. Students will be able to understand the essence and applications of electronic components used in different electronic circuit. They will understand the working of diode and transistor and their characteristics, benefits of feedback in amplifier, oscillators, design of simple circuits like amplifiers (inverting and non- inverting), adders, integrator and differentiator using OPAMPS, a digital logic and apply it to solve real life problems.

Course Outcomes: At the end of course the students will be able to:

- CO1: understand the properties of semiconductors and current conduction mechanisms
- CO2: comprehend the working of P-N junction diodes; identify different diode circuits and analyze them
- CO3: understand the working of BJT, different modes and configuration, identify and analyze their biasing circuits, understanding the working of CE amplifier and its properties
- CO4: analyze the working of op-amp using either inverting or non -inverting configurations, timing circuit, regulated power supply ICs and their applications
- CO5: comprehend the concept of feedback in electronic circuits, types of feedback, their applications
- CO6: comprehend the working of different logic gates, combinational and sequential circuits, develop a brief idea about microprocessor and microcontrollers

Topics:

- Semiconductors
- Junction Diodes
- Bipolar Junction Transistor (BJT)
- Feedback Concept
- Operational Amplifiers (OPAMP) and 555 timer
- Digital Electronics

Textbook(s):

1. Electronics- Fundamentals & Applications- D. Chattopadhyay and P.C Rakshit- 11th Edition (New Age International)
2. Electronic Devices and Circuits- D. A. Bell- 5th Edition (Oxford)

Reference Book (s):

1. Electronic Devices & Circuits- R. L. Boylestad- 10th Edition(Pearson)
2. Digital Principles and Applications- A. Malvino and Leach-7th Edition(TMh)

EC 2027      Analog Electronics

Credit:      4

Category:    PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

This course deal with basic circuit components and semiconductor components viz., diode, BJT, FET based circuits and op-amp based practical circuits. Design and analysis of circuits such as rectifier, amplifier, oscillator are covered under this course.

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

CO1: comprehend the significance of terminology associated with semiconductor devices and solve the different diode circuits

CO2: explain and analyze different biasing circuits using BJTs and FETs

CO3: analyze and design different amplifier circuits using BJTs and FETs with the help of their small signal model

CO4: analyze and design electronic circuits using BJTs or FETs for different feedback topologies depending on applications as amplifier and oscillators

CO5: explain and analyze different power amplifier circuits, differential amplifier and current mirror circuits

CO6: explain and design different analog circuits using Operational amplifiers and 555 timer

Topics:

- Semiconductor
- P-N junction
- Transistors
- Transistor biasing circuits
- Small signal analysis of transistor amplifiers
- Feedback and oscillator circuits
- Power amplifiers
- Differential amplifiers
- Operational amplifiers

Textbook(s):

1. Integrated Electronics, Analog and Digital Circuits and Systems, J. Millman & Halkias, C.D. Parikh, Mc-Graw Hill India, 2nd edition, 2013, 10th Reprint.
2. Op-Amps and LIC, Ramakant A. Gayakward, Pearson, 4th edition.

Reference Book(s):

1. Microelectronics circuits, A. S. Sedra and K. C. Smith, Oxford University Press, 5th edition, 2011.
2. Linear Integrated Circuits, D. Roy Choudhury and Shail B. Jain, 4th edition, New Age International Publishers.

EC 2090            Microprocessor and Microcontroller Laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This lab is utilized by 4th semester Electronics and Telecommunication Engineering, Electronics and Computer Science Engineering students, 5th semester Electronics and Electrical Engineering and Electronics and Instrumentation Engineering students. Students develop Assembly language programming skills on 8085, 8086 and 8051 kits. Students do their experiments in both hardware and software platforms. They use TALK software and design some Interfacing circuits on bread board like seven segment display to glow decimal digits 0-9 and four-way traffic control circuits and design of LEDs to glow in proper sequence. They also Interface with CRO to display square wave and interface with Digital to Analog Converter to display Triangular and Saw tooth wave forms.

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

- CO1: develop Assembly language programming skills on 8085, 8086 Microprocessor and 8051 Microcontroller trainer kit
- CO2: utilize PCLink communication software for Intel 8085 & 8086 Assembly language programming to execute programs and design practical circuits
- CO3: design practical circuits like 4 way traffic light system, generation of square wave using CRO, interfacing of seven segment display using PPI
- CO4: utilize 86DRV communication software for Intel 8086 Assembly language programming to execute programs and design practical circuits
- CO5: utilize B30DRVM communication software for 8051 Microcontroller & Assembly language programming to execute programs and design practical circuits
- CO6: formulate, design and solve real life engineering problems for executing projects

Topics:

- Familiarization with 8085 and 8086 Microprocessor Kit and verification of instruction sets
- Execution of sample Assembly language programs on 8085 MP Kit
- Introduction to TALK communication software and execution of Assembly language programs using Cross Assembler
- Design a circuit and write a suitable program to display decimal digits 0 to 9 using 8085 and seven segment display
- Design a four lane Traffic control system using PC, 8085 MP Kit and additional hardware
- Familiarization with 8051 Microcontroller Kit and execution of basic programs using TALK communication software & Cross Assembler
- Generation of a 2 KHz square wave on Port 1.3 (Pin-4) with Timer 0 interrupt, using TALK software and 8051 MC Kit
- Open Ended Experiments



EC 2091          Electronic Circuits & Network Laboratory

Credit:            1.5

Category:        PCLC

Prerequisite(s): Basic Electrical Engineering (EE 1003), Basic Electrical Engineering Lab (EE 1093)

#### Course Description:

This laboratory course is basically designed to impart essential practical knowledge of electronic devices and its associated circuits for 3rd semester undergraduate Electronics Engineering students. Hardware and Simulation experiments here are designed specifically for augmented learning . This will help students to understand and design various electronic circuits such as rectifiers, amplifiers and oscillators using discrete components like BJT/FET which are essential building blocks for any electronic system. Major equipment include function generator, CRO, multi-meter, Variac, voltmeter, ammeter, breadboard trainer kit and software's like Tina-TI, Lab VIEW and NI My DAQ v. 2016. A well-organized systematic procedure is included in each experiment to facilitate the hardware testing and simulation. This course imbues the students with necessary practical knowledge which will help them in making their minor and major undergraduate projects.

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

CO1: identify different discrete components, understand the function of Cathode Ray Oscilloscope, Function Generator & multi-meter and use these equipment for circuit related learning

CO2: explain and verify basic linear network theorems

CO3: plot and demonstrate the V-I characteristics of a P-N junction diode and the Zener diode

CO4: explain and analyze the input and output characteristics of BJT and JFET

CO5: design and simulate amplifier, oscillator circuits using BJT and JFET

CO6: formulate, design and implement different types of low frequency amplifiers and oscillator circuits using BJT/JFET to solve the real life engineering problems by executing mini projects

#### Topics:

- Basic linear network theorems
- P-N junction diode and Zener diode
- Transistors (BJT and JFET)
- CE amplifier and RC-coupled amplifier
- CS amplifier and CD amplifier
- LC and RC oscillators
- Open ended experiments

EC 2093          Digital Electronics Laboratory

Credit:            1  
Category:        PCLC  
Prerequisite(s): Nil

Course Description:

This lab is utilized by 3rd semester Electronics and Telecommunication Engineering, Electronics & Computer Science Engineering, Computer Science and System Engineering, Computer Science and Communication Engineering students. In this laboratory Analog to Digital converters, Digital to Analog converters, Lab designer Kits, Cathode Ray Oscilloscopes, Function generators and NI-MyRIO Kits are available . The DEC Lab is containing some Verilog simulation experiments along with the hardware implementation of simple digital circuits. Students do their experiments and open ended experiments in both hardware and software platforms. They use discrete components and Xilinx, PSpice, LabVIEW software to design and simulate the combinational and sequential logic circuits. This lab is also used by B. Tech and M. Tech students for executing projects.

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

- CO1: comprehend the significance of terminology associated with Verilog HDL and the procedure to Simulate and Verify combinational logic circuits in EDA Playground and TinkerCAD
- CO2: simulate and design combinational logic circuits like adder using Logic Gates in association with EDA Playground and TinkerCAD
- CO3: simulate and design combinational logic circuits like decoder using Logic Gates in association with EDA Playground and TinkerCAD.
- CO4: simulate and design combinational logic circuits like Multiplexer using Logic Gates in association with EDA Playground and TinkerCAD
- CO5: simulate and design sequential logic circuits of different Flip-Flops and Flip-Flop conversion in association with EDA Playground and TinkerCAD
- CO6: simulate and design sequential logic circuits like Synchronous type counter , Asynchronous type counters and shift registers using flip-flops in association with EDA Playground and TinkerCAD

Topics:

- Logic Gates
- 2-Line-to-4 line Decoder
- 2X1 Multiplexer
- J-K Flip-Flop and D Flip-flop
- 2-bit Synchronous Up Counter
- 2-bit Asynchronous Up Counter
- Serial In-Parallel Out(SIPO) Shift Register
- Open ended experiments

EC 2096          Digital and Linear Integrated Circuit Laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Analog Electronics (EC 2027), Electronic Circuits & Network Laboratory (EC 2091)

Course Description:

This laboratory includes analog to digital converters, digital to analog converters, lab designer kits, Cathode Ray Oscilloscopes, Function generators and NI-MyRIO Kits for different experiments. Verilog, Xilinx, LabVIEW, TinkerCAD and PSpice simulation experiments along with the hardware implementation of simple digital and analog circuits are performed in this laboratory.

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

CO1: comprehend the significance of terminology associated with Verilog HDL and the procedure to Simulate and Verify combinational logic circuits in EDA Playground and TinkerCAD

CO2: analyze and simulate combinational logic circuits like adder. using Logic Gates in association with EDA Playground and TinkerCAD

CO3: analyze and simulate combinational logic circuits like decoder using Logic Gates in association with EDA Playground and TinkerCAD

CO4: analyze and simulate sequential logic circuits like synchronous type counters and shift registers using flip-flops in association with EDA Playground and TinkerCAD

CO5: design and simulate the analog circuits like R-C differentiator circuit in association with TinkerCAD

CO6: design and simulate the analog circuits like practical Integrator and Comparator using operational amplifier IC LM 741 in association with TinkerCAD

Topics:

- Logic Gates
- Half Adder
- 2 Line- to- 4-Line Decoder
- 2 bit Synchronous Up Counter
- Serial In-Parallel Out(SIPO) Shift Register
- R-C Differentiator circuit
- Integrator circuit using Operational Amplifier IC LM 741
- Comparator circuit using Operational Amplifier IC LM 741
- Open ended experiments

EC 2098          Simulation Laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Principle of Signals and Systems (EC 2023), Mathematics-II (MA 1004)

Course Description:

This lab uses Matlab and LABVIEW platform to perform various experiments on generation and analysis of various signals and their behavior to solve different industrial and engineering problems.

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

CO1: comprehend the requirement and analyze the different types of signals using mathematical models in MATLAB

CO2: apply different control structures to find out the parameters of a signal like PSD, Amplitude etc.

CO3: simulate and find the transfer function for different circuits to observe the system behavior

CO4: comprehend, analyze and represent digital system design using graphical system methods in LabVIEW

CO5: explain and analyze and represent a system equation using MATLAB

CO6: solve different industrial and engineering problems

Topics:

- Basic familiarization to MATLAB Environment
- Control Flow- conditional and case structure, loop structure
- Finding Correlation and autocorrelation, ESD using MATLAB
- Numerical integration and differentiation using MATLAB
- Implementation of system transfer function and finding the damping factor and natural frequency
- Basic introduction to LabVIEW - Conversion of Celsius scale to Fahrenheit and vice-versa
- Control Flow- conditional and case structure, loop structure with graph and chart, File handling using LabVIEW
- Digital system implementation using LabVIEW
- Open Ended Experiments

EC 3007      Digital Signal Processing

Credit:      4

Category:    PCC

Prerequisite(s): Principle of Signals and Systems (EC2023), Signals and Networks (EC2021)

Course Description:

This course begins with the mathematical concepts behind digital processing. It includes implementation of signal processing techniques used in hardware and software systems. The course covers Discrete time signals and systems, Z transform, DFT, FFT and properties. The concepts of digital filter design, realization of systems, multi-rate signal processing and introduction to adaptive filters with their applications will be discussed.

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

CO1: determine and understand appropriate transformation technique for signal analysis

CO2: analyze the signal and its properties in its frequency domain

CO3: apply Fourier transform techniques in real time applications

CO4: apply the knowledge of analog filters to digital filters, design and realization of digital filter

CO5: design and implement multi-rate systems and filter banks

CO6: explain and apply the adaptive filtering concepts for system identification, channel equalization, noise cancellation and line enhancer

Topics:

- Fundamental of Signals and System & Z-Transform
- Fourier Transforms:
- DFT, IDFT and FFT
- Digital filters
- Multi-rate DSP
- Adaptive filters

Textbook(s):

1. Digital Signal Processing – J. G. Proakis & D. G. Manolakes, 4th edition – PHI
2. Digital Signal Processing – T. K. Rawat, Oxford University Press, 1st edition

Reference Book(s):

1. Digital Signal Processing – Oppenheim & Schaffer, PHI, 1st edition.
2. Digital Signal Processing – P. Ramesh Babu, Scitech Publication, 4th edition.

EC 3011          VLSI Design

Credit:            3

Category:        PCC

Prerequisite(s): Digital Electronics Circuits (EC 2011)

Course Description:

The VLSI design course introduces students to basic theories and techniques of digital VLSI design in CMOS technology, fabrication and layout techniques pertaining to digital integrated circuits domain. The course enables students to analyze and design different VLSI architectures using the fundamental concepts of digital VLSI systems. The domain specific skill sets include deep understanding of CMOS devices and circuits, CMOS design rules, static and dynamic logic structures, interconnect analysis and low power techniques in ultra-deep sub-micron regime.

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

CO1: understand and explain VLSI design flow, design strategy, role of different methods for chip design and basic fabrication process flow

CO2: analyze different components of threshold voltage, drain current and scaling strategy

CO3: evaluate different performance metrics of MOS inverter architecture

CO4: illustrate the logic design process used for complex combinational circuit and its layout using static CMOS

CO5: analyze different switch based logic involving pass transistor, complementary pass transistor and transmission gate

CO6: create different high performance dynamic CMOS logic

Topics:

- VLSI Methodologies
- Unit process in VLSI IC fabrication
- MOSFET Analysis
- CMOS Inverter and its analysis
- Transient characteristics
- CMOS logic design
- CMOS switch-based logic
- Dynamic Logic Circuit

Textbook(s):

1. CMOS digital integrated circuits by Sung –Mo KANG Y. Lebelec, 4th edition, Mc-Graw Hill publications

Reference Book(s):

1. CMOS Circuit Design, Layout, Simulation R. Jacob baker, Harry W. Li, David E Boyce, 4th edition, Wiley publications.

EC 3013 Principles of Digital Signal Processing

Credit: 3

Category: PEC

Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

This course begins with the mathematical concepts behind digital processing. It includes implementation of signal processing techniques used in hardware and software systems. The course covers Discrete time signals and systems, Z transform, DFT, FFT and properties. Techniques to design FIR and IIR filters are discussed.

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

CO1: comprehend the significance of terminology associated with various components of a digital system

CO2: analyze the different types of digital systems and linear convolution

CO3: analyze and apply the discrete Fourier transform (DFT)

CO4: solve Z-transform and apply it for discrete signals

CO5: analyze and apply the sectional convolutional methods

CO6: design digital filters using different techniques

Topics:

- Difference between analog and digital signals
- Types of digital systems
- Linear time invariant system
- Linear convolution
- Discrete Fourier transform (DFT) and its calculation
- Properties of DFT
- Circulation convolution and its significance
- Sectional convolution using overlap-add and overlap save methods
- Fast Fourier transform (FFT) algorithm for fast computation of DFT
- z-transform of digital signals and its applications
- Design of digital filters

Textbook(s):

1. Digital Signal Processing by T. K. Rawat, Oxford Publication 1 st Edition
2. Principle of Signal Processing and Linear System: B.P.Lathi, First Edition, Oxford University Press

Reference Book(s):

1. Digital Signal Processing – J.G.Proakis and D.G.Manolakis , 4th Edition-PHI
2. Signals & Systems: Alan V. Oppenheim & Schafer-2nd Edition 2011 Pearson
3. Digital Signal Processing: P. Ramesh Babu: Scitech,2nd Edition

EC 3015          Microwave Engineering

Credit:            3

Category:        PCC

Prerequisite(s): Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course is intended to describe the principles of operations and design aspects of microwave sources, devices and components. Course includes the propagation characteristics and design parameters of rectangular waveguide, circular waveguide and cavity resonator. Microwave amplifiers and sources like, Klystron amplifier, travelling wave tubes, Reflex Klystron, Magnetron oscillator, backward wave oscillator are part of this course. The operations of microwave solid state devices, like, Gunn diode, Gunn oscillator, PIN diode, READ diode, IMPATT diode and microwave components are described in the course. Different types of microwave measurement techniques are included in the course.

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

CO1: explain propagation characteristics and design parameters of rectangular waveguide, circular waveguide and cavity resonator

CO2: comprehend the limitations of conventional vacuum tubes at microwave frequencies

CO3: analyze the design aspects of Klystron amplifier and Reflex Klystron oscillators, and slow wave structures

CO4: explain and Analyze the operations of microwave solid state devices, like, Gunn diode, Gunn oscillator, PIN diode, READ diode, IMPATT diode

CO5: explain the principles of operation and design aspects of various types of microwave components

CO6: perform power measurements, frequency and impedance measurements, gain and radiation pattern measurement of antennas

Topics:

- Waveguide and Cavity Resonator
- Microwave Vacuum Type Amplifiers and Sources
- Microwave Solid State Devices & Sources
- Microwave Components
- Microwave Measurements

Textbook(s):

1. Microwave Devices & Circuits. S. Y. Liao, PEA Publication, 2009

Reference book(s):

1. Electromagnetic Waves and Radiating Systems by E. C. Jordan and K. G. Balmain, Prentice Hall of India, New Delhi.
2. Microwaves: Introduction to Circuits, Devices & Antennas. M. L. Sisodia and V. L. Gupta, New Age Publication, 2012.



EC 3021          Neural Networks and Machine Learning

Credit:            3

Category:        PEC

Prerequisite(s): Mathematics-I (MA 1003) and Mathematics-II (MA 1004)

Course Description:

This course will cover the history of neural networks, study the fundamental structures and state-of-the-art approaches to machine learning. The course will focus on theory and practice of these models, how they are trained and validated, and how they can be deployed in practice. Students will learn to design neural network architectures and training procedures via hands-on assignments. Students will learn how to use neural networks and machine learning algorithms for identifying, classifying and solving different problems related to pattern recognition, function approximation, data visualization etc.

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

CO1: understand the context of neural networks and develop broad overview of learning strategies

CO2: explain the fundamental neural network models, their learning strategies and apply them for modeling problems

CO3: analyze multi-layer feed forward neural networks, recurrent neural networks, radial basis functions and employ them for different applications

CO4: comprehend the concepts, architecture, training and testing algorithms of associative memory networks and Hopfield networks and apply them to evaluate practical problems

CO5: develop a comprehensive idea on unsupervised learning networks and advanced neural networks

CO6: explain the motivation for architectures and models and select the appropriate architecture for a given problem

Topics:

- Artificial neural network architecture
- Applications of neural networks
- Associative memory networks
- Unsupervised learning networks and advanced networks

Textbook(s):

1. Principles of Soft Computing by S. N. Sivanandam and S. N. Deepa - Wiley

Reference Book(s):

1. Neuro-fuzzy and soft computing by J. S. R. Jang, C. T. Sun and E. Mizutani - PHI Publications
2. Neural networks and learning machines by Simon Haykin - Parson, Prentice Hall

EC 3023          Optimization Techniques in Engineering

Credit:            3

Category:        PEC

Prerequisite(s): Mathematics-I (MA 1003) and Mathematics-II (MA 1004)

Course Description:

The objective of this course is to give exposure about the different optimization problems and related algorithms to the students. In this course, the students learn about single and multiple variable constrained optimization algorithms. The course includes formulation of optimal problems for real time applications, simple codes for implementing the same and demonstrates convergence with optimal results.

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

CO1: comprehend the need for optimization, formulate fitness/cost functions for simple problems and identify constraints involved (if any)

CO2: analyze the concepts behind single variable optimization algorithms

CO3: apply gradient based optimization algorithms for problem solving

CO4: comprehend the importance of multivariable optimization, different multi-variable optimization techniques and concept of Pareto-front

CO5: analyze the different techniques for constrained optimization algorithms and their applications

CO6: analyze and apply the algorithms for different nature inspired optimization algorithms

Topics:

- Optimal problem formulation, Design variables constraints, Objective function, Variable bounds,
- Engineering optimization problems, Optimization algorithms
- Single-variable Optimization Algorithm
- Gradient-based Methods
- Multivariable Optimization Algorithm
- Constrained Optimization Algorithm
- Advanced Optimization Algorithms

Textbook(s):

1. Optimization for Engineering Design-Algorithms & Examples – K. Deb, PHI, 2nd edition, 2012.
2. Multi-objective Optimization Using Evolutionary Algorithms-K. Deb, John Wiley & Sons, 1st edition,2001.

Reference Book(s):

1. Optimization: Theory and Applications - S.S. Rao, Wiley Eastern Ltd, 2nd edition, 1979.

EC 3028          Data Communication & Networking

Credit:          3

Category:        PCC

Prerequisite(s): Analog Communication Techniques (EC 2012), Digital Communication Technique (EC 3005), Communication Engineering (EC 2016), Introduction to communication Engineering (EC 3044)

Course Description:

Data Communication & Networking course deals with down-to-top approach to TCP/IP protocol stack, OSI layered architecture for packet switched data networks and the TCP/IP stack implements by focusing in details from Physical, Data-Link, Network, Transport, and Quality of Service (QoS) parameters. This course covers different key concepts of networking like physical media dependant layer, MAC, Flow Control, Error Control, IP addressing, Sub-netting, IPv4/ IPv6, Routing, DHCP, ARP, ICMP, NAT, TCP/UDP and QoS.

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

- CO1: analyze, compare and contrast OSI layered Architecture and TCP/IP protocol stack
- CO2: analyze different techniques and algorithms implemented in Logical Link Control (LLC) Media Access Control (MAC) sub-layers associated with data-link layer
- CO3: explain design scenario-specific datagram networks based on IPv4 and IPv6
- CO4: investigate various protocols associated with TCP/IP stack
- CO5: investigate connection-oriented (TCP) and connection-less (UDP) protocols in transport layers to comprehend design features and functionalities
- CO6: analyze data communication networks to differentiate various Quality of Service (QoS) approach

Topics:

- Packet switched network
- OSI Layered Architecture, TCP/IP protocol stack implementation
- Services of Physical Layer, Data-Link Layer
- Error detection and correction techniques, Framing, High level Data-Link Control (HDLC)
- Multiple Access Control (MAC) protocols, Link-Layer Addressing, ARP
- Ethernet IEEE 802.3 Standards Frame format, GIGABIT Ethernet, wireless LAN IEEE 802.11 Architecture, Network Layer
- IPv4 & IPv6 protocol, IPv4 Addressing, Sub-netting, Super-netting, IPv6 Addressing
- Routing Algorithms and protocols, DHCP, ICMP, NAT
- Transport Layer Services, TCP, UDP, QoS

Textbook(s):

1. Data Communications and Networking, B A Forouzan, McGraw-Hill, 4th Edition, 2011.
2. Computer Networking – A top-down approach featuring the Internet, James F. Kurose and Keith W. Ross, 2nd Edition, Pearson Education, Asia, 2004.

Reference Book(s):

1. Internetworking with TCP-IP: Principles, Protocols and Architecture, D. E. Comer, Vol I, 2nd Edition, Prentice Hall, 1991.
2. Data and Computer Communications, William Stalling, 10th edition, Prentice Hall, 2013.
3. Communication Networking – An analytical Approach, Anurag Kumar, D Manjunath and JoyKuri, Morgan Kaufmann, 2004

EC 3029          Optical Communication and Networking

Credit:          3

Category:        PEC

Prerequisite(s): Communication Engineering (EC 2016), Introduction to communication Engineering (EC 3044), Analog Communication Technique (EC 2012), Digital communication techniques (EC 3005)

Course Description:

The course intend to introduce the students to light signal propagation through optical fiber, various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and to study about various optical sources and optical detectors and their use in the optical communication system. This course provides a basic understanding of various measurement techniques used for optical communication system. The optical networking system is also explained with the concept of fiber optic network components, variety of networking aspects, topologies, FDDI, SONET/SDH and operational principles WDM.

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

CO1: comprehend the significance of terminology associated with optical communication, analyze the principle of light propagation through optical fiber with concept of modes and solve problems on this concept

CO2: analyze various types of losses and dispersions in optical fiber and solve related problems associated with the concept

CO3: explain and analyze the structure, principle of operation and the characteristics of optical sources and detectors

CO4: comprehend and analyze the optical communication system link elements and prepare link budget

CO5: comprehend various measurement techniques for optical communication system

CO6: comprehend and analyze the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM

Topics:

- Transmission characteristics of optical fibers
- Optical sources and detectors
- Optical Communication System and Measurements
- Optical measurements
- Optical networks

Textbook(s):

1. Fiber Optic Communications, Joseph C. Palais, Pearson Education, 5th Edition 2013
2. Optical Fiber Communication, Gerd Keiser, McGraw Hill, Third Edition, 2000.

Reference Book(s):

1. Optical Fiber Communication, John M. Senior, Pearson Education, Second Edition, 2007.
2. Optical Communication System, J. Gower, Prentice Hall of India, 2001.
3. Optical Networks, Rajiv Rama swami, Elsevier, Second Edition, , 2004.
4. Optical Communication Network, Viswanath Mukherjee, McGraw Hill Publication, 2000.

EC 3031          ARM and Advanced Processors

Credit:          3

Category:        PEC

Prerequisite(s): Microprocessors, Microcontrollers & Interfacing (EC 2020)

Course Description:

The objective of this course is to teach the higher level concepts of Advanced Microprocessors (like 80286, 80386, 80486 and Pentium) and Microcontroller (like ARM) to the students. In this course, the students learn about Multitasking, Virtual memory, Memory management, Paging, TLB, RISC features, Pipelining and Branch Prediction like concepts. They develop skills for writing programs on ARM to solve simple problems as well as some real time applications.

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

CO1: analyze the concepts implemented in higher level Processors like Multitasking, Virtual Memory, Memory Management etc.

CO2: analyze the mode of Operation of 80286 like Real Address Mode and Protected Virtual Address Mode, Concept of program in visible registers, Segment Descriptors etc.

CO3: explain the Mode of Operation of 80386, Segment Descriptors, Privilege level and Protection, Virtual'86 Mode, Paging

CO4: analyze the RISC features implemented in the design of Pentium Processors, Parallel processing through U&V Pipelines/Superscalar Execution and Branch Prediction Techniques

CO5: analyze the concept of a 32-bit ARM Processor, its RISC features, Registers, Pipelining and Interrupts

CO6: analyze the 32-bit ARM instruction set vis-a-vis 16-bit Thumb instructions and its applications

Topics:

- Intel higher level Processors, Concept of Multitasking, Virtual memory & Memory management
- Intel 80286 Microprocessor, Real mode, Protected virtual Address mode, Program Invisible Registers, Segment descriptor, Limitation of 80286
- Intel 80386 & 80486 , 80386 Segment descriptor, Privilege level & protection, Task switching, Virtual 86 mode, Paging, TLB, Enhanced features of 80486
- Pentium Processor: Features of RISC processors & Implementation of RISC features in Pentium, Pipelining, Super scalar execution & Branch prediction
- ARM Microcontroller: Introduction to RISC design philosophy and ARM design, Arm Processor Registers, CPSR, Memory map, Pipelines, Exceptions, Interrupt Vector Table
- ARM Instruction set and Thumb instructions

Textbook(s):

1. The 8088 and 8086 Microprocessors : Programming, Interfacing, Software, Hardware and Applications by Triebel and Singh-Pearson Education, 4th Edition.

Reference Book(s):

1. Microprocessors & Interfacing, Programming & Hardware by D.V. Hall-TMH-3rd Edition, 2012.
2. The Intel Microprocessors 8086/8088, 80186/80188, 80386, 80486, Pentium and Pro-Processor by B.B. Brey-PHI-8th Edition.
3. Microprocessors & Microcomputer based System Design by Md. Rafiquzzaman-UBS-2nd Edition.
4. An Introduction to the Intel Family of Microprocessors by James L. Antonakos-Pearson Education-3rd Edition.

5. ARM Assembly Language Programming &Architecture- M A Mazidi &others -  
[www.MicroDigital Ed.Com](http://www.MicroDigital Ed.Com).
6. ARM System Developers Guide Design &Optimizing System Software – Andrew N. Sloss  
&others-Elsevier

EC 3033          Embedded System Design and Application

Credit:            3

Category:        PEC

Prerequisite(s): Microprocessor, Microcontrollers and Interfacing (EC2020)

Course Description:

This course covers fundamentals of embedded system hardware and firmware design. Topics such as embedded processor selection, hardware/firmware partitioning, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051 and PIC18F series microcontroller with instructions will be studied. The course briefly covers ARM processor architecture, instruction set and programming. The course will culminate with a significant design examples using ARM processor.

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

CO1: understand the architecture, programming, and interface requirements of Embedded System Design

CO2: learn to apply assemblers, compilers, simulators and emulators to help with design and verification for ARM processors

CO3: create Interface of Microcontroller to displays, memories, different I/O ports

CO4: analyse and apply ALP / Embedded C code to solve real-time problems like timers, counters, A2D, Motors, etc. using ARM

CO5: understand and explain RTOS and its functionality, different scheduling for real time application

CO6: design closed and open embedded systems with firmware

Topics:

- Embedded system description and design aspects
- Processor and memory selection for embedded system
- Interrupt service and its uses in the embedded system design
- Embedded system design flow
- Embedded system programming concepts
- Brief introduction to 8051 and PIC18F series architecture and its instruction sets
- ARM architecture and its assembly language programming
- Designing hardware interface with ARM using embedded C programming
- Real Time Operating system and its scheduling

Textbook(s):

1. Embedded Systems: Architecture, Programming & Design, Raj Kamal, TMH, 2011
2. ARM Assembly Language: Fundamentals and Techniques by William Hohl, Christopher Hinds, CRC Press, 2nd Edition, 2015.

Reference Book(s):

1. Embedded System Design : A unified Hardware/Software Introduction by Rank Vahid, Wiley Student Edition, Wiley, 2002
2. Arm Assembly Language Programming & Architecture: Volume 1 by Muhammad Ali Mazidi, Sarmad Naimi, SepehrNaimi, Microdigitaled.com, 2nd Edition, 2016

EC 3035          High Speed Digital System Design

Credit:            3

Category:        PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This course describes the ASIC design flow and FPGA design flow. It also introduces different design methodology such as top-down and bottom-up methodologies. Here, students will learn different coding styles that can be used in Verilog HDL to design and synthesize digital circuits. Also, it is necessary to verify the correctness of the design by applying different input patterns. Therefore, students will also learn testbench writing strategies to verify the correctness of the design. Several examples that include important arithmetic units of digital systems are covered in this course which demonstrate how to design and test the digital circuits using Verilog HDL. In addition, the course discusses the mapping of Verilog HDL to logic gates. It depicts with examples how Verilog HDL constructs are transformed into logic gates and their interconnections. Finally, a brief introduction on how logic-level circuits are converted into transistor-level circuits is illustrated in this course.

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

CO1: comprehend and analyze the ASIC-based and FPGA-based design flow and VLSI design methodology

CO2: design digital systems using Hardware Description Language (HDL)

CO3: develop test cases to simulate and verify the correctness of the design

CO4: convert Hardware Description Language to a gate-level netlist

CO5: implement optimized digital circuits using different HDL-based mechanisms

CO6: design circuits by using knowledge of translating logic circuits to transistor-level circuits

Topics:

- Digital design methodology
- Coding styles of Verilog HDL
- Synthesis of logic circuits
- Mapping of logic circuits to transistor-level circuits
- Case studies for Verilog HDL

Textbook(s):

1. Verilog HDL: A Guide to Digital Design and Synthesis; Samir Palnitkar; 2nd edition, Pearson Education, 2011.

Reference Books (s) :

1. A System Verilog Primer by J. Bhaskar, BS Publication 2013.
2. Advanced Digital Design with the Verilog HDL; Michael D. Ciletti; 2009,1st edition, PHI,2010.
3. Design Through Verilog HDL by T. R. Padmanabhan (Author), B. Bala Tripura Sundari, Wiley Student Edition, Wiley, 2012.



EC 3044 Introduction to Communication Engineering

Credit: 3  
Category: OEC  
Prerequisite(s): Nil

Course Description:

The course covers different types of signals and their analysis in time domain and frequency domain, different analog modulation techniques such as Amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM). Sampling technique and its application in Pulse Code Modulation (PCM) is discussed. The course further discusses different digital modulation techniques such as Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) and Phase Shift Keying (PSK), Binary PSK and Quadrature PSK. Data transmission techniques such as frequency division multiplexing, time-division multiplexing and multiple access techniques are covered. Finally fundamentals of several modern communication system viz. satellite communication system, cellular system are explained.

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

- CO1: analyze signals in time domain and frequency domain
- CO2: interpret analog modulation techniques, investigate their limitations, advantages and applications
- CO3: explain sampling theorem and investigate pulse code modulation
- CO4: comprehend digital modulation techniques and multiplexing techniques
- CO5: interpret different types of noise, their sources and investigate their effect on communication systems
- CO6: analyze several modern communication systems

Topics:

- Representation of signals in time and frequency domains
- Understanding of Fourier series and Fourier Transform, Need of modulation and their types
- Amplitude modulation techniques such as AM, DSB-SC, SSB-SC, VSB
- AM modulators and demodulators, Super-heterodyne radio receiver
- Qualitative concepts of different angle modulation techniques such as FM (Narrowband FM and Wideband FM) and PM
- FM modulators and demodulators
- Sampling theorem and Nyquist rate, sampling types, quantization, Pulse code modulation
- Concept of digital modulation (ASK, FSK, PSK, QPSK) probability of error
- Frequency division multiplexing and Time division multiplexing
- Random processes, concept of noise, different types of noises and their sources
- Representation of white noise in frequency domain, concept of signal to noise ratio
- Introduction to satellite communication, wireless and mobile communication

Textbook(s):

1. Principles of Communication System- H. Taub and D.L. Schilling-TMH, 3rd Edition.

Reference Book(s):

1. Introduction to Analog and Digital Communication System-Simon Haykins, Wiley Student Edition 2011-John Wiley.
2. Electronics Communication System by Kennedy and Davis, Tata McGraw-Hill Publishing Company Limited, 4th Edition.

EC 3050            Internet of Things & Applications

Credit:            3

Category:        PEC

Prerequisite(s): Microprocessors, Microcontrollers & Interfacing (EC 2020), Principles of Microprocessors and Microcontrollers (EC 3066)

Course Description:

This course is designed to provide essence and applications of Internet of Things and connected devices. This course establishes solution for real-world applications including appropriate modules and instruments. It also describes the IoT industry, the technologies used to create these types of devices, working principles, information storage and the types of distributed networks required to sustain them.

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

- CO1: explain different characteristics of IoT and demonstrate the need of appropriate sensors, microprocessor and microcontroller units and communication networks to develop IoT systems
- CO2: identify application specific need of suitable sensors and actuators by analyzing the working of various sensors
- CO3: design and evaluate application specific IoT prototypes based on Arduino platform by means of hardware interfaces like Digital IO, Analog In, PWM, UART, SPI, I2C and applications using Arduino IDE
- CO4: design and evaluate application specific IoT prototypes based on Raspberry Pi Family development boards and develop small scale applications using python in Linux environment
- CO5: apply suitable TCP/IP protocols and networking standards for development of IoT projects
- CO6: design IoT application based on Client Server Model, HTTP, ThingSpeak, AWS, Cloud MQTT and evaluate the design specifications and requirements from case studies in the context of various IoT applications

Topics:

- Introduction & Overview of IoT.
- Sensors, Actuators & Signal Conditioning.
- Embedded Platforms & Prototyping (Arduino family and relevant topics)
- Advanced Embedded Development Platforms (PI family and relevant topics)
- Data Communication & Networking
- Cloud, Analytics, User interfaces
- IoT Applications and relevant case studies

Textbook(s):

1. "Internet of Things" by Jeeva Jose, 1st Edition-2018, Khanna Publications
2. "Internet of Things: A Hands-On Approach" by Arshdeep Bahga, Vijay Madiseti

Reference Book(s):

1. "Designing the Internet of Things" by Adrian McEwen, Hakim Cassimally, 1st Edition, Wiley Publishers
2. "Getting Started with the Internet of Things" by Cuno Pfister 1st Edition, O'Reilly Media.
3. "IoT: Building Arduino-Based Projects" by Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, 2016 Edition, Packt Publishing Ltd.
4. "Raspberry Pi IoT Projects: Prototyping Experiments for Makers" by John C. Shovic, 2016 Edition,

EC 3056      Speech & Audio Signal Processing

Credit:      3

Category:    PEC

Prerequisite(s): Digital Signal Processing (EC 3007), Principle of Digital Signal Processing (EC 3013)

Course Description:

The aim of this subject is to cover fundamental application research areas such as audio and speech signal processing for separation, recognition, transcription, enhancement, coding, synthesis as well as applications to advanced fixed and wireless communication systems. This course begins with preliminaries to digital signal processing and different transformations. Then the course continues to Speech production, Time domain analysis, Frequency domain analysis, LPC analysis, Speech coding, Speech recognition, Speech enhancement. Signal Processing Models of Audio Perception, Psycho-acoustic analysis, Spatial Audio Perception and rendering, Transform coding of digital audio, audio quality analysis are covered. Applications like speaker verification, identification and enhancement of speech quality are discussed.

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

CO1: determine the digital model of speech production

CO2: analyze the spectral characteristics of the speech signal

CO3: distinguish and analyze between different speech coding techniques

CO4: apply various types of algorithms for speech analysis and synthesis

CO5: design different models for speech recognition

CO6: develop to perform speaker verification, identification and enhance the quality of speech signal

Topics:

- Preliminaries of digital Signals processing and different transform techniques
- Digital modelling of speech signal
- Spectral analysis of speech signal
- Speech coding
- Speech transformation
- Speaker verification, identification and enhancement of speech signal

Textbook(s):

1. Lawrence R. Rabiner and Ronald W. Schafer, Theory and Applications of Digital Speech Processing Pearson, 2010.

Reference Book(s):

1. Thomas F. Quatieri , Discrete-time Speech Signal Processing: Principles and Practice, Prentice Hall, Signal Processing Series, 2002.
2. Philipos C. Loizou, Speech Enhancement – Theory and Practice, CRC Press, 2013.

EC 3058          Nanoelectronics

Credit:            3

Category:        PEC

Prerequisite(s): Electronics Devices and Circuits (EC 2019), Analog Electronic Circuits (EC 1004)

Course Description:

Nanoelectronics has emerged as a new advanced discipline due to rapid growth in Integrated Circuit (IC) Industry. This course imparts knowledge and understanding of physical background and application of nanoelectronics. To describe electrons at the nanoscale, the course starts with an introduction to the principles of quantum mechanics, including quantization, the wave-particle duality, wave functions and Schrödinger's equation. The course will further discuss different properties of materials and nanostructures, fabrication of nanostructures, nanoelectronic devices including resonant-tunneling devices, transistors, and single-electron transfer devices. The course will also focus on MEMS and NEMS and its applications in Sensors.

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

CO1: understand the basic and advanced concepts of nanoelectronics

CO2: understand and evaluate the use of fundamental science of quantum mechanics in nanoelectronics

CO3: get an idea on nanoelectronics materials and will be able to distinguish from other materials

CO4: analyze the different fabrication and characterization techniques of nanostructure materials

CO5: learn the concepts of few nano electronics devices

CO6: analyze and evaluate the idea of single electron transistors and its further applications

Topics:

- Introduction to Particles and waves
- Nanoelectronics Materials
- Tunnel junction and applications of tunnelling
- Growth, fabrication, and measurement techniques for nanostructures
- Nano structure devices: MEMS AND NEMS
- The Single-Electron Transistor

Textbook(s):

1. Stephen D. Sentaria, Microsystem Design, Kluwer Academic Press, 2005
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication, CRC Press, 2011.
3. T. Fukada & W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 1998

Reference Book(s):

1. WR Fahrner, Nano Technology and Nano Electronics – Materials, devices and measurement Techniques, Springer, 2004.

EC 3060      Mobile Communication Engineering

Credit:      3

Category:    PEC

Prerequisite(s): Communication Engineering (EC 2016), Introduction to communication Engg.(EC 3044)

Course Description:

The course covers the evolution of mobile communication from first generation to third generation digital communication. The concept of Frequency reuse, handoff, trunking and the interference between mobiles and base stations which are the core of mobile communication for providing service to the subscribers are explained in this course. This course also explains different type of propagation path loss, fading and modulation techniques used in mobile communication, Inter Symbol Interference (ISI) by multipath propagation within time dispersive channel and its mitigation technique by Equalizer. Implementation of different diversity techniques for the compensation of fading is elaborated here. This course also explains various type of multiple access techniques and impacts on capacity for a cellular architecture.

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

- CO1: define and explain basic Cellular Architecture, Different propagation models, various modulation schemes, multiple access schemes and GSM technology
- CO2: classify different generation of mobile communications and improvements, different types of Handoff Strategies, different types of System capacity Improvement Techniques , various fading in multipath propagation, Different modulation techniques, various diversity techniques and different type of multiplexing
- CO3: identify different parameters required to improve channel capacity, requirement of Handoff in mobile communication, reasons of Fading, development of transmitter and receiver using different modulation schemes and the requirement of multiplexing
- CO4: analyze improvements in different generation of mobile communications, the reason of considering cellular architecture, generation of ISI (Inter symbol Interference ) due to multipath propagation, different modulations e.g. QPSK, Offset QPSK,  $\pi/4$  QPSK, MSK, GMSK, QAM and spread spectrum modulation and its properties
- CO5: compare various technologies implemented among different generation of mobile communications
- CO6: solve problems related to different aspects of mobile communication

Topics:

- Mobile Communication Principle
- RF Propagation & Multi-path Model
- Modulation Techniques
- Equalization and Diversity Techniques
- Spread Spectrum modulation
- Multiple Access Techniques

Textbook(s):

1. Wireless Communication – T.S. Rappaport , Pearson Education, 2nd edition, 2012
2. Wireless Communication – Andrea Goldsmith, Cambridge Press, 1st edition, 2005

Reference Book(s):

1. Wireless and Cellular Communication – C. Y. Lee, McGraw Hill, 3rd edition, 2006
2. Mobile Communication – Schillar, Pearson Education, 2nd edition, 2010
3. Wireless Communication-Tse and Viswanath, Cambridge Press, 2010

EC 3066      Principle of Microprocessors and Microcontrollers

Credit:      3

Category:    PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This subject deals with Microprocessors 8085, 8086, 8255 PPI, 8259 PIC and 8251 USART and basics of 8051 Microcontroller. In this course, the students learn about assembly language programming on Microprocessors, Microcontrollers and develop programs for simple applications.

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

- CO1: understand and explain the concept of Bus structure, a basic 8 bit Microprocessor system
- CO2: explain the architecture of a 16 bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation technique
- CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems
- CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor
- CO5: explain the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16 bit processor
- CO6: analyze memory organization of a 8 bit Microcontroller (like 8051), its addressing modes, instructions

Topics:

- Semiconductor Memory Chips, Tristate Concept & Bus Structure, A Basic Microprocessor based system
- 8 bit Processor, Bus Structure, 8085 Microprocessor Architecture, Concept of stack, Instructions & Addressing Modes
- 8086 (16 bit Microprocessor) Architecture, Pins & Signals, Minimum & Maximum Mode Configuration, Timing Diagrams; 8086 Addressing Modes and Instructions, Memory Interfacing, Interrupts
- Interfacing chips : 8255 (PPI), 8259 (PIC), 8251 (USART)
- 8051 Family of Microcontrollers, Overview of MCS-51 Family of Microcontrollers Memory Organization Pins & Signals, Addressing Modes, 8051 Instruction set, Interrupts

Textbook(s):

1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall, McGraw Hill Education Pvt Ltd., 3rd Edition

Reference Book(s):

1. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd Edition
2. Advanced Microprocessor and Peripherals - Architecture, Programming and Interfacing by A. K. Ray and K. M. Bhurchandi - McGraw Hill Education Pvt Ltd - 3rd Edition.
3. 8051 Microcontroller - Hardware, Software & Applications - V Udayshankara & M. Mallikarjunswamy - TMH - 1st edition.

EC 3068      Real Time Systems and Application

Credit:            3  
Category:        PEC  
Prerequisite(s): Nil

Course Description:

This course covers the principles of real-time systems, modeling of a real-time system, task assignment and scheduling, resource management, real-time operating systems, RTOS services. Programming language with real-time support, system design techniques, inter task communication, fault tolerant techniques, reliability evaluation methods, performance analysis, and case studies of real-time systems applications are also covered.

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

- CO1: differentiate between a real time system and other systems
- CO2: identify the different parts of hardware needed for real time system
- CO3: analyse and design to interface a microprocessor to displays, memories, different I/O ports
- CO4: analyse and use RTOS for Real Time System design
- CO5: design and Evaluate the function of a real time System
- CO6: apply the knowledge to different real time System for solving engineering and social problems

Topics:

- Basic overview of Operating System
- Real Time concepts and hardware considerations.
- Real Time Operating Systems
- Software requirements and Design process
- Application of Real time systems
- Case study

Textbook(s):

1. Real-Time Systems Design and Analysis by Phillip A. Laplante John Wiley & Sons, Inc. Publication,3rd edition, 2011.

Reference Book(s):

1. Embedded and Real-Time Operating Systems by K.C. Wang, Springer, 2017
2. Real-Time Systems: Theory and Practice by Rajiv Mall, Pearson Publisher, 1st edition,2017

EC 3070      MANET and WSN

Credit:      3

Category:    PEC

Prerequisite(s): Communication Engineering (EC 2016)

Course Description:

The objective of the course is to provide the basic knowledge of MANET and WSN, identify and analyze the goals, challenges, protocols and the issues involved in designing and implementing MANET and WSN for providing a good quality of service.

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

CO1: comprehend the working and features of MANET

CO2: comprehend and explain the goals, challenges, protocols and issues involved in designing MANET and the quality of service required

CO3: comprehend the fundamentals of WSN

CO4: explain the working principles of physical layer of WSN

CO5: explain and analyze the different protocols, transport layer features and routing of WSN

CO6: identify the challenges in WSN and cross layer solutions

Topics:

- MANET
- MAC, routing and QoS in MANET
- Introduction to WSN
- Physical, MAC & Routing for WSN
- Challenges in WSN and cross layer solutions

Textbook(s):

1. C.Sivaraman Murthy and B.S.Manoj, “Ad Hoc Wireless Networks” , Person Education, Second Edition, India,2001
2. Ian F. Akyildiz and MehmetCan Varun, “Wireless Sensor Networks”, John Wiley and Sons Ltd, Publication 2010

Reference Book(s):

1. K Toh, “Adhoc mobile wireless networks, protocols and Systems”, 2nd Edition, Pearson Education,2009
2. Stefano Basangi, “ Mobile Adhoc Networking”, Wiley Inter science, IEEE Press, 2004
3. George Aggelou, “Mobile Adhoc Networks”, McGrawHill, 2004
4. Jun Zhny and Abbos Jama, “ Wireless Sensor Network - a networking perspective” 2009
5. C. Raghavendram, K.Sivalingam and T.Znati, “Wireless Sensor Network”,Springer,ISBN:1-4020-7883-8,August,2005



EC 3072          Introduction to Machine learning

Credit:            3  
Category:        PCC  
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the basics of machine learning algorithms which are pervasive in engineering applications. Students will be able to understand the essence and applications of various clustering and classification techniques. Further, they will understand how it can be applied in real world problems. Then, the course covers the detailed analysis on artificial neural network along with few ensemble methods.

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

- CO1: develop appreciation for various concepts involved in learning models
- CO2: comprehend a wide variety of learning algorithms
- CO3: analyze and evaluate ML models
- CO4: apply ML algorithms to real-world problems
- CO5: optimize the models and report on the expected accuracy
- CO6: comprehend the concepts of bagging and boosting

Topics:

- Foundations for ML
- Clustering
- Classification
- Artificial Neural Networks
- Ensembles methods

Textbook(s) :

1. Shai Shalev-Shwartz and Shai Ben-David “Understanding Machine Learning” Cambridge University Press. 2017.
2. Christopher Bishop “Pattern Recognition and Machine Learning” Springer. 2006.

Reference Book (s):

1. Neural Networks, C.M. Bishop, Oxford Press, 1995.
2. Machine Learning for Audio, Image and Video Analysis, F. Camastra, Vinciarelli, Springer, 2007.

EC 3074      Internet Technologies for Cloud & Edge Computing

Credit:      3

Category:    PEC

Prerequisite(s): Computer Programming (CS 1093)

Course Description:

The course objective is to introduce various aspects of internet, cloud computing and edge computing. Through this course student can learn about TCP/IP stack implementation for internet. The objective deals with analyses of cloud and edge applications and its requirement in the real world. Several tools for application specific cloud and edge computing models are discussed in this subject.

Course Outcomes: At the end of course the students will be able to:

CO1: comprehend the idea of TCP/IP stack implementation for application specific requirements of Internet

CO2: comprehend the cloud computing concepts and differentiate between different cloud based services

CO3: comprehend the design aspects of edge computing and analyze the application specific resource requirements

CO4: analyze various cloud & edge application design aspects and software technologies

CO5: evaluate the select tools for application specific cloud and edge computing models

CO6: design cloud and edge computing frameworks for scenario specific IoT applications

Topics:

- Cloud computing
- Edge Computing
- Feedback Concept
- Cloud & Edge application design aspects
- Application specific design aspects for IoT

Textbook(s):

1. Janakiram, "Grid and Cloud Computing", TMH, 2016
2. Shailendra Singh, "Cloud Computing", Oxford University Press, 2018

Reference Book(s):

1. Perry Lea, "IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security", 2nd Edition. Packt.
2. R. Buyya, C. Vecchiola and S. T. Selvi, Mastering Cloud Computing Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.
3. R. Buyya, S.N Srirama "Fog & Edge computing Principles & Paradigms": Wiley , 2019.
4. R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson education, 2008.

EC 3076      IoT & Cyber-Physical System Design

Credit:      3

Category:    PEC

Prerequisite(s): Internet of Things and its applications (EC 3050)

Course Description:

The course objective is to introduce the fundamentals of Internet of Things (IoT) and Cyber Physical System (CPS). This course covers identification and evaluation of different entities pertaining to IoT and CPS. This course enables student to model IoT and CPS in general. The course envisages discussing IoT and CPS components from the various perspectives including design, networking, communication protocols and standards. The course objective is to evaluate the highly complex infrastructure of CPS using several parameters such as security, privacy, integrity, reliability and resiliency. Different data analytics and platform have also been introduced in the course.

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

CO1: comprehend IoT and Cyber-Physical Systems components and design blocks

CO2: analyze IoT and Cyber-Physical Systems design issues and challenges

CO3: analyze Sensors, Actuators & Embedded System, Network & protocol design aspects and select appropriate components for designing IoT & Cyber-Physical Systems

CO4: evaluate the performance of various scenario specific requirements of IoT & Cyber-Physical Systems

CO5: evaluate and select appropriate computing & analytics platforms for IoT & Cyber-Physical Systems

CO6: design application specific IoT & Cyber-Physical Systems

Topics:

- IoT and CPS Design issues and challenges
- Sensors, Actuators & Embedded System design aspects
- Network & Protocol design aspects
- Computing platforms and Analytics
- Scenario specific applications of CPS

Textbook(s):

1. Complexity Challenges in Cyber Physical Systems, Saurabh Mittal, Andreas Tolk, Wiley.
2. Cyber-Physical Systems: A Computational Perspective, Gaddadevara Matt Siddesh, et. Al, CRC Press.
3. Scalable Computing and Communications: Theory and Practice, Samee U. Khan, et. al., Wiley-IEEE Press

Reference Book(s):

1. Principles of Cyber-Physical Systems, Rajeev Alur, the MIT Press.
2. Security and Privacy in Cyber-Physical Systems: Foundations, Principles, and Applications.
3. Data Analytics for IT Networks: Developing Innovative Use Cases, First Edition, John Garrett, CISCO press
4. Cyber-Physical Systems, Fei Hu, CRC Press

EC 3078      Signal Understanding Using Machine Learning

Credit:      3

Category:    PCC

Prerequisite(s): Signals and Networks (EC 2021)

Course Description:

This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition. It provides an introduction to computer vision including fundamentals of image formation, feature detection and matching, motion estimation and tracking, and classification. Foundations of pattern recognition algorithms and machines learning methods for feature selection, and classification based on supervised and unsupervised learning methods.

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

CO1: comprehend signal processing basics

CO2: apprehend supervised and unsupervised learning mechanisms

CO3: design machine learning models by using various mathematical tools

CO4: use machine learning models for audio & music processing applications

CO5: use machine learning models for image processing applications

CO6: apply machine learning methods in signal processing and communication

Topics:

- Basic of Machine learning Techniques
- Artificial Neural Networks
- Applications of ML for Audio, Music and Image Processing
- Deep Learning Models and its application for image and signal processing

Textbook(s) :

1. Pattern Recognition and Machine Learning, C.M. Bishop, 2nd Edition, Springer, 2011.
2. Deep Learning, I. Goodfellow, Y, Bengio, A. Courville MIT Press, 2016.
3. Automatic Speech Recognition: A Deep Learning Approach, D. Yu and L. Deng Springer, 2016.

EC 3095          VLSI Laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The prime objective of this laboratory is to provide a compact idea about recent trends in digital system design, ASIC design and FPGA based hardware design and implementations. The hardware description language (HDL) such as Verilog is used in this lab for FPGA programming. This lab provides exposure to CAD tools used in analog system design.

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

CO1: understand the basics of XILINX VIVADO tools and HDL for implementation of digital logic

CO2: implement different combinational circuits using different modeling style

CO3: implement sequential logic circuit such using Verilog HDL

CO4: analyze and implement of memory using Verilog

CO5: model finite state machines (FSM) using HDL and real time applications using HDL and FPGA

CO6: model of CMOS logic circuits using SPICE

Topics:

- Introduction to XILINX VIVADO tools and Verilog HDL, design flow
- Gate level and data flow modelling
- Behavioral modelling of sequential logic circuits
- Modelling of Finite state machines
- Modelling of memory
- Real time application: Traffic light controller design
- Design and SPICE simulation of MOSFET, CMOS inverter, NAND and NOR gates

EC 3099          Digital signal processing laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Digital signal processing (EC-3007)

Course Description:

This course is designed to teach implementation methods of various aspects related to digital signal processing on OCTAVE. It imparts the knowledge of discrete time LTI signals and systems and theoretical concepts are analyzed on software platforms. Design concepts on various kinds of filters based on the requirements and specifications are also covered. The implementation of basic concepts of multirate signal processing is also explained.

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

- CO1: apply the fundamentals of OCTAVE programming to simulate discrete time signals and systems and compute Circular convolution, linear convolution and correlation of discrete time signals
- CO2: find solution to the causal difference equations and compute step response and impulse response, compute transfer function, poles and zeros and determine stability of the system
- CO3: analyze the signal and its properties in its frequency domain using MATLAB Simulation environment. Use the Discrete time Fourier transform (DTFT) and Discrete Fourier Transform (DFT) in a variety of applications including: signal analysis, circular convolution and long data filtering
- CO4: design digital FIR low pass, high pass and band pass filters using OCTAVE after determining the required specifications for a given scenario
- CO5: design digital FIR low pass, high pass and band pass filters using OCTAVE after determining the required specifications for a given scenario
- CO6: design sampling rate converters, and analyze the effects of the change of sampling rate in the frequency spectrum of the signals

Topics:

- Analysis of an LTI system in time domain using OCTAVE
- Analysis of discrete time signals and system in frequency domain using DFT and DTFT in OCTAVE
- Design of FIR and IIR filters in OCTAVE
- Analysis of multirate signal processing using OCTAVE

EC 4059      Computer Vision & Pattern Recognition

Credit:      3

Category:    PEC

Prerequisite(s): Digital Image Processing (EC 6108)

Course Description:

This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition. It provides an introduction to computer vision including fundamentals of image formation, feature detection and matching, motion estimation and tracking, and classification. Foundations of pattern recognition algorithms and machines learning methods for feature selection, and classification based on supervised and unsupervised learning methods. We focus less on the machine learning aspect of CV and image classification as that is really classify the theory best learned in an ML course.

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

CO1: understand basic concepts, terminology, and theories in the field of computer vision

CO2: become familiar with the major technical approaches involved in computer vision

CO3: identify various approaches of computer vision and pattern recognition, and design the components for it

CO4: understand a wide variety of learning algorithm for pattern recognition

CO5: apply machine learning techniques to solve problems of image classification

CO6: exposure to advanced concepts leading to object categorization and segmentation in images

Topics:

- Introduction
- Motion Estimation
- Computer Vision
- Pattern Recognition
- Image Processing
- Segmentation
- Machine Learning Techniques
- Applications: Surveillance, Object detection, classification etc.

Textbook(s):

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Pattern Recognition and Machine Learning, B. Christopher Bishop, Springer, 2008

Reference Book(s):

1. Computer Vision: A modern Approach, David Forsyth and Jean Ponce, Prentice Hall India, 2004
2. Pattern Classification, Richard O. Duda, Peter E. Hart, and David G. Stork, 2nd edition, Wiley Asia, 2002.

EC 4061      AI and Machine Learning for IoT

Credit:      3

Category:    PEC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004), Internet of Things and its applications (EC 3050)

Course Description:

The course objective is to explain the data sciences including different types of data acquisition methods using IoT and to their statistical analysis. The course describes the fundamentals of machine learning, artificial intelligence, artificial neural network and deep learning. Understanding the rising importance of IoT it intends to design various IoT based applications using artificial intelligence and machine learning.

Course Outcomes: After completion of course, the students would be able to:

CO1: comprehend data acquisition using IoT and its analysis using mathematical and statistical tool using Machine learning approach

CO2: analyze & apply different techniques and algorithms used in machine learning like regression, clustering, classification & decision trees

CO3: analyze fundamentals of artificial neural network (ANN) techniques and apply it

CO4: analyze fundamentals of AI & deep learning techniques and apply it

CO5: analyze fundamentals of convolutional neural network (CNN) techniques and apply it

CO6: design application specific ML & AI modeling on data acquired through IoT & CPS for intelligent system design

Topics:

- Data science, AI and ML
- ML fundamentals
- Artificial Neural Networks
- Deep Learning
- Application of AI and ML for IoT

Textbook(s):

1. Understanding Machine Learning, Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2017.
2. Deep learning, Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, MIT Press, 2015.

Reference Book(s):

1. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2006.
2. Machine Learning, Tom Mitchell, McGraw Hill, 1997.



EC 4097          Machine Learning Laboratory

Credit:            1

Category:        PCC

Prerequisite(s): Introduction to Machine learning (EC 3072), Deep Learning (EC 3080)

Course Description:

Machine Learning is concerned with computer programs that automatically improve their performance through experience. This course covers the theory and practical algorithms for machine learning from a variety of perspectives. This laboratory introduces the Python software which is very helpful for implementation of machine learning and deep learning techniques. Familiarization of various important machine learning libraries such as NumPy, Pandas, Matplotlib and Keras will be done followed by implementation of clustering and classification problems using traditional machine learning techniques. Further, the lab covers the implementation of solving real life problems using deep learning techniques.

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

CO1: gain knowledge about basic functions of Python

CO2: identify various useful machine learning libraries

CO3: understand the implementation procedures for the machine learning algorithms

CO4: identify and apply machine learning algorithms to solve real world problems

CO5: analyze basic operation on data such as accessing, plotting etc.

CO6: design application using deep learning techniques for real-world problems

Topics:

- Python fundamentals
- Machine learning libraries: NumPy, Pandas, Matplotlib, Keras
- Basic operation such as data accessing, data manipulation, plotting etc.
- Implementation of classification using traditional machine learning techniques
- Clustering using different clustering techniques
- Implementation of classification using deep learning techniques

EC 4099      IoT & Connected Intelligent Systems Laboratory

Credit:      2

Category:    PCLC

Prerequisite(s): Internet of Things & its Applications (EC3050), Internet technologies for cloud and Edge Computing (EC 3074), Introduction to Machine Learning (EC 3072), AI & Machine Learning for IoT (EC 4061), IoT & Cyber-Physical System Design (EC 3076)

#### Course Description:

This laboratory is to provide hands-on exposure in IoT and AI-ML based connected-intelligent systems for industry readiness by bolstering the hands-on aspects of technical-Know-how and practical-skill in IoT & ML based a connected intelligent system that is highly demanded in industry. This lab deals with experiments on IoT-based intelligent systems design. Experiments on IoT-based system design using Embedded systems like NodeMCU, Raspberry Pi etc. along with the complete data communication framework based on TCP/IP protocol stack implementation for various application-specific intelligent connected sensors & actuators are covered. It also provides hands-on exposure to IoT and connected intelligent framework with protocols like MQTT/CoAP with sensor and application based device control technique with machine perception techniques (AI & ML) for scenario-specific application requirements of real-world engineering problems on Smart healthcare, smart city, smart home and smart sustainable IoT-based systems.

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

- CO1: design different application-specific sensor data acquisition for IoT-cloud using TCP/IP stack
- CO2: implement sensor-data acquisition system and intelligent actuator control application using cloud and MQTT protocol for intelligent IoT-based systems
- CO3: implement computing on Raspberry Pi and equivalent embedded development platform for intelligent IoT-based systems
- CO4: simulate appropriate Machine learning (ML) techniques on acquired sensor data for intelligent application-specific IoT-based systems
- CO5: design intelligent Machine perception technique on cloud data for intelligent IoT-based systems
- CO6: analyze of AI & ML based techniques on acquired IoT-based Sensor data

#### Topics:

- Data acquisition for IoT-cloud using TCP/IP stack using NodeMCU and Arduino IDE
- Application- sensor data for IoT-cloud using TCP/IP stack, and Raspberry Pi
- Intelligent actuator control application using cloud and MQTT
- Apply Machine learning (ML) techniques on acquired sensor data
- Analyze and implement of AI & ML based techniques on acquired IoT-based Sensor data and intelligent inference management and actuator control for application-specific requirements of real-world Smart healthcare application
- Implement of AI & ML based techniques on Sensor data and intelligent inference management and actuator control for application-specific requirements of real-world smart city, smart home and smart sustainable IoT-based systems
- Open Ended Design problems

EC 6108          Digital Image Processing

Credit:            3

Category:        PEC

Prerequisite(s): Digital Signal Processing (EC 3007), Introduction to Digital Signal Processing (EC 3013)

Course Description:

This course introduces the concept of Digital image formation, representation and processing of digital image using digital devices such as computers. The processing or manipulation of digital image is achieved via both spatial and frequency domain with an aim to improve pictorial information for better human interpretation, storage, transmission and representation. Towards this goal the course provides both basic and in-depth coverage of image processing techniques such as image enhancement, restoration, color image processing, compression, segmentation, morphological processing and different mathematical transforms.

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

CO1: analyze different image processing applications and learn different techniques to create and apply on digital image for better interpretations of an image

CO2: implement various enhancement and restoration techniques

CO3: explain and analyze the concept of color image processing

CO4: evaluate different image compression techniques for various applications

CO5: explain the concept of morphological operations and image segmentation

CO6: interpret the effect of applying different image transforms

Topics:

- Fundamentals of image processing
- Spatial domain methods of image enhancement
- Frequency domain methods of image enhancement
- Image degradation model and restoration via Inverse filter, Weiner filter and constrained least square approach
- Color image processing via different color models and inter conversion between them
- Different image transforms such as DFT, DCT, Hadamard, KL and SVD and its importance in processing of a digital image so that different types of redundancy can be overcome, hence an adequate of image compression can be occurred
- Morphological processing through dialation, erosion, opening and closing and discussion on few applications
- Region and edge based method of image segmentation and discussion on few applications
- Review of matrix algebra, 2-D convolution

Textbook(s) :

1. Digital Image Processing, R. C. Gonzalez and R. E. Woods, Prentice Hall, 3rd edition, 2008

Reference Book(s):

1. Fundamentals of Digital Image Processing, A.K. Jain, Prentice Hall
2. Digital Image Processing, S.Jayaraman, S. Esakkirajan, T. Veerakumar, TMH, 2009.
3. Digital image processing and Analysis, B. Chanda, D. Dutta Majumder, PHI, 2004.

EC 6112          Communication and Network Security

Credit:            3

Category:        PEC

Prerequisite(s): Data Communication and Networking (EC 3028)

Course Description:

This course is intended to explain various communication security attacks and counter mechanisms. Design and implementation of the security services and mechanisms are also covered.

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

CO1: analyze different security threats and attacks with reference to ISO/OSI model security

CO2: differentiate between various cryptography, watermarking, steganography methods

CO3: analyze different symmetric and asymmetric cryptographic algorithms

CO4: differentiate various key distribution and digital signature

CO5: analyze the working of various communication security protocols with respect to OSI layer

CO6: analyze different network security systems implementation in wireless systems

Topics:

- Ciphers & Algorithm
- Cryptographic Key distribution system
- Communication Security layer classification
- Network security

Textbook(s):

1. Cryptography & Network Security, B A Forouzan and D Mukhopadhyay, Mc-Graw Hill, India, 2nd edition, 2010.
2. Security of Information and Communication Network, S V. Kartalopoulos, Wiley-IEEE Press, 2009.

Reference Book(s):

1. Handbook of Information and Communication Security, Stavroulakis Peter, Springer, 2010.
2. Secure Broadcast communication in Wired and Wireless Communication, Adrian Perrig & Doug Tygar, Kluwer Publication, 2002.
3. Modern Cryptography: Theory and Practice, W Mao, Pearson Education, India, 1st edition, 2003.

EC 6122          Satellite Communication Systems

Credit:            3

Category:        PEC

Prerequisite(s): Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course offers basic concepts of satellite communication. The satellite subsystems, orbital parameters, orbital placement of satellites, LEO, MEO, GEO, and HEO satellite systems are also covered under this course. The satellite link budget preparation and various satellite communication applications are also explained.

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

CO1: comprehend basic parameters for satellite communication

CO2: explain satellite launching methods and orbital control mechanisms

CO3: comprehend different types of losses in satellite link and satellite link design

CO4: differentiate between different types of noises and interferences associated with satellite link

CO5: evaluate the stability of a satellite in orbit and different satellite sub-systems

CO6: investigate different types of multiple access techniques for digital satellite communication

Topics:

- Frequency spectrum for satellite communication, Types of orbits, Kepler's Laws of planetary motion, Orbital perturbations, Geostationary orbit, Satellite launching, General satellite communication, Block diagram uplink, Downlink frequencies, Types of modulation techniques used orbits, and altitude control Satellite launch vehicles - Arian, SLV space shuttle
- Signal loss on transmission through earth's atmosphere, Atmospheric losses, Ionospheric effects, Rain attenuation, Satellite link budget: Transmission losses, Interference, System noise temperature, Link power budget
- Antenna sub-systems, Altitude and orbit control sub-system, Power sub-system, Communication sub-system, TTC&M sub-systems
- Satellite application in TV, Internet, Mobile telephony, Receive only home TV, Master Antenna, TV, Low earth orbit satellite systems and uses. Multiple access techniques - FDMA, TDMA, SS-TDMA, Interference in FDMA systems

Textbook(s):

1. Satellite Communications, T. Pratt & C.W. Bostia, Wiley, 2003
2. Satellite Communication, D. Roddy, McGraw Hill, 2006

Reference Book(s) :

1. Digital Satellite Communications, T.T. Ha, McGraw Hill, 1990

EC 6224      Low power VLSI Design

Credit:      3

Category:    PEC

Prerequisite(s): VLSI Design

Course Description:

This course describes the factors that are responsible for power dissipation in MOSFET devices and circuits. It also teaches how to estimate the average and maximum power dissipations in a circuit. In addition, different design techniques to reduce the power dissipations in VLSI circuits are outlined in this course.

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

CO1: comprehend and analyze different MOS Logic circuits and power dissipation concept

CO2: differentiate and apply scaling techniques in different topology

CO3: optimize the power dissipation in CMOS circuits through switched capacitance minimization approach

CO4: optimize the power dissipation in CMOS circuits through different lower power minimization techniques in architecture level

CO5: optimize the power dissipation in CMOS circuits through different lower power minimization techniques in gate level

CO6: design different low power memory logic

Topics:

- Power dissipation and its types.
- Scaling methods.
- Switched capacitances.
- Leakage power optimization in architecture design.
- Leakage power optimization in design.
- Circuit level implementation for optimum performance

Textbook(s):

1. Low-Power CMOS VLSI Design, Kaushik Roy and Sharat C. Prasad, Wiley-India, 2011.
2. CMOS Digital Integrated Circuits, Sung-Mo Kang and Yusuf Leblebici, 3rd edition, TMH, 2011.

Reference Book(s):

1. CMOS VLSI Design: A circuits and Systems Perspective, West, Harris and Banerjee, 3rd edition, Pearson Education.
2. Low Power VLSI CMOS Circuit Design, A. Bellamour, and M. I. Elmasri, Kluwer Academic Press.
3. Low Power Digital CMOS Design, Anantha P. Chandrakasan and Robert W. Brodersen, Kluwer Academic Publishers, 2002.
4. Essentials of VLSI Circuits and Systems, Eshraghian, Puckness and Eshraghian, 2nd edition, Pearson Education.
5. Digital Integrated Circuits: A Design Perspective, J. M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, 2nd edition, PHI, 2001.

EE 2015          Electric Circuit Analysis

Credit:            3

Category:        PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Type of sources, Theorems, Analysis of circuit with one nonlinear network, Self and Mutual Inductance, Dot convention, Coupled circuits, Transient response for R-L, R-C and R-L-C circuits, Two port network configuration, Interconnection of two port networks, Concepts of graph theory and different incidence matrices, Design of low pass, high pass, band pass, and band elimination filter.

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

CO1: analyze different electrical circuits using network theorems

CO2: understand the magnetically coupled circuits.

CO3: apply time domain and Laplace Transforms for finding transient responses.

CO4: analyze various parameters of two port networks.

CO5: analyze the electrical circuits using network topology

CO6: design the filters for elimination of undesired signals.

Topics:

- Network Theorems
- Magnetic Coupled Circuits
- Transient Response
- Two-Port Networks
- Network Topology
- Filter

Textbook(s):

1. Network Analysis by M. E. Van Valkenburg, Pearson Education, 3<sup>rd</sup> Edition, 2006.
2. Networks and systems by D.Roy Choudhury, New Age Publication, 2<sup>nd</sup> Edition, June 2013.

Reference Book(s):

1. Circuits and Networks Analysis and Synthesis (2nd Edition) A Sudhakar Shyammoan and S Palli, McGraw-Hill, 5<sup>th</sup> Edition, 2011.
2. Basic Circuit Analysis (2nd Edition), John O'Malley, Schaum's Outlines, McGraw-Hill, 2010 (Reprint).
3. Fundamentals of Electric Circuits, Charles K. Alexander, Matthew N.O. Sadiku, McGraw Hill Education; 5 edition (1 July 2013).

EE 2017      Transformers and Induction Motors

Credit:            3

Category:        PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Construction, Principle of Operation of single phase and three phase transformer, different tests, Regulation, Losses and Efficiency, equivalent circuit and Parallel operation of Transformer. Three Phase Transformer Connections and vector group, parallel operation of three phase transformer, construction and operation of Three-phase induction motor, Equivalent Circuit, different tests and Phasor Diagram, Torque-Slip characteristics, Circle Diagram, Methods of starting and speed control methods.

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

CO1: remember the construction, principle, losses, efficiency and Phasor diagram of transformers and induction motors

CO2: explain the different tests to develop the equivalent circuit of transformer and induction motor

CO3: plan for the parallel operation of single phase and three phase transformers

CO4: compare different connections and conversions of three phase transformers

CO5: evaluate the performance characteristics, different methods of starting and speed control of three phase induction motors

CO6: discuss the construction and principle of operation of different single phase induction motors

Topics:

- Single Phase Transformer
- Three Phase Transformer
- Three Phase Induction Motor
- Single Phase Induction Motor

Textbook(s):

1. Electrical Machinery by P. S Bimbhra, 7<sup>th</sup> Edition, Khanna Publishers, 2008.
2. Electric Machines, by Kothari. D P and I J Nagrath, 3<sup>rd</sup> Edition, Tata McGraw-Hill, New Delhi. 2004.
3. Electric Machinery, by E. Fitzgerald, C. M. Kingsley (Jr) and S. D. Umans, Tata McGraw Hill, 6<sup>th</sup> Edition 2003.

Reference Book(s):

1. Electrical Machines by Ashfaq Hussain, Dhanpat Rai, Delhi, 2<sup>nd</sup> Edition, 2008.
2. Electrical Machines, by P. K. Mukharjee and S. Chakravorti, Danpat rai Publication, 2<sup>nd</sup> Edition, 18<sup>th</sup> reprint 2013.
3. Electrical Machines, by P. Purkait and I. Bandyopadhyay, Oxford University Press. 1<sup>st</sup> Edition, 2017.



EE 2020      D.C. Machines and Synchronous Machines

Credit:        3

Category:     PCC

Prerequisite(s): Transformers and Induction Motors (EE 2017)

Course Description:

Principle of operation, Types of DC Machines, Losses and Efficiency, Characteristics of different DC Machines, Speed control of DC Motor, Necessity of starters, Different testing methods, Principle of operation of synchronous generator, Phasor Diagram, Voltage Regulation, Method of Starting, Equivalent Circuit and Phasor diagram of synchronous motor, Construction of V curve and inverted V curves.

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

CO1: remember the Construction, principle and efficiency of synchronous machines and different DC machines

CO2: understand the armature reaction and characteristics of DC machines and Synchronous machines

CO3: apply phasor diagram to find the voltage regulation of a Synchronous generators

CO4: analyze the concepts of equivalent circuit and power flow diagram of synchronous motors

CO5: evaluate the V and the inverted V curves of synchronous motors

CO6: elaborate the power angle equations for the salient and cylindrical rotor synchronous motors

Topics:

- DC Generator
- DC Motor
- Synchronous Generator
- Three Phase Synchronous Motor

Textbook(s):

1. Electrical Machinery by P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Machines by P. Purkait and I. Bandyopadhyay, Oxford University Press, 1<sup>st</sup> Edition 2017.
3. Electric Machinery by E. Fitzgerald, C. M. Kingsley (Jr) and S. D. Umans, McGraw Hill, 6<sup>th</sup> Edition 2003.

Reference Book(s):

1. Electrical Machines by Ashfaq Hussain, Dhanpat Rai, Delhi, 2<sup>nd</sup> Edition, 2008.
2. Electric Machines by C. I. Hubert, , Pearson Education, 2<sup>nd</sup> Edition, 2003.
3. A Text Book of Electrical Technology, Vol. –II, AC and DC Machines, by B. L Theraja, A. K Theraja, S. Chand and Sons, 23<sup>rd</sup> Edition , 2006.

EE 2024            Generation, Transmission and Distribution of Electric Power

Credit:            4

Category:        PCC

Prerequisite(s): Electrical Circuit Analysis (EE 2015)

Course Description:

Generation of Electric Power from Thermal, Hydro and Nuclear Power plant, Calculation of Line constants, Analysis of short, medium and long Transmission Line, Ferranti effect, Surge Impedance Loading, Sag and Stress calculation, different Insulators, String Efficiency, corona, Types, construction and Grading of Cables, Classification of distribution system, Load curve, Load duration curve, different factors, Classification and types of Substation, Equipment used, Bus-bar arrangement.

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

- CO1: remember the operation of conventional generating stations
- CO2: outline the utility of the circuit parameters of transmission lines
- CO3: analyse the transmission line performance
- CO4: examine mechanical design of transmission line
- CO5: evaluate the performance analysis of different distribution system
- CO6: elaborate the economic aspects of power plants and components of substation

Topics:

- Generation of Electric Power
- Transmission of Electric power
- Line constants
- Performance of Transmission line
- Mechanical Design of over head transmission lines
- Corona
- Distribution Systems
- Economics Aspects and Substation

Textbook(s):

1. Electrical Power System, by C.L. Wadhwa, New Age International (P) Limited, Publishers, 7th Edition, 2009.
2. A Text Book on Power System Engineering, by A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., 2<sup>nd</sup> Edition, Reprint 2012.

Reference Book(s):

1. A Course in Power System, by J. B. Gupta, S K Kataria and Sons Publishers and Distributors, 2013<sup>th</sup> Edition, 2011.
2. Power System Analysis and Design, by B. R. Gupta, S. Chand Publications, 3rd Edition, Reprint, 2003.
3. Principle of Power System, by V.K.Mehta, S.Chand Publishers, 3<sup>rd</sup> Revised Edition 2012.
4. Elements of Power System Analysis, by W.D. Stevenson Jr, MGH, 4th Edition, 1982.
5. Overhead Power lines planning, design and construction, by F Kiessling, P Nefzger, J F Nolasco and U Kaintzyk, Springer- Verlag, 1<sup>st</sup> Edition.

EE 2028          Linear Control System

Credit:            3

Category:        PCC

Prerequisite(s): Analog Electronic Circuits (EE 2013), Signals and System (EE 2022)

Course Description:

Open loop and closed loop control system, Mathematical modeling of mechanical system and electrical system,

Transfer function from signal flow graph using Mason's gain formula, Time response of first and second order system, Minimization of Errors through P, PI and PID controllers, Routh- Hurwitz stability criterion, Construction of Root Locus and rules, Polar plots, Bode plots, Nyquist stability criterion, Concept of state, State variable, State model for LTI system, Lag, Lead and lag lead compensators.

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

CO1: recall the terminology of control systems

CO2: understand the mathematical model of physical systems

CO3: apply the concepts of time domain analysis of different systems

CO4: analyze the stability of a system by classical methods

CO5: analyze frequency domain response and different compensators

CO6: discuss about the state space modeling of different systems

Topics:

- Introduction to Control System
- Modeling of Physical System
- Time Domain Analysis
- Concept of Stability
- Root Locus Technique
- Frequency Domain Analysis
- Compensators
- State Space Analysis

Textbook(s):

1. Control System Engineering, by Noran S Nise, John Wiley Publication, 6<sup>th</sup> Edition, 2012.
2. Modern Control Engineering, by K. Ogata PHI publication, 5th Edition, 2010.

Reference Book(s):

1. Control Systems Engineering ,by R. Anandnatarajan and P. Ramesh Babu, SCITECH,4th edition, 2016.
2. Control Systems: Theory and applications, by Smarajit Ghosh, Pearson. Publication ,2<sup>nd</sup> Edition,2012
3. Automatic control system, by Hasan Saeed, S.K. Kataria and Sons, 6th revised edition 2008
4. Modern Control Engineering, by D. Roy Choudhury PHI publication, 5th Edition,2009.
5. Automatic Control Systems, by Benjamin C. Kuo, Prentice-Hall,7th Edition,2009.
6. Control System Engineering, by I. J. Nagrath and M Gopal ,New age international publication, 4th Edition,2011.
7. Control System, by D N Manik, Cengage Learning India Pvt, 1<sup>st</sup> Edition,2012.
8. Automatic control systems, by Prof. B.S. Manke and S. N. Verma , Khanna publication,5<sup>th</sup> Edition, 2012.

EE 2096      Electrical Machines Laboratory

Credit:          1.5

Category:        PCLC

Prerequisite(s): Basic Electrical Engineering Laboratory (EE 1093)

Course Description:

The main objective of the Electrical machines laboratory is to provide the practical exposure to the student regarding operation of various electrical machines like DC generators, DC Motors, Alternators, Synchronous motors, Induction Motors, Special Motors and Transformers. Students are allowed to conduct various experiments for the validation of performance characteristics of all the machines. From this laboratory courses student will gain the skill to select correct machine for a specific application.

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

CO1: memorize the working principle and applications of different electrical machines

CO2: understand the challenges in industrial applications of electric motors

CO3: utilize different electrical machines

CO4: analyse different electrical machine according to the requirement in the industrial applications.

CO5: assess the safety precautions to be taken while using electrical equipment

CO6: design the equivalent circuit of the transformer and construct the circle diagram of an induction motor

Topics:

- No Load and Load Characteristics of a (i) D.C Shunt Generator and (ii) Separately Excited Generator
- Design of the equivalent circuit by using the open circuit and short circuit test on a single phase Transformer
- Determination of the voltage regulation of a three phase alternator using the Open circuit and short circuit test
- Design of the circle diagram using the No load and Block rotor test on three phase induction motor

Textbook(s):

1. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Machines, by P. K. Mukherjee and S. Chakravorti, Dhanpat rai Publication, 18th reprint 2013

Reference Book(s):

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Technology, Volume -II. B. L. Theraja, S .Chand Publications. 2010.
3. Electric Machines, C. I. Hubert, , Pearson Education, 2003.
4. Electric Machines ,by Kothari. D P and I J Nagrath, , 3rd Edn, Tata McGraw-Hill, New Delhi. 2004.

EE 2098      Power Electronics Laboratory

Credit:            1.5

Category:        PCLC

Prerequisite(s): Basic Electrical Engineering Laboratory (EE 1093)

Course Description:

Utilities of Power Electronic Converters are introduced. The AC-DC converters are examined in details with R and RL loads. Analysis of DC-DC converters are done so that experimental verification can be facilitated. The principle of chopper is applied in the Fly-Back Converters for SMPS. The waveforms and the output voltage equation of SMPS are experimentally verified.

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

CO1: choose an appropriate converter for variety of needs

CO2: comprehend the principles of operation of various converters

CO3: apply AC-DC converters for rectification

CO4: analyze the parameters and the waveforms of the output of the converters

CO5: assess the efficacy of a converter

CO6: discuss about the merits and demerits of the converters

Topics:

- Study of output voltage waveforms and parameters of three phase uncontrolled rectifier
- Study of single phase fully controlled AC-DC converter with R and RL load
- Verify the performance of DC-DC Buck-Boost converters
- Verify the performance of Fly-Back Converters for SMPS

Textbook(s):

1. Power Electronics by M. H. Rashid, Pearson Education, 3rd Edition, 2009.
2. Elements of Power Electronics, by Philip T. Krein, Oxford University Press, 25 Sept 1997.
3. Power Electronics, by P S Bhimbra, Khanna Publishers, 5th Edition, 2011.

Reference Book(s):

1. Power Electronics, Converters, Applications and Design, by N. Mohan, Undeland and Robbins, John Wiley and Sons, 3rd Edition, 2009.
2. Modern Power Electronics by P. C Sen, S Chand Publisher- 2013.
3. Power Electronics, by K.R.Varmah and Chikku Abraham, Cengage Publications- 2014.
4. Power Electronics, by M. D. Singh and K.B. Khanchandani, Tata McGraw - Hill publishers, 2nd edition, 2008.

EE 3002          Power System Operation and Control

Credit:          4

Category:        PCC

Prerequisite(s): Generation, Transmission and Distribution of Electric Power (EE 2024), Linear Control System (EE 2028)

Course Description:

Bus classification, Nodal Admittance matrix, Formulation of load flow problem, Optimal operation of generators, Distribution of load on various generating units, Symmetrical components, Symmetrical and Unsymmetrical Fault analysis, Modeling of speed governing system, Steady state analysis, Dynamic response, Excitation system, Dynamics of synchronous machines, Swing equation, Equal area criterion, Effect of clearing time on stability.

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

CO1: understand the automatic generation control

CO2: classify different Power system faults

CO3: solve load flow problems

CO4: analyze economic operation of power system generation

CO5: apply various types of power system stability concept

CO6: elaborate the concepts of generation control and voltage control

Topics:

- Load Flow Analysis
- Economic Operation of Power Generation
- Symmetrical and Unsymmetrical Fault Analysis
- Automatic Generation and Voltage Control
- Stability Analysis

Textbook(s):

1. Modern Power System Analysis, I. J. Nagrath, D. P. Kothari, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 3<sup>rd</sup> Edition, 2003.
2. Power System Analysis- By John. J. Grainger & W. D. Stevenson, Jr., MGH, 2003 ,4<sup>th</sup> Edition, (15<sup>th</sup> Reprint).

Reference Book(s):

1. Power System Analysis by T K Nagsarkar and M S Sukhija, 1st Edition, Eighth impression 2012, Oxford University Press.
2. Power System Analysis Operation and Control, Abhijit Chakrabarti, Sunita Halder, Third Edition, 2010, PHI Learning Private Limited

EE 3006          Electric Drives and Control

Credit:            3

Category:        PEC

Prerequisite(s): DC Machines and Synchronous Machines (EE 2020), Power Electronics (EE 2026)

Course Description:

Four quadrant operation of an electric drive, Modification of characteristics of DC shunt and series motors, Concept of Electric Braking, Open loop, Closed loop speed control, Hysteresis controller, Chopper and rectifier based DC Separately excited motor and series motor drive control, characteristics of three phase Induction motors, Electric Braking of Induction Motors, Regenerative Braking, DC Dynamic braking, Plugging, Slip Power recovery scheme, PWM Voltage Source Inverter fed induction motor drives, Current source inverter fed induction motor drives, Comparison of VSI and CSI fed drives, Permanent magnet AC motor drives, Sinusoidal PMAC motor drives, Brushless DC motor Drives.

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

CO1: spell the need of Electric Drives in the industry

CO2: understand the characteristics and braking techniques of DC Motor Drives

CO3: apply the knowledge of drives for the Control of DC Motor Drives

CO4: analyze the characteristics of Induction Motor Drives

CO5: analyse the different speed control techniques for various industrial drives

CO6: discuss about the performance of Synchronous Motors and Brushless DC motor drives

Topics:

- Introduction to Electric Drive System
- D Motor Drives
- Control of DC Motor Drives
- Solid State Control of DC Drive
- Induction Motor Drives
- Speed Control of Induction Motors
- Synchronous and Brushless DC Motor Drives

Textbook(s):

1. G.K. Dubey, Fundamentals of Electric Drives, Second Edition, Narosa Publishers, 2007.
2. S. K. Pillai: A First Course on Electrical Drives, New Age International Publishers, 2nd Edition, 2007.

Reference Book(s):

1. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, Har/Cdr edition (13 September 2006).
2. N. K. De, P. K. Sen: Electric Drives, PHI Learning Pvt. Ltd., 7th Edition, 2004.
3. Modern Power Electronics and AC Drives by Bimal. K. Bose, PHI Publisher, 1st Edition, 2013.
4. S.A. Nasar, Boldea , Electrical Drives, CRC Press, Second Edition, 2006
5. M. A. El-Sharkawi , Fundamentals of Electrical Drives , Thomson Learning, 1st Edition, 2000.
6. R. Krishnan, Electrical Motor Drives, PHI, Second Edition ,

EE 3008          Power System Protection

Credit:            3

Category:        PCC

Prerequisite(s): Generation, Transmission and Distribution of Electric Power (EE 2024)

Course Description:

Philosophy of protection, Basic elements in protective scheme, Principle of AC and DC arc interruption, Recovery voltage, Re-striking voltage, Current chopping, Types of circuit breakers, Arc extinction methods, Principle, Characteristics of H.R.C fuse, Method of grounding, Differential protection scheme of alternator, Differential protection scheme of transformer, Differential scheme for Bus Bar Protection, Time graded feeder protection, Circulating current and Merz-Price protection, Surge diverters.

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

CO1: remember the need of protective devices in power system

CO2: explain the classification of different AC and DC Circuit Breakers

CO3: apply the knowledge of Circuit Breakers, protective Elements and Earthing for the Alternator Protection

CO4: analyze the practices of Transformer Protection and Bus Bar Protection

CO5: analyse the protection technique used for Feeder

CO6: discuss about the Surge Protection

Topics:

- Circuit Breakers
- Protective Elements
- Earthing
- Alternator Protection
- Transformer Protection
- Bus Bar Protection
- Feeder protection
- Pilot Wire Protection
- Protection against Surges

Textbook(s):

1. Fundamentals of Power System Protection”, Y. G. Paithankar, S. R. Bhide, 2<sup>nd</sup> edition, Prentice Hall of India Private Limited, New Delhi, 2011.
2. Power System Protection and Switchgear by B Rabindranath and M Chander , Wiley Eastern 2017, 2<sup>nd</sup> Edition.

Reference Book(s):

1. A Course in Power Systems, J. B. Gupta, S. K. Kataria and Sons Publishers and Distributors, 2013<sup>th</sup> Edition, 2009.
2. Principles of Relaying”, Van Warrington, Y. G. Paithankar. PHI, 1<sup>st</sup> Edition, 2009.
3. Power system Switchgear and Protection N.Veerappan and S R Krishnamurthy, S Chand Publication, 1<sup>st</sup> Revised edition 2013.
4. Power system Protection and Switchgear, Badri Ram and D N Vishwakarma McGraw Hill, 2<sup>nd</sup> reprint 2012
5. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited,, second Edition , 2009.



EE 3017            Renewable Energy Sources

Credit:            3

Category:        PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Classification and Importance of Non-Conventional Energy Sources, Solar Radiations Measurement, Solar Cell Characteristics, Solar Cell Classification, Maximum Power Point Tracker (MPPT), Wind Turbine Siting, Major Application of Wind Power, Wind Turbine Construction, Biomass Resources, Biomass Conversion Technologies, Urban Waste to Energy Conversion, Biomass Gasification, Liquefaction, Ethanol Production, Geothermal Energy, Types of Geothermal Resources, Exploration and Development of Geothermal Resources, Ocean Thermal Electric Conversion (OTEC) systems, Energy from tides, Limitation and scope of tidal energy, Wave energy conversion Devices, Principle of working of various types of fuel cells and their working, Performance and limitations, MHD generation principles.

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

CO1: define the fundamentals of Energy

CO2: explain the concept of Solar Thermal and Photovoltaic Systems

CO3: utilize Wind Energy Systems for the benefit of mankind

CO4: analyze Biomass Energy Resources

CO5: understand the operation of Geothermal Energy and Ocean Energy Systems

CO6: know the principles of Fuel Cells

Topics:

- Fundamentals of Energy
- Basics of Solar Energy, Solar Thermal and Photovoltaic Systems
- Basics of Solar Energy
- Wind and Biomass Energy
- Geothermal and Ocean Energy
- Fuel Cells

Textbook(s):

1. B. H. Khan, "Non – Conventional Energy Resources" Tata Mc Graw Hill, 2nd edition 2009.
2. N. K. Bansal, Manfred Kleemann, Michael Meliss, "Renewable energy sources and conversion technology", Tata Mc Graw Hill, 1<sup>st</sup> Edition, 1990.

Reference Book(s):

1. Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd, 2<sup>nd</sup> Edition, 2006.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 4th Edition 2000.
3. Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd, 1<sup>st</sup> Edition Reprint 2003.

EE 3035          Energy Storage Technology

Credit:            3

Category:        PEC

Prerequisite(s): Chemistry (CH 1007)

Course Description:

Energy availability, Demand and storage, Need for energy storage, Different types of energy storage, Comparison of energy storage technologies, Flywheel storage, Hydro storage, Thermal energy storage, Energy analysis of thermal energy storage, Solar energy and thermal energy storage, Battery fundamentals and technologies, Comparison of Lead-acid, Nickel-Metal hydride, Lithium Ion; Equivalent Circuit of an Electrochemical Cell, Charging and discharging operation of batteries, State-of-charge (SOC) of batteries, battery management systems, Hydrogen as energy carrier and storage, Fuel cells, Application of Energy Storage: Food preservation, Waste heat recovery, Solar energy storage: Greenhouse heating; Drying and heating for process industries.

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

CO1: remember different energy storage systems

CO2: understand the performance of different types of energy storage device

CO3: apply energy storage principles to different electrochemical system

CO4: analyze the principle of different types of fuel cell

CO5: solve the state of charge of batteries using different techniques

CO6: apply the energy storing devices to different types of industries

Topics:

- Energy Availability
- Mechanical, Thermal Energy Storage
- Electrochemical Energy Storage
- Fuel Cells

Textbook(s):

1. Huggins R. A., Energy Storage: Fundamentals, Materials and Applications, second edition, Springer International Publishing, 3<sup>rd</sup> Edition, 2015.
2. Dincer I., and Rosen M. A., Thermal Energy Storage: Systems and Applications, second edition, Wiley, 2011.

Reference Book(s):

1. Fuel Cell Fundamentals, O'Hayre R., Cha S., Colella W., and Prinz F. B., Wiley, Second Edition, 2009.
2. Chemical and Electrochemical Energy System, Narayan R. and Viswanathan B., Universities Press, (1998).
3. Battery Systems Engineering, Rahn C. D. and Wang C., First Edition, Wiley, 2013.
4. Electrochemical Energy Storage for Renewable Sources and Grid Balancing, Moseley P. T., and Garche J., Elsevier Science, 2014.
5. Compressed Air Energy Storage, Miller F. P., Vandome A. F., and John M. B., VDM Publishing, 2010.

EE 3038 Utilization of Electrical Power

Credit: 3

Category: PEC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Selection of motor capacity, Equivalent current, Torque and power methods, Various kinds of Tariff, Economics of Generation, Load duration curve, Effect of Load Factor, diversity Factor and power factor on tariff, Heating methods, Resistance Heating, Induction Heating, Dielectric Heating, Resistance furnace, Arc furnace, Welding methods, Resistance, Electric arc, Atomic hydrogen, Ultrasonic and Laser welding, Terminology in illumination, lamp efficiency, Polar curve, Laws of illumination, Co-efficient of utilization, Maintenance factor, Depreciation factor, Solid Angle, Types of Lamps, Arc Lamp, Incandescent lamp, Sodium vapor lamp, Mercury Vapor Lamp, Fluorescent Lamp, Neon Lamp, Types of Lighting Scheme, Faradays law of electrolysis.

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

CO1: remember the considerations for Selecting Motor Power Rating and Capacity

CO2: understand the formulation of Electric Tariff

CO3: apply the knowledge of electric power in the field of Electric Heating and Welding

CO4: analyze various techniques of Illumination

CO5: analyse various types of lamps

CO6: analyse the Electrolytic Processes

Topics:

- Motor power rating and selection
- Electric Tariff
- Electric Heating and Welding
- Illumination
- Electrolytic Processes

Textbook(s):

1. Generation, Distribution and Utilization of Electrical Power by C.L. Wadhwa, Wiley Eastern Ltd, New Delhi, 2<sup>nd</sup> Edition, 2012.
2. Utilization of Electrical Power and Electric Traction by J B Gupta, S K Kataria and Sons, Delhi, 2<sup>nd</sup> Edition, 2011.

Reference Book(s):

1. Art & Science of Utilization of Electrical Energy by H. Pratab, Dhanpat Rai & Co.(P) Ltd. 2<sup>nd</sup> Edition, 2013.
2. Utilization of Electric power by Er. R K Rajput, Lakshmi publications Pvt. Ltd, 1<sup>st</sup> Edition 2006.
3. Electrical Technology volume – III, by B L Thereja, A.K Thereja, S Chand Publisher, 2<sup>nd</sup> Edition, 2013.

EE 3048      HVDC and FACTS

Credit:        3

Category:     PEC

Prerequisite(s): Generation, Transmission and Distribution of Electric Power (EE 2024), Power Electronics (EE 2026)

Course Description:

Application of HVDC transmission, Choice of converter configuration, Analysis of a twelve pulse converter. Principles of DC Link control, System control hierarchy, Firing angle control, Current and extinction angle control, Power Control, Reactive power requirements in steady state, Conventional control strategies, Alternate control strategies, Sources of Reactive Power, harmonics and filters, Generation of harmonics, types of ac filters, Definition of FACTS, types of FACTS compensators. Principle of SVC scheme, FACTS based shunt compensators: TCR, TSC, STATCOM, FACTS based series compensators, Combined Series –shunt Compensator: Unified Power Flow Controller (UPFC).

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

- CO1: remember the introductory concepts of HVDC Transmission
- CO2: describe the control of HVDC transmission systems
- CO3: analyze the converter faults in HVDC transmission systems
- CO4: analyze the harmonic generation and elimination
- CO5: describe the application of FACTS devices in power system
- CO6: understand shunt and series compensation in a transmission system

Topics:

- HVDC Transmission
- HVDC System Control
- Reactive Power Control in HVDC
- FACTS Controllers and Shunt Compensation
- Principle of Series Compensation

Textbook(s):

1. “HVDC Power Transmission Systems – Technology and System Interactions”, K. R. Padiyar, Third Edition, New Age International Publishers, 2015.
2. “Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems” - Narain G. Hingorani, Laszlo Gyugyi-Wiley India publications 2011.

Reference Book(s):

1. Sang, Y.H. and John, A.T., Flexible AC Transmission Systems, IEEE Press (2006).
2. Ghosh, A. and Ledwich, G., Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers (2005).
3. FACTS Controllers in Power Transmission and Distribution", K. R. Padiyar, New Age International Publishers, 2007.

EE 3058      Energy Audit and Accounting

Credit:            3

Category:        PEC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Indian Energy scenario, Energy audit-need, Types of energy audit, Energy audit instruments, Energy Conservation schemes, Classification of furnace, Controlled atmosphere in furnace, furnace fuels, efficiency of energy in furnace, thermal efficiency, heat losses, Characteristic of prime movers, Resistance heating, Induction heating, arc Heating, dielectric and microwave atmosphere generators, Radiant heating, Lighting: Lamp lifetime, Efficient lighting, Cost of electrical Energy, Power factor improvement, Capacitor rating, sitting the capacitor, Effect of power factor improvement, Interest Rate, Inflation Rate, Tax Rate, Cash Flows, Break even charts, Compounding Factors, Payments, Present Worth, Rate of Return Benefit–Cost Ratio, Payback Period, Life-Cycle Cost Analysis Method, Economic Evaluation.

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

CO1: recall the need of energy audit

CO2: understand the concept of energy conservation and audit

CO3: apply the concept of accounting in energy audit

CO4: analyse the capacitor rating for power factor improvement

CO5: evaluate the energy efficiency of furnace & CHP System

CO6: create a report for an Economic Evaluation

Topics:

- General Aspects of Energy Audit
- Energy Utilization and Conversion System
- Economic Analysis

Textbook(s):

1. W.R. Murphy and G. McKay, “Energy management”, Butterworth & Co Publishers, Oxford, UK, 2001.
2. Energy Audit of Building systems: An Engineering approach, by: Moncefkrarti, CRC PRESS, Second Edition, 2009.

Reference Book(s):

1. A Workbook for Energy Management in building by: Tarik Al-Shemmeri, Wiley-Blackwell.
2. Energy audit: Thermal power, combined cycle, and co-generation plants, by: Y. Pabbi, TERI, 2011.
3. Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007) by WC Turner.
4. Bureau of Energy Efficiency (BEE) (2016); Study material for Energy managers and Auditors Examination: Paper I.

EE 3068      Power Converter Analysis and Design

Credit:      3

Category:    PEC

Prerequisite(s): Power Electronics (EE 2026)

Course Description:

Single phase Rectifier Circuit: L-C filter design, Non-isolated dc-dc converters: Design and operation of buck-boost, Cuk, SEPIC, Zeta in DCM and CCM, Operation of Flyback Converter, Forward Converter and push-pull Converters in CCM, Design of Magnetic Materials suitable for high frequency transformers, Difference between hard and soft switching, Resonant circuit concept; ZCS and ZVS resonant converters; Electronic Ballasts, Modulation Strategies: Bipolar and Unipolar switching scheme; Performance parameters of 3 phase Sinusoidal PWM Inverters; Harmonic reduction techniques, Multi-level inverters, Gate drive circuits for Thyristor, MOSFET, IGBT, BJT, GTO.

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

CO1: chose appropriate power electronics converters for different applications

CO2: understand the need of high frequency transformers and Inductors

CO3: apply the knowledge of convertors to the operation and application of inverters

CO4: describe resonant converter and SMPS in various industrial applications

CO5: know the power quality improvement strategies using power electronic converters

CO6: design the gate driver circuit for different semiconductor devices

Topics:

- AC to DC Converters
- DC to DC Converters
- Switch Mode Power Supply
- Resonant Converters
- Inverters
- Gate drive Circuits

Textbook(s):

1. Power Electronics By M.H. Rashid Pearson Education, 3rd Edition, 2009.
2. Power Electronics, Converters, Applications and Design, by N. Mohan, Underland and Robbins, John Wiely and Sons, 3rd Edition,2011.

Reference Book(s):

1. Power Electronics By M.D. Singh and K.B. Khanchandani, Tata McGraw - Hill publishers, 2nd edition, 2008.
2. Modern Power Electronics, by P.C Sen, Wheeler publishing Co, First Edition, 2009.
3. Elements of Power Electronics, by Philip T. Krein, Oxford University Press, 25 Sept 1997.

EE 3072          Computer Aided Power System

Credit:          3

Category:        PEC

Prerequisite(s): Power System Operation and Control (EE 3002)

Course Description:

Formation of  $Y_{bus}$  when regulating transformer present, Network matrices, Network graph, Basic Incidence matrices, Augmented matrices, Primitive networks, Network matrices by Singular and Non-singular transformation, Balance excitation, Un-balance excitation, Transformation matrices for symmetrical components, Incidence and network matrix for 3-phase elements, Formation of Z bus, Addition of branch, and link, Short circuit study of balanced network by  $Z_{bus}$ , LG fault, L-L fault, 3-ph fault with and without fault impedance, Problems. Load representation, Network performance equation, Swing equation, Machine equation, Solution techniques in transient stability study.

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

- CO1: formulate Bus admittance matrix during load flow study
- CO2: model power system components using graph theory
- CO3: understand the incidence and network matrix of 3-phase networks
- CO4: calculate the Bus impedance ( $Z_{bus}$ ) using algorithm
- CO5: analyze the different fault study of 3-phase network using  $Z_{bus}$
- CO6: know the solution methods for transient stability analysis

Topics:

- Load Flow Study using Computer Techniques
- Three Phase Networks
- Representation of Three Phase Elements in Short Circuit Study
- Transient stability Analysis

Textbook(s):

1. Computer Methods in Power System Analysis by Glenn W. Stagg, Ahmed H. El-Abiad, McGraw-Hill Book Company, International Editions, 2009.
2. Advanced Power System Analysis and Dynamics by L. P. Singh, New Age International (P) Limited, Publishers, Revised 4th Edition, 2011.

Reference Book(s):

1. Power System Analysis by N.V.Ramana, Pearson Publication, 2011
2. Computer application techniques in Power System by M.A.Pai, TMH, 2006.
3. Electric Vehicle Technology by James and John, John Wiley & Sons, Ltd First Edition, 2004

EE 3092      Power Systems Laboratory

Credit:            1.5

Category:        PCLC

Prerequisite(s): Network and Electronics circuit Laboratory (EE 2091)

#### Course Description:

The main objective of the Power Systems laboratory is primarily used for teaching power system basic and advance modelling of transformers, transmission lines, fault analysis, protective relays characteristics and its schematics. The Power Systems Laboratory is equipped with different Protection Scheme of Alternator, over Current Relay, over voltage relay, Percentage biased Differential Relay, Microcontroller based negative sequence relay, Transmission line simulator kit. From this laboratory courses student will gain the skill to analyse the performance of power system networks, study different power system protective relays & develop computer software programs for analysis of power systems.

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

CO1: spell the characteristics of a transmission line

CO2: comprehend the uses of different relays in power systems

CO3: apply suitable techniques to locate the fault of an underground cable

CO4: analyze the results of short circuit analysis for symmetrical and unsymmetrical faults

CO5: assess the characteristics of a solar PV module

CO6: discuss the procedural steps needed to implement for interpreting the results of the power system software

#### Topics:

- Determine the ABCD parameters of a transmission lines.
- Study of electromechanical type over current relay & over voltage relay
- Fault location of Under Ground Cable by Varley Loop Test
- Develop software programs for analysis of power systems

#### Textbook(s):

1. Modern Power System Analysis, I. J. Nagrath, D. P. Kothari, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 4<sup>th</sup> Edition 2013.
2. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2010.

#### Reference Book(s):

1. Power system analysis by Hadi Sadat Tata McGraw Hill.
2. Power System Protection and Switchgear by B Rabindranath and M Chander, Wiley Eastern (1977)
3. Fundamentals of Power System Protection”, Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011
4. A Text Book on Power System Engineering, A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., Reprint 2012



EE 3098          Control Laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Basic Electrical Engineering Laboratory (EE 1093)

Course Description:

The main objective of the Control laboratory is design of controllers for different systems. The Control Laboratory is equipped with different modules for DC position control, AC position Control, DC Motor Speed Control, Frequency Response Analysis, Time Response Analysis, Tuning of PID controller, Temperature Controller, Pressure Controller, Flow Rate Controller etc. From this laboratory courses student will gain the skill to evaluate the performance of PID controller with respect to changes in control parameters, study the effect of controllers on different electrical and mechanical systems, analyse the stability of designed controller and develop computer software programs for analysis of controllers.

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

CO1: remembers the modern software tools for feedback controllers

CO2: understand the iterative nature of a successful controller design

CO3: apply the theoretical concepts and computational tools while designing controllers

CO4: analyse the characteristics obtained by by varying the input parameters in a SIMULINK environment

CO5: evaluate the electrical and mechanical parameters of a given system and to find the transfer function

CO6: create new programs in MATLAB environment

Topics:

- Time response analysis of linear system
- Tuning of PID controller or a First Order Process with Time Delay (FOPTD) Simulated System by Process Reaction Curve Method
- Lead Compensator design
- Stability analysis using bode plot
- Stability analysis using root locus plot
- Design of Speed Controller for Armature controlled DC motor

Textbook(s):

1. Modern Control Engineering- By D. Roy Choudhury, PHI Publication, 5th Edition, 2009.
2. Control Systems- By Smarajit Ghosh, Pearson, Second Impression, 2013.

Reference Book(s):

1. Automatic Control System- By Hasan Saeed, Sixth Revised Edition, 2008
2. Modern Control Engineering- By K. Ogata, PHI publication, 5th edition 2010
3. Automatic Control Engineering- By B. C. Kuo , Prentice Hall, 7th edition 2009
4. Control System Engineering- By I. J. Nagrath and M. Gopal, New Age International Publication
5. Automatic control systems- By Prof. B.S. Manke & S.N.Verma ,Khanna publication, 2012.

EL 2002      Principle of Control Systems

Credit:            3

Category:        PCC

Prerequisite(s): Principle of Signals and Systems (EC 2023), Signals and Networks (EC 2021)

Course Description:

This course covers concepts of open- and closed-loop systems, mathematical modeling of physical system, transfer functions, signal flow graphs, feedback theory, time domain analysis, design specifications & performance indices. This course also deals with time response of 2nd order systems, stability analysis using Routh-Hurwitz criteria and root-locus methods, Nyquist plots, frequency responses, Proportional, PI, PID controllers and Lead-lag compensators.

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

CO1: comprehend open and closed loop control systems

CO2: compare various time domain specifications and describe their significance

CO3: explain the concept of P, PI and PID Controller

CO4: analyze stability using root locus and Routh stability criterion

CO5: determine the stability of the given control system by constructing Nyquist Plot

CO6: plot Bode plots for stability analysis and design lag, lead, lag-lead compensators based on its specifications

Topics:

- Mathematical modeling of physical system
- Feedback Theory
- Time domain analysis, design specification & performance indices
- Time response of Second order system
- Stability Criteria
- Frequency domain Analysis
- Cascade Compensation in Frequency Domain

Textbook(s):

1. Control System Engg, I. J. Nagrath & M. Gopal, New Age International (P) Ltd, 2nd edition, 1996.

Reference book(s):

1. Modern Control Engg, K. Ogata, PHI, 3rd edition, 1997.
2. Control Systems Engineering, Norman Nise, Wiley, 3rd Edition.
3. Automatic Control Systems, Benjamin C. Kuo, Prentice Hall.

EL 3022          Advance Control Systems

Credit:            3

Category:        PEC

Prerequisite(s): Principle of Control Systems (EL 3001)

Course Description:

This course is intended for undergraduate students of the Electronics and Control Systems Engineering and Electronics & Electrical Engineering programs. The course will help in forming a strong foundation for the broad areas of Advance control theory. It emphasizes on the basic concepts, lays stress on the fundamental principles and motivates their application to practical problems. Advance Control systems in this introductory course, we will start with the basics of Time and Frequency correlation. Subsequently, we will discuss the theory of Lead & Lag compensator, PID controller tuning, State space Analysis.

Finally, we will introduce the basics of Non linear systems, And Discrete control systems. Wherever possible, applications of the theory in real world scenarios have been provided.

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

CO1: comprehend the importance and design of lead compensator and lag compensator to practical systems

CO2: analyse the importance and design of PID controller and its tuning methods

CO3: analyse the importance of state space approach and realization of physical systems

CO4: apply the knowledge of controllability and observability to perform various tests for finding it

CO5: comprehend the importance of nonlinear elements and apply it to make nonlinear to linear and its stability methods

CO6: design discrete control system and its applications to analyze the real time processes

Topics:

- Cascade and feedback compensation
- Design of Lead, Lag Compensator
- PID controller Tuning
- Introduction to State Space Analysis
- Solution of State equations and State transition matrix
- Nonlinear Control Systems
- Discrete Control Systems

Textbook(s):

1. Control System Engg, J. Nagrath& M. Gopal, 3rdEdition, New Age International Publisher
2. Modern Control Engg., By K. Ogata, 3rdEdition, PH

Reference Book(s):

1. Discrete Time Control System, K. Ogata, 2ndEdition, Pearson Education

EL 3024          Industrial Automation and Control

Credit:            3

Category:        PEC

Prerequisite(s): Principle of Control System (EL 2002), Linear Control System (EE 2028)

Course Description:

The course discusses a wide range of topics for different types of sensors, actuator, and signal conditioning circuits. This course also discusses about the different types of controllers and its tuning technologies used in the industry. Different automation techniques like PLC including ladder programming, SCADA, DCS are also covered. Different advanced control techniques have also been discussed.

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

CO1: comprehend the working of sensors in signal conditioning circuits and actuators

CO2: determine the effect of gain constant on system performance

CO3: understand different components of PLC and design of the ladder logic

CO4: analyze DCS hardware, its merits/demerits in an industrial automation in comparison with PLC

CO5: analyze SCADA hardware-software and its merits/demerits in industrial automation in comparison with PLC and DCS

CO6: comprehend advanced control techniques

Topics:

- Sensors, Actuators and Signal conditioning
- Controller
- Automation
- PLC
- SCADA
- DCS
- Advanced control techniques

Textbook(s):

1. Computer-Based Industrial Control, Krishna Kant, 2nd edition Prentice Hall of India Ltd.
2. Chemical Process Control – Theory and Practice, Stephanopoulos, Prentice Hall of India Ltd, 1984.
3. Fundamentals of Industrial Instrumentation and Process Control, William C. Dunn, Tata McGraw Hill, 2009.

Reference Book(s):

1. Modern Automation Systems, Muhammad Abdelati, University Science Press, 2009.
2. Modern Control Engineering, 4th edition, Ogata, Prentice Hall of India

EL 3082          Minor Project

Credit:            2

Category:        PROJ

Course Description:

Students are required to undertake a minor project either as an individual or in a group in consultation with the project guide which may be completed in one semester. The project work is aligned with the discipline of the student and its allied areas. It is preferably related to certain research objective or advanced technical domain. Students will demonstrate higher level learning outcomes and cognitive skills in the implementation of the project.

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

CO1: perform a background study on certain technical aspect and formulate a project objective

CO2: outline a pathway for the implementation of the project within the time line

CO3: apply fundamental engineering concepts, advanced technical know-how, use modern engineering tools, perform experiments and critically analyze the data

CO4: provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices

CO6: communicate effectively with a range of audiences and prepare technical reports

EL 4081          Project-I

Credit:          3

Category:        PROJ

Course Description:

Students are required to undertake a final year major project either as an individual or in a group in consultation with the project guide which may be completed in one year. The project should be related to certain research objective or advanced technical domain. The work encompasses two semesters and to be carried out in two phases (Project-I and Project-II). In Project-I, students are expected to complete detailed literature review, identify their objective and start working on the same; perform experiments, carry out analyses and report their findings to their supervisors and the panel.

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

CO1: conduct a detailed research survey or background study and summarize the theory and findings

CO2: formulate a research question or a general objective of the project

CO3: propose and outline the solution to the research question or a pathway for the implementation of the project with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

CO4: conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices

CO6: communicate effectively with a range of audiences and prepare technical reports

EL 4082      Project-II

Credit:      10

Category:    PROJ

Course Description:

Project-II is a continuation of Project-I, the second phase of final year major project. Students should complete all related experiments, develop a final solution, product or system and validate the applicability of the same under real time scenario with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They produce a detailed technical report on their work as well as individual contribution reports. Throughout the implementation of the major final year project, students should demonstrate all cognitive skills and attainment of all program outcomes and student outcomes.

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

CO1: readily apply fundamental concepts in their area of study for executing the projects

CO2: demonstrate skill in using modern technical tools, apply advanced technical knowledge, integrate information from different sources, perform complex experiments and critically analyze the findings to draw conclusions

CO3: provide engineering solutions to predefined research question or project objective; design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

CO4: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices

CO5: communicate effectively with a range of audiences and prepare detailed technical reports

CO6: demonstrate knowledge and understanding of the management principles in executing their project as a member or leader of the team, and willingness to engage in life-long learning

## COURSES OF OTHER PROGRAMMES

CS 2001            Data Structures And Algorithms

Credit:            4

Category:        PCC

Pre-requisite(s): Computer Programming (CS 1093)

Course Description:

This course explores several fundamental algorithms and data structures of computer science. Some of the data structures include arrays, linked lists, stacks, queues, trees, heaps, hash tables, and graphs. Students also study and analyze algorithms for searching, traversing trees, hashing, sorting, finding shortest searching, and much more.

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

CO1: understand the concepts of data structure, data type, abstract data type (ADT) and compute the complexity of different algorithms

CO2: understand, distinguish and implement Array and Linked data structure on different types of problems

CO3: apply different linear data structures such as Stack and Queue to solve various problems

CO4: apply and Evaluate different non-linear data structures such as Tree and Graph on various computing problems

CO5: apply and Evaluate standard algorithms for searching, sorting and hashing

CO6: create the data structure that efficiently models the information in a problem

Topics:

- Introduction
- Arrays
- Linked List
- Stacks and Queues
- Trees
- Graphs
- Sorting
- Searching

Textbook(s):

1. Fundamentals of Data Structures in C, 2nd edition, Horowitz, Sahani, Anderson-Freed, Universities Press.

Reference Book(s):

1. Data Structures, Schaum's OutLines, Seymour Lipschutz, TATA McGRAW HILL
2. Data Structures using C by Aaron M. Tenenbaum, Yedidyah
3. Data Structures A Pseudocode Approach with C, 2nd Edition, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India Edition
4. Data Structures Using C, Second Edition, Reema Thereja, Oxford University Press
5. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education, 2nd Edition.



CS 2091            Data Structures Laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Computer Programming (CS 1093)

Course Description:

The data structure lab is to develop skills for the design, analysis and implementation of operations like search, insertion, deletion, traversal, and other specified problem definition on various linear and nonlinear data structures. It improves the ability to define, apply the appropriate data structure for the real world problem and various techniques for representation of the data in the real world. In addition, it helps them to gain knowledge of data structure applications related to industry.

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

CO1: understand the importance of structure, unions and abstract data type, and their basic usability in different applications through C programming language

CO2: analyze, differentiate and implement different algorithms based on their time and space complexity

CO3: understand and implement the linked implementation, and its uses both in linear and non-linear data structure

CO4: understand and implement various data structures such as stacks, queues, trees, graphs, etc. to solve various computing problems

CO5: understand and implement various kinds of searching and sorting techniques, and know when to choose which technique

CO6: decide and implement the suitable data structure and algorithm to solve a real world problem

Topics:

- Array, pointer with Dynamic Memory Allocation
- Structure, Single Linked List
- Doubly Linked List, Circular Linked List
- Polynomial Representation, Addition & Multiplication, Sparse Matrix Representation, Addition & Multiplication
- Stack
- More on Stack & Applications of Stack
- Queue
- Tree
- Graph
- Searching & Sorting

EI 2003            Electrical & Electronic Measurement Techniques

Credit:            3

Category:        PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

The objective of the course is to provide the basic knowledge of Instruments and Measurement techniques providing an in-depth understanding of errors in measurement techniques, Bridge measurements, Function Generator and Spectrum Analyzer, Display devices, watt meters, energy meters and analytical instruments.

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

CO1: comprehend and explain different measurement techniques and universal instruments

CO2: explain different measurement techniques for measuring the parameters of various electrical components

CO3: explain and analyze construction of instruments used for measuring current, voltage, frequency and spectrum

CO4: measure the power, energy and power factor using watt-meters and energy-meters

CO5: apply the CRO for various electronic measurements

CO6: analyze spectral analysis of the signals on spectrum analyzers

Topics:

- Introduction to instrumentation and measurements
- Classification and characteristics of Instruments.
- Overview of electrical and electronic measuring instruments
- DC and AC bridges
- Measurement of Power, Energy
- Function generator and Spectrum analyzer

Textbook(s):

1. A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Dhanpat Rai & Co, Reprint, 2013.
2. Modern Electronic Instrumentation and Measurement Techniques, Helfrick & Cooper, 2nd Edition, PHI.

Reference Book(s):

1. Electrical Measurements and Measuring Instruments, Golding & Widdis , 5th edition, Reem Publication.
2. Electronic Instrumentation, H S Kalsi, 3rd Edition, TMH.
3. Electronic Instrumentation &Measurements, David A. Bell, 3rd Edition, Oxford University press.
4. Elements of electronic instrumentation and measurement, Joseph J. Carr, 3rd Edition

EI 2012          Sensors & Signal Conditioning

Credit:            3

Category:        PCC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003)

Course Description:

The main aim of introducing this course is to provide the basic concept of instrumentation and its characteristics. It covers the details on identification, classification, construction, working and domestic as well as industrial applications of various transducers. The course also includes sensing principle for the measurement of motion, force, torque using analog, digital transducers and methods for signal conditioning and analysis.

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

CO1: comprehend the concept of various transducers , sensors and their brief performance specifications

CO2: analyze different types of errors in measurement and instrumentation

CO3: explain the principle of operation for various transducers used to measure temperature and pressure

CO4: explain the principle of operation for various transducers used to measure force, acceleration, displacement etc.

CO5: analyze various signal conditioning techniques

CO6: apply various transducers for domestic and industrial uses

Topics:

- Introduction to Sensor and Transducer
- Resistive Transducer
- Displacement transducer
- Proximity sensor
- Digital transducer
- Voltage generating transducer
- Magnetic type transducer
- Signal conditioning circuit
- Transducers for Miscellaneous measurement

Textbook(s):

1. Transducer & Instrumentation, MurthyDVS,2001,Prentice Hall of India.
2. Principle of Measurement Systems- J.P. Bentley 4th edition, Pearson education.

Reference Book(s):

1. Sensors & Transducers, Patranabis. D, 2003,PHI.
2. Introduction to Measurement and Instrumentation- AK.Ghosh, 2012, PHI.

EI 2095            Electrical & Electronic Measurements Laboratory

Credit:            1  
Category:        PCLC  
Prerequisite(s): Nil

Course Description:

In this E&EM laboratory, experiments will be conducted to measure different parameters such as strain, distance, temperature, level, resistance, inductance, capacitance etc.

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

CO1: calibrate the ammeters and voltmeters using DC potentiometer  
CO2: measure and analyze unknown electrical parameters such as medium and low resistances using DC bridges  
CO3: measure and analyze unknown electrical parameters such as capacitance and inductance using AC bridges  
CO4: measure the frequency of an unknown periodic signal  
CO5: determine the accurate quality factor of an unknown coil  
CO6: analyze and measure of 3-Phase power using 2-wattmeter method

Topics:

- Measurement of resistance using Wheatstone and Kelvin's double bridge
- Measurement of inductance using Maxwell's bridge, Hay's bridge
- Measurement of Capacitance using Schering's bridge
- Measurement of frequency using Wien's bridge
- Calibration of ammeter and voltmeter by using DC potentiometer
- Measurement of 3-Phase power using 2-wattmeter method

EI 3009            Instrumentation Measurement Techniques

Credit:            3

Category:        PCC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003)

Course Description:

This course deals with the construction and operating principles and applications to Industrial Instruments used for measurement of parameters like temperature, pressure, level, flow, viscosity & humidity and its safety precautions during process measurement.

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

CO1: explain and analyze the construction and working principle of Industrial Instruments for Temperature, Level, Pressure, Flow, Viscosity & Humidity

CO2: identify and explain sensor, transducer and their performance specifications for measurement of different process variables

CO3: apply different measurement techniques of instruments in industry

CO4: apply specific instruments for the measurement of different process variables

CO5: analyze the industrial application and calibration of Industrial Instruments

CO6: analyze the use of Industrial Instruments in hazardous locations

Topics:

- Temperature measurement
- Pressure Measurement (Gauge and vacuum)
- Level measurement, Flow measurement
- Viscosity, density, conductivity and humidity measurements
- Instrumentation in hazardous locations

Textbook(s):

1. Industrial Instrumentation & Control, S. K. Singh, 3rd Edition, TMH.
2. Industrial Instrumentation, K.Krishnaswamy, S.Vijayachitra, 2nd Edition, New age international.

Reference Book(s):

1. Instrument Engineers Handbook, Vol1, B.G Liptak, CRC Press
2. Measurement System Application and Design E.O Doebelin, 5th Edition, TMH

EI 3022          Bio-Medical Instrumentation

Credit:            3

Category:        PEC

Prerequisite(s): Chemistry (CH 1007)

Course Description:

This course focuses on the use of multiple sensors to monitor physiological characteristics of a human or animal. It involves measurement of biological signals like ECG, EMG, or any electrical signals generated in the human body.

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

CO1: identify various bio-medical signals and instruments

CO2: analyze various bio-medical transducers, sensors and their brief performance specifications

CO3: analyze the principle of various bio-medical instruments, transducers used to measure temperature, pressure

CO4: analyze the principle of various bio-medical instruments used to measure heart rate

CO5: differentiate between various bio-medical instruments

CO6: analyze applications of various bio-medical instruments in medical purposes

Topics:

- Biomedical Signals & Electrodes
- Blood pressure measurements
- Engineering analog of Heart
- X-ray imaging
- Computer aided tomography (CAT)
- Bio-telemetry
- Patient Safety

Textbook(s):

1. Hand Book of Biomedical Instrumentation- by R. S. Khandpur, 2nd Edition, Tata McGraw Hill.
2. Biomedical Instrumentation and Measurements- by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd Edition, PHI learning Pvt. Ltd.

Reference Book(s):

1. Introduction to Biomedical Equipment Technology- by Joseph J. Carr, John M. Brown, 4th Edition, Pearson Education.

EI 3023          Neural Network and Fuzzy Logic Control

Credit:          3

Category:        PEC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004), Control Systems (EL 3001)

Course Description:

This course is about Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems. Objective of this course is to impart adequate background knowledge so that in future students will be able to design and implement various machine learning algorithms in a range of real-world applications. The course covers learning based solutions for regression and classification, by using error minimization, concept of association, competitive learning, and fuzzy rule based methods. The course also covers applications of ANN and fuzzy logic for solving pattern recognition and control system.

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

CO1: analyze supervised and unsupervised learning for regression, classification and clustering

CO2: comprehend the concepts of feed forward neural networks

CO3: identify and describe appropriate Artificial Neural Network techniques in building intelligent machines

CO4: demonstrate the concept of fuzziness involved in various real world phenomena and need of fuzzy set theory

CO5: comprehend fuzzy rule based or expert system

CO6: analyze applications of Neural Network and Fuzzy logic in image processing

Topics:

- Introduction to Machine Learning
- Feed Forward Neural Network and Back-Propagation
- Pattern Association and Adaptive Resonance models
- Learning of ANN models based on Competition
- Fuzzy Set Theory and Fuzzy Membership
- Fuzzy-Inference-Systems
- Applications of Neural Network and Fuzzy Logic

Textbook(s):

1. Fundamentals of Neural Networks, Laurene Fausett, Pearson Education, 2004
2. Fuzzy Logic with Engineering Applications, Timothy Ross, McGraw-Hill, 1998

Reference Book(s):

1. Introduction to Neural Networks Using Matlab, Sivanandam , S. N , Sumathi, S. and Deepa, S. N, 2005, TMH.
2. Fundamentals of Artificial Neural Networks, Mohammad H. Hassoun, 1st edition, 2019, PHI
3. Neural Networks and Fuzzy Systems, Bark Kosko, 1st edition, PHI

EI 3024          Virtual Instrumentation

Credit:            3

Category:        PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This course provides the basic knowledge of PC based instrumentation systems and to develop concepts of designing virtual instruments along with its applications in various fields ranging from signal processing, image processing to motion control.

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

CO1: identify and explain the components of Virtual instrumentations and use them for PC Based Measurement

CO2: develop programming skills on application development software

CO3: simulate with LabVIEW software for instrument control, measurement, data acquisition and data handling

CO4: differentiate between different data acquisition techniques on virtual instrumentation

CO5: implement different controllers and conduct testing using industry standard software

CO6: differentiate between various Industrial network components and protocols

Topics:

- Sensors and Transducers
- PC Based Measurement
- Introduction to LabVIEW
- Organization of the LabVIEW system and software
- Program elements of LabVIEW
- Data Acquisition & Signal Conditioning
- Remote laboratory for Electrical experiments
- Examples of real time control and measurement applications
- Communication networked modules

Textbook(s):

1. Virtual Instrumentation Using LabView, Jerome, 1st Edition, PHI
2. LabView Graphical Programming, Gary W. Johnson, Richard Jennings, 4th Edition, TMH

Reference Book(s):

1. Practical Data Acquisition for Instrumentation and Control Systems, John Park and Steve Mackay, 2003, Newnes
2. LabVIEW based advanced instrumentation system, Psumathi, 1st edition,2007, Springer science Elsevier.



EI 3025          Principle of Analytical Instrumentation

Credit:            3

Category:        PEC

Prerequisite(s): Chemistry (CH 1007)

Course Description:

This course covers different types of Spectrophotometers such as Infrared Spectrophotometers, Flame Photometers with their instrumentation, Gas Chromatograph and Liquid Chromatography. It also deals with Spectrometers, Radiochemical Instruments and Pollution Monitoring Instruments.

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

CO1: differentiate between various techniques involved to determine the concentration of each component from a mixture

CO2: analyze methods to measure the pH level of a liquid using pH meters

CO3: comprehend different gas analyzers are used in industry

CO4: analyze the different spectrums using spectrometers

CO5: comprehend the operating principle of instruments used for radiation detection

CO6: analyze the operating principle of instruments used for pollution monitoring

Topics:

- Spectrophotometry
- Chromatography
- pH Meters and Ion Analyzers
- Analyzers
- Spectrometers
- Radiochemical Instruments
- Pollution Monitoring Instruments

Textbook(s):

1. Handbook of Analytical Instruments – by R.S. Khandpur, 2nd edition, TMH

Reference Book(s):

1. Instrumental Methods of Analysis, Hobart H. Willard, 2012, 7th edition, CBS publisher
2. Principles of Industrial Instrumentation, D. Patranabis, 3rd edition, TMH.

EI 3027            Industrial Instrumentation

Credit:            3  
Category:        PEC  
Prerequisite(s): Nil

Course Description:

This course is designed to improve knowledge and skills by providing a better understanding of process variables, control systems, sensors, transmitters, and more. It also provides the basic overview of power plant instrumentation and control techniques.

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

- CO1: explain sensor, transducer and their performance specifications for measurement of different process variable
- CO2: analyze the construction and working principle of instruments used in various industries for measurement of different process variables like Temperature, Level and Pressure
- CO3: analyze various instrumentation and control used in power plant
- CO4: identify appropriate analytical instrument for measuring, analyzing and establishing the composition of materials
- CO5: solve design problems of the power plant and its various control mechanisms
- CO6: perform measurements and control of turbine systems and its safety

Topics:

- Principles of various temperature, pressure, and level sensors used in industrial instrumentation.
- Analytical measurements.
- Basics of power plant instrumentation – water circuit, air-fuel circuit.
- Turbine monitoring and control

Textbook(s):

1. Power plant Instrumentation-K. Krishnaswamy, M. Ponnibala, 2nd edition, PHI publication
2. Industrial instrumentation & control, S. K. Singh, 3rd Edition, TMH publication.

Reference Book(s):

1. Instrument Engineers Handbook, Vol-1, B.G Liptak, CRC press.
2. Handbook of Analytical Instruments- by R. S. Khandpur, 2nd edition, TMH

EI 3029          Process Dynamics and Control

Credit:            3

Category:        PEC

Prerequisite(s): Principle of Control System (EL 2002)

Course Description:

This course covers the fundamental aspects of process dynamics and control, which includes developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects. The course deals with the development of models for control system design.

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

CO1: develop mathematical model and process

CO2: analyze dynamic behavior of different processes

CO3: design basic control schemes using hydraulic, electronic and pneumatic methods

CO4: tune PID controller to improve the performance

CO5: design various complex control schemes for SISO systems

CO6: design controller for multivariable processes

Topics:

- Process dynamics and modelling
- Dynamic response of processes
- Basic control schemes
- Controller tuning
- Complex control schemes
- Controller design for multivariable process

Textbook(s):

1. Process control: Principles and applications, Surekha Bhanot, Oxford,2008.

Reference Book(s):

1. Modern control engineering, K.Ogata, 5th edition, PHI
2. Process control, Dynamic concepts and applications, S.K.Singh, PHI,2007

EI 3030          Power Plant Instrumentation

Credit:            3  
Category:        PEC  
Prerequisite(s): Nil

Course Description:

This course provides a knowledge of the instruments that are used to measure and control the processes of electric power generation, processes of the generation of electricity from tradition fuel sources. The course covers an overview of power generation covering the various conventional and non-conventional energy sources , instrumentation and control of boilers and turbine monitor.

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

- CO1: comprehend various components of thermal power plants and their operations
- CO2: measure the water flow, steam flow and pressure in the water circuit
- CO3: design control schemes for the water circuit
- CO4: measure flow, pressure, temperature and level in air fuel circuit.
- CO5: measure electrical, mechanical and process turbine parameters
- CO6: design the control schemes for turbines

Topics:

- Overview of Power Generation
- Instrumentation and Control in Water Circuit
- Instrumentation and Control in Air-Fuel Circuit
- Turbine–Monitoring and Control

Textbook(s):

1. Power Plant Instrumentation – K.Krishnaswamy, M.Ponnibala, 2nd edition, PHI publications.
2. Power Plant Engineering - P.K Nag, 3rd edition, Tata McGraw-Hill.

Reference Book(s):

1. Standard Boiler Operations - S.M. Elonka and A.L Kohal, Tata McGraw-Hill.
2. Mechanical and Industrial Measurements - R.K Jain, 2008, Khanna Publishers.
3. Power Plant Engineering – EL. Wakil, Tata McGraw-Hill.

EI 3032          Principle of Sensors & Data Acquisition

Credit:          3

Category:        PEC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003), Principle of Measurement & Instrumentation (EI 2010)

Course Description:

The main aim of introducing the course is to demonstrate a critical understanding of elements of signal conditioning necessary for a number of sensors and transducers. This course includes operation of analog to digital and digital to analog converters. This course includes appropriate techniques and devices for realizing a data acquisition system and function of output drivers and devices also.

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

CO1: comprehend working principle of sensors & transducers

CO2: characterize and calibrate the sensors & transducers

CO3: comprehend the design of motion transducers used for measuring rotational displacement and velocity

CO4: understand the working of industrial automation systems such as PLC, SCADA

CO5: design amplifiers used for signal conditioning

CO6: understand the application of different data acquisition and conversion systems

Topics:

- Introduction to sensors and transducers
- Rotational displacements
- Rotational velocity
- PLC and SCADA
- Signal Conditioning
- Data acquisition systems
- Instrument calibration concepts

Textbook(s):

1. Electronics measurements and Instrumentation, R.K.Rajput, S.Chand, 2nd revised edition, 2011

Reference Book(s):

1. Digital control and state variable methods: Conventional and Intelligent control systems, M.Gopal, 4th edition, 2012.

EI 3091            Instrumentation Laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Basic Electrical Engineering (EE 1003), Analog Electronics (EC 2027)

Course Description:

This lab will deal with various sensors, their operations, different interfacing techniques with microcontrollers and use of LCDs for output.

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

CO1: analyze characterization of strain and force sensors

CO2: measure the level of fluid by capacitive transducers

CO3: design flow sensors for flow measurement

CO4: analyze characterization of temperature sensors

CO5: analyze characterization of the displacement, pressure sensors

CO6: interface sensors with micro-controller for precise measurement

Topics:

- Strain and force sensor
- Capacitive transducers
- Flow sensor
- Temperature sensors
- Displacement, pressure sensors
- Interfacing sensors with microcontroller for precise measurement

EI 3092          Process Control Laboratory

Credit:            1

Category:        PCLC

Prerequisite(s): Process Control (EI 3010)

Course Description:

Process control lab deals with automation(PLC/DCS) and different controllers(P, PI, PID) for understanding the characteristics and performance of the level, temperature and flow. PLC platform with HMI is also available through which different on-board applications like conveyor belt control, temperature control, dc motor speed control using ladder logic can be performed. Experiments on pc based level, pressure, flow, temperature loop stations with air compressor using digital PID controller are also conducted.

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

CO1: determine the characteristics of open and close loop systems using PID controller

CO2: apply the concepts of interacting and non-interacting liquid level system

CO3: apply the concepts of PLC, DCS & SCADA and its interfacing with real time system

CO4: control traffic light, water level in tank, speed of DC motor and control conveyor belt with PLC using ladder logic programming

CO5: obtain the response using P, PI & PID controller for a typical flow, level, pressure & temperature process station with air compressor

CO6: analyze the characteristics of control valve, I/p & P/I converter

Topics:

- Introduction to Basic Ladder Logic Programming
- Development of Ladder Logic Using Universal PLC Platform With HMI
- Hardware Verification of Open and Closed Loop Performances of Tank Filling Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Flow Rate Regulatory Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Heat Furnace Process Using E-906 PID Controller
- Hardware Verification of Level Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Flow Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Pressure Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Temperature Control Loop Performance Using Digital PID with Air Compressor

HS 2002      Engineering Economics

Credit:            3  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

The course on Engineering Economics is a specialized need-based extension of applied Economics which is aimed at developing an understanding of the principles governing Economy's vital parameters like market, finance, Production, consumption and distribution.. The course focuses on learning methodical and rational conceptualization and developing the knowledge for effectively implementing these market principles in actual organizational activities and forums. The course intends to develop the ability of taking decisions related to project selection and implementation, optimization of market vitals like sales, revenue, profit, cost etc. It serves as the base of learning all Economics related elective papers offered in higher semesters as well as preparation for any competitive exams like civil services, MAT etc.

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

- CO1: apply economic theory for optimisation of the economic variables of demand, supply, sales, profit, cost and revenue
- CO2: apply the budgeting principles in making economic decisions during project appraisals
- CO3: develop awareness towards all the economic issues related to the financial market, Budget, Money, Credit and Fiscal Policies etc.
- CO4: relate and apply theoretical concepts in Economics with contemporary/modern business practices
- CO5: understand the vitals of the financial market, know the source and methods of raising capital for an organization
- CO6: understand the depreciation of asset principles and efficient inventory/resource management

Topics:

- An Introduction to Economics and Engineering Economics
- Basic Concepts of Economics: Market equilibrium and Consumers and Producer's equilibrium
- Elasticity and Demand Forecasting
- Optimization of Profit and cost
- Break Even Analysis
- Evaluation of Projects: Economic Appraisal Techniques
- Depreciation calculation and Inventory management
- Vitals of Money and capital market

Textbook(s):

1. Managerial Economics: Principles and Worldwide Applications. Dominick Salvatore, Siddhartha K. Rastogi, 8th Edition, Pub. Oxford University Press. ISBN: 9780199467068.
2. Engineering Economics – James L. Riggs, David D. Bedworth and Sabah U. Randhawa, 4<sup>th</sup> Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2016.

Reference Book(s):

1. Principles of economics, Deviga Vengedasalam and Karunakaran Madhavan, Oxford University Press, New York, 3rd Edition, 2013.
2. Managerial Economics-Principles and Worldwide Applications-Dominick Salvatore, Adapted by Ravikesh Srivastava, 7<sup>th</sup> Edition, Oxford University Press, 2012.



3. Micro ECON-A South-Asian Perspective-by William A. McEachern and Simrit Kaur, Cengage Learning, 2013.
4. Engineering Economy-Zahid A. Khan, Arshad Noor Siddiquee, BrajeshKumar, Pearson Publication, 2012.
5. Engineering Economics – R.Panneerselvam, Pub: PHI Learning Private Limited, New Delhi, 9thEdition, 2008.

HS 2008          Economic Environment of India

Credit:            3  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

The Course on Economic Environment of India is designed to cater encompassing discernment of Indian Economy to the students. The course precisely highlights the role of different sectors in Indian economy and also touches upon the normative aspect of striking balance among different sectors. It covers the status of public economics in Indian context. Besides, it ensures the students to have knowledge on the role of foreign sector.

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

- CO1: develop the analytical understanding of the economic situation of the country
- CO2: develop the skill to interpret the economic indicators during steady growth path and economic crisis
- CO3: acknowledge the role of different policy making bodies in India related to economic affairs
- CO4: develop the ability to analyze the occupational structure of the country and sectoral contribution to growth
- CO5: examine the extent and role played by foreign sector in the form of exchange rate, FDI etc in the domestic economy
- CO6: develop a critical understanding of the fiscal position of the country

Topics:

- Economic Crises and Way out: Economic Crisis of early 1990s-Macro Economic Reforms since 1991
- Primary Sector and Secondary Sector: Agriculture during the Reform Period; New Industrial Policy
- Tertiary Sector and Foreign Sector: Service sector as the engine of growth in India; Trade reforms
- Public Finance: Fiscal reforms in India post 1991; Centre-State Fiscal relationship

Textbook(s):

1. Dutt and Sundaram. Indian Economy. latest edition.

Reference Book(s):

1. Uma Kapila (2019), Indian Economy since Independence, New Delhi, Academic Foundation.
2. Balakrishnan, P. (2010): 'Economic Growth in India: History and Prospect'. Oxford University Press, New Delhi.
3. Bhagwati Jagdish and Arvind Panagariya( 2012): ' India's Tryst with Destiny'. Collins Business, Noida, India.
4. Jean Dereze and Amartya Sen (1996): 'Indian Development: Selected Regional Perspectives'. Oxford University Press, New Delhi.
5. Ajijava Raychaudhuri and Prabir De (2012), International Trade in Services in India, New Delhi, Oxford University Press.

HS 2010          Financial Institutions, Markets and Regulations

Credit:            3  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

The course on Financial Institutions, Markets and Regulations is a specialized need-based extension of Financial Economics. This course is designed to present the fundamental concepts and theories in financial market and promote the application to the workplace and professional practice. It introduces current financial concepts and tools towards money management in organizations participating in the local and global economies. The course covers the current best practices in financial analysis and planning through the application of financial concepts in a nutshell. These include financial vitals relate to money and capital markets, time value of money, cost of capital, risks and return, long-term financial budgeting. In addition, the course also introduces topics on lease financing, hybrid securities and derivatives, trust funds, mergers and acquisitions and related issues in current financial sector.

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

- CO1: have comprehensive understanding of the nature and functions of the several types of financial institutions operating in the market
- CO2: develop critical skills in applying the principles of finance and financial inter-mediation to the real world situations
- CO3: effectively interact with the financial markets they need to approach for their future economic endeavors and/or in their place of employment
- CO4: make economic decisions and analysis of issues related to security market transactions and policies
- CO5: develop the understanding of the structure and functions of Indian financial institutions, instruments and policies
- CO6: take decisions regarding saving, investments, portfolio contents and diversification to maximize their return and reduce associated risks

Topics:

- Financial systems: Significance of banks and all other Financial institutions
- Financial Innovations
- Overview of Structure of Financial Debts and Equity markets
- Functions of Financial Intermediaries
- Monetary authority: Reserve Bank of India: Its role, structure and functioning
- Subprime crisis
- Derivative markets
- Capital market authority: structure and functions
- Regulation of Capital market, Role of SEBI

Textbook(s):

1. Madura, Jeff (2008), Financial Markets and Institutions, 8th edition, Thomson Publications.

Reference Book(s):

1. Fabozzi, Frank, Modigliani, Franco, Jones, Frank (Feb 2009), Foundations of Financial Markets.
2. Eakins, Stanley G. (2005), Financial Markets and Institutions (5th Edition), Addison Wesley.
3. Howells, Peter, Bain, Keith (2007), Financial Markets and Institutions, 5th Edition.

4. Barth, James R., Caprio, Gerard, and Levine, Ross (2008), *Bank Regulations are Changing: For Better or Worse?*, Association for Comparative Economic Studies.
5. Goldstein, Morris (2006), *Financial Regulation after the Subprime and Credit Crisis*, Washington: Peterson institute.

HS 2012      Development Economics

Credit:            3  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

The course on Development Economics is a specialized need-based extension of Economics dealing with issues related to economic growth and development. It provides an in depth discussion of the different economic description of development and underdevelopment. It will put a deep insight into the most challenging economic issues of poverty, inequality and underdevelopment faced by the humanity. It will deal with the various existing, modern and developing strategies and policies to tackle these issues and foster the economy onto the path of development. The students will be able to assess the pros and cons of a proposed development intervention and its likely impact on the target population.

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

- CO1: develop the understanding of issues related to economic growth and economic development
- CO2: relate and apply the major growth theories in their related academic projects
- CO3: develop the familiarity with major economic issues faced by the country like poverty, inequality, underdevelopment etc.
- CO4: analyse and compare the development paths adopted across countries of the globe
- CO5: analyse the empirical evidence on the pattern of growth and development
- CO6: develop critical understanding of the existing, adopted and needed policies and strategies for sustainable growth and development

Topics:

- Concepts and difference between growth and development.
- Measures of growth and development
- Models of growth and development
- Poverty and Inequality : Perceptions, estimation and measures of improvement
- Impact of poverty and inequality on growth and development
- Cross country perspectives of development

Textbook(s):

1. Todaro, M. P. & Smith, S. C. (2015), Economic Development, Pearson (12<sup>th</sup> Edition).
2. Thirlwall A. P. Growth and Development ( 6 th and 7 th edition)

Reference Book(s):

1. Debraj Ray : Development Economics
2. Meier and Rauch, : Leading Issues in Economic Development, OUP, Latest Edition
3. Kaushik Basu :Analytical Development Economics , OUP
4. Human Development Reports, various years
5. Bagchi A. K. The Political Economy of Underdevelopment, Cambridge University Press 1982.

HS 2081 Business Communication

Credit: 1  
Category: HSMC  
Prerequisite(s): Nil

Course Description:

This course is designed to give students a comprehensive view of communication, its scope and importance in business. This is an interactive course with a view to enhance language and soft skills with the aid of live demonstration within the framework of the syllabus. It is a foundation building measure to enable the students to excel in the corporate world and in day to day life.

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

- CO1: develop competence in reading and comprehension, develop skimming skills for extracting the main idea(s) from the text, and scanning for keywords
- CO2: enrich the fluency of the students with Collocations and Phrasal Verbs
- CO3: use Email effectively and efficiently as per the organization hierarchy. To retain a logical flow while drafting emails, make aware students about the importance of succinct written expression in modern Business Communication
- CO4: write standard and effective Cover Letters and Resume
- CO5: bridge the gap between native language and target language i.e. English, make students communicative competent and develop their fluency in public speaking
- CO6: prepare effective Power Point Slides. Maintain and arrange proper data structure in presentations. To learn skills of making effective presentation (verbal and non-verbal aspects)

Topics:

- Reading Comprehension – Activity based on BEC Training – Matching, Multiple Choice Questions, Open Close, Giving Appropriate Headings
- Collocation – Activity based on Word-Stock, Phrasal Verbs & Vocabulary Building
- E-mail – Activities based on Writing Appropriate Salutation, Paragraphs & Conclusion
- Resume Writing
- Thematic Discussions
- Speaking in Pairs – Everyday Activities & Detailed Introduction
- Activity based on PowerPoint Presentation

HS 3006          Entrepreneurship

Credit:            3

Category:        HSMC

Prerequisite(s): Nil

Course Description:

The course has been designed for the students in order to provide basic knowledge of an entrepreneur and opportunities for new entrepreneurship. To provide idea about various financial sources available for small and medium enterprise by different financial institutions. To provide knowledge how to manage working capital of an organization in an efficient manner. To have an idea about motivational tools for increasing the productivity of employees in an enterprise.

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

CO1: know the contribution of an entrepreneur in growth and development of socioeconomic condition of our country

CO2: understand the role of SSI units in growth and development of socioeconomic condition of our country

CO3: learn market survey, sales promotions and management of working capital through costing and book keeping

CO4: know different decision making technique and benefit of personal management system.

CO5: learn motivational methods of an enterprise

CO6: learn how to prepare a project report and knowledge about different tax system of an enterprise

Topics:

- Introduction to entrepreneurship
- SSI Units
- Market survey and research
- Marketing mix
- Financial management
- Working capital management
- Personnel management
- Motivation

Textbook(s):

1. Entrepreneurial Development, S.S.Khanka, S.Chand

Reference Book(s):

1. Industrial Organisation and Engg. Economics, Sharma & Banga, Khanna Publication
2. Entrepreneurship New Venture Creation, David H. Holt, Prentice Hall, PHI

HS 3008      Management Concepts And Practices

Credit:            3  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

The course curriculum is designed for student in order to provide fundamental knowledge in management area. The students will be able to know about general management concepts and various specialization in management area like marketing, finance, production and strategy management. The marketing management portion of the course will benefit the students to develop their career in marketing line, as most of the organisations give priority for marketing skills. Finance and production management will help the students in their respective domain and serve as a guide in their corporate career. The strategy management portion of this course will serve as a guide for the students to contribute in strategy formulation of the organization and how to achieve that strategy within a stipulated time period.

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

- CO1: perform the critical management functions effectively and develop ideas about implementing principles and theories of management in organizations efficiently
- CO2: develop various marketing skills in order to be successful in corporate world
- CO3: utilize different financial techniques for better management and control of organisational financial resources
- CO4: take strategic decision for day to day operation through proper working capital management.
- CO5: have competency in production planning as well as control measures will become easy in their professional career
- CO6: do strategy formulation of the organization and how to achieve that strategy within a stipulated time period

Topics:

- Introduction to management
- Marketing mix
- Market research
- Financial management
- Working capital management
- Production planning and control
- Inventory management
- Strategy management

Textbook(s):

1. Modern Business Organisation and Management. Sherlekar & Sherlekar, Himalaya Publishing House.
2. Business Organisation and Management. M. C. Shukla, S. Chand

Reference Book(s):

1. Principles & Practices of Management. L. M Prasad
2. A framework for marketing management, Philip Kotler
3. Financial Management. I. M Panday
4. Production and Operation Management, Everett E. Adam Jr. Ronald J. Ebert



HS 3002      Organisational Behaviour

Credit:            3  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

The course has been designed for the students to provide an understanding about the behaviour of individuals, groups and the system in the organization. The course will help the students how to develop personality and leadership style for achievement of individual and organizational objective. To know about the benefit of motivation for increasing individual and organizational productivity. To Provide knowledge to work in groups and develop techniques for group decision making for organizational development.

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

- CO1: know about organization, organizational behaviour its nature, scope and significance
- CO2: develop their personality as per industry requirement
- CO3: apply motivational techniques to make the employees work with confidence and satisfaction
- CO4: develop different leadership style to adjust themselves in different organizational situations
- CO5: improve the knowledge of group behaviour and techniques of group decision making
- CO6: apply the concepts for managing changes in organization as well as the development of an organization's human resources

Topics:

- Introduction to Organisation and organisational behaviour
- Personality
- Motivation
- Leadership
- Group dynamics
- Organisational change
- Organisational development

Textbook(s):

1. Organisational behaviour. Stephen P. Robbins, Timothy A. Judg, S. Sanghi, Pearson
2. Organizational Behaviour and Work, F. M. Wilson, Oxford University Press.

Reference Book(s):

1. Organizational Behaviour, Dipak Kumar Bhattacharya, Oxford University Press
2. ORGB, Organizational Behaviour, Nelson, Quick, Khandelwal, Cengage
3. Organisational Behaviour. Dr. S. S Khanka, S. Chand
4. Managing Organisational Behaviour, Moorhead & Griffin, Cengage Learning.

HS 3004          Human Resource Management

Credit:            3  
Category:        HSMC  
Prerequisite(s): Nil

Course Description:

The course has been designed in order to provide knowledge and idea about human resource management and how to become a professional human resource manager. It will help the students to follow different HR processes like recruitment, training, performance appraisal effectively in organizational level. The students will able to learn how to manage industrial dispute and develop industrial relation in corporate sector. The course will enable the students to understand the workers participation in management concept through employee discipline and the process of effective bargaining system in the organisation.

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

- CO1: develop personal and professional qualities of a manager in order to manage human resource of an organization effectively
- CO2: meet the human resource requirement of the organization for achieving its objective effectively
- CO3: follow different HR processes like recruitment, selection, training, performance appraisal effectively in organizational level
- CO4: inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives
- CO5: achieve strategic objectives of the organizations, by optimizing the potentiality of the human resource through workers participation in management
- CO6: know the technique of managing and being managed by the organisation

Topics:

- Human resource management
- Human resource planning
- Recruitment
- Selection
- Training
- Performance appraisal
- Industrial relation
- Industrial dispute
- Collective bargaining
- Workers participation in management

Textbook(s):

1. Human Resource Management, P. Jyoti & D. N. Venkatesh, Oxford Publication, 2016
2. Human Resource Management, B. Varkkey & G. Dessler, Pearson, 2017

Reference Book(s):

1. Human Resource Management. K. Aswathappa, Mc Graw Hill Education, 2013.
2. Human Resource Management. S. S. Khanka, S. Chand, 2019
3. Human Resource Management. P. Subba Rao, Himalaya Publishing House, 2018.

HS 4001 Professional Practice, Law and Ethics

Credit: 2  
Category: HSMC  
Prerequisite(s): Nil

Course Description:

The course on Professional Practice, Law and Ethics is designed to cater comprehensive insight of law and ethics to the students for practicing in their professional life. The course incisively highlights the role of morals and ethics in leading a sustainable profession. Besides, by containing different relevant laws like laws of contracts, intellectual property law and information technology law, the course provides foundation in law to the students which will help them a lot to face the real life situations with ease.

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

CO1: select appropriate engineering decisions in consideration of professional ethics in realization of more critical impact of engineering compared to general experiments

CO2: evaluate and prescribe risk reducing measures

CO3: comprehend the dynamics in engineers' roles and responsibilities with emerging issues in global scene

CO4: know the various compliance requirements and the regulatory bodies to protect environment

CO5: have a fair idea to protect their engineering inventions from unauthorized exploitation under intellectual property rights system and laws relating to information communication technologies

CO6: understand, analyze and prevent misuse of IT related transactions

Topics:

- Morals and ethics in engineering
- Engineering as social experimentation
- Engineer's responsibility for safety
- Global issues
- Law of contracts and law of torts
- Environmental laws
- Intellectual property law
- Information technology law

Textbook(s):

1. R. Subramaniam, Professional Ethics, Oxford University Press, 2013
2. Indian Contracts Act 1872
3. Patents Act 1970 (Unit-3)
4. Designs Act 2000 (Unit-3)
5. Information Technology Act 2000 (Unit-4)

Reference Book(s):

1. Mike Martin and Ronald Schinzinger, "Ethics in Engineering", McGraw Hill New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thomson Learning, 2000

HS 4003          Legal Issues and Requirements in Engineering

Credit:            1  
Category:        HSMC  
Prerequisite(s): Nil

Course description:

It depicts on law of contracts and law of torts, Consumer Protection Act 1986, Environmental Protection Act 1986, Environmental Impact Assessment 2006, standards for emission, discharge of environmental pollutants from various industries, Intellectual Property Law, Protecting engineering invention, the U.S Utility model approach and need for Utility model in India, Protecting Software and other engineering technologies in cyberspace, maintaining data security and technological privacy in Cyberspace, e-contracts, electronic and digital signatures.

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

- CO1: understand the various legal requirements in terms of contracts
- CO2: interpret the product liability which an engineer is required to take care while processing his engineering innovations
- CO3: illustrate the various compliance requirements and the regulatory bodies to protect the environment
- CO4: demonstrate to protect their engineering inventions from unauthorised exploitation under intellectual property rights system and laws relating to information communication technologies
- CO5: identify Legal Issues in a given case
- CO6: analyse and prevent misuse of IT related transactions

Topics:

- Law of contracts and law of torts
- Environmental Laws
- Intellectual Property Law
- Information Technology Law

Textbook(s):

1. Gurdeep Singh “Environmental Laws” Eastern Book Company, 2nd Edition 2016.
2. V K Ahuja “Law Relating To Intellectual Property Rights” Lexis Nexis, 3rd Edition. July 2017.
3. Pavan Duggal “Cyber Law”-Indian Perspective”. 2nd Edition 2016.
4. Avtar Singh” Law of Contracts” Eastern Book Company, 12th Edition, Reprinted 2020.
5. Dr. R K Bangia “Law of Torts”. Allahabad Law Agency; 24th 2019 edition (2019).

Reference Book(s):

1. Rosencranz “Environmental Law and policy in india”. Oxford University Press, 2001.
2. Howard b rockman “Intellectual Property Law for engineers and scinentists”. ISBN: 978-0-471-69740-4, Wiley-IEEE Press, June 2004.
3. Mireille Hidebrant “ smart technologies and the end of law”. ISBN: 978 1 78643 022 9.

MA 2009      Mathematics-III

Credit:        4  
Category:      BSC  
Prerequisite(s): Nil

Course Description:

Students are taught Partial differential equations based on the propagation of heat, wave etc to use in solving engineering problems. The concept of Complex analysis, Residual integration are included to get the knowledge on complex plane. Numerical analysis is included to get approximate solutions to difficult problems for which analytical solution is hard to obtain. Students are given common Probability and Statistical knowledge to use statistical analysis of data.

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

- CO1: solve the PDE problems by separable method, Laplace transform
- CO2: know Complex plane, Complex functions, their differentiation and integration
- CO3: find series expansion of complex functions and evaluate real integrals by residue method
- CO4: determine roots of algebraic/transcendental equations through Newton and Lagrange method and obtain interpolating Polynomials
- CO5: solve ODE numerically by single step and multi step method
- CO6: work out problems related to probability distribution and statistical regression and co- relation

Topics:

- Partial Differential Equation
- Complex Analysis
- Numerical Methods
- Probability

Textbook(s):

1. Advanced Engineering Mathematics(10th edition) by E. Kreyszig, Wiley.

Reference Book(s):

1. Engineering Mathematics by S. Pal and S.C. Bhunia, Oxford University Press.



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