Curriculum Structure & Syllabi

(As per National Education Policy 2020)

of

B. Tech.

in

(ELECTRONICS AND COMMUNICATION ENGINEERING)

(w.e.f. 2024-25)

Vision

Mission

Program Educational Objectives

Program Outcomes

Program Specific Outcomes

Overall Credit Structure

Curriculum

Syllabus

Offered By

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY
GORAKHPUR-273 010, UP, INDIA
JULY 2024

Department of Electronics and Communication Engineering

CURRICULA & SYLLABI

B. Tech. Electronics and Communication Engineering

Vision:

To become a leader of education, research and innovation in the area of Electronics and Communication Engineering and to train students to be innovative and well-prepared professionals in the area of Electronics and Communication Engineering.

Mission:

1. Educate and mentor students to meet the current as well as future challenges by providing them with a firm foundation in both theory and practice of Electronics and Communication Engineering.
2. Create, develop and disseminate new knowledge by top quality applied research in Electronics and Communication Engineering by interacting with government agencies and private industry.
3. Promote a sense of leadership and service to the society.

Program Educational Objectives (PEOs)

PEO-1: Excel in professional career and/or higher education by acquiring knowledge in area of Electronics and Communication Engineering.

PEO-2: Analyse real life problems, design appropriate system to provide solutions that are technically sound, economically feasible and socially acceptable.

PEO-3: Exhibit professionalism, ethical attitude, communication skills, teamwork in their profession and adapt to current trends by engaging in life-long learning.

Programs Outcomes (POs)

B.Tech. Electronics and Communication Engineering students will demonstrate the ability to:

PO-1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3 **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO-6 **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7 **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9 **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10 **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11 **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12 **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programs Specific Outcomes (PSOs)

PSO-1 An ability to understand the concepts of basic Electronics & Communication Engineering and to apply them to various areas like Signal processing, VLSI, Embedded systems, Communication Systems, Digital & Analog Devices, etc.

PSO-2 An ability to solve complex Electronics and Communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.

PSO-3 Wisdom of social and environmental awareness along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an entrepreneur.

SYLLABUS AND CREDIT STRUCTURE FOR B. TECH.
(ELECTRONICS AND COMMUNICATION ENGINEERING)
(SESSION 2024-2025 ONWARDS)
OVERALL CREDIT STRUCTURE FOR B.TECH.
(ELECTRONICS AND COMMUNICATION ENGINEERING)

<table>
<tr><th colspan="4">Credit Courses</th></tr>
<tr><th colspan="2">Core Courses (CC)</th><th colspan="2">Electives Courses (EC)</th></tr>
<tr><th>Category</th><th>Min. Credits</th><th>Category</th><th>Min. Credits</th></tr>
<tr><td>Basic Sciences & Maths (BSM)</td><td>20</td><td rowspan="3">Professional Electives (PE)/ Open Electives (OE)</td><td rowspan="3">36</td></tr>
<tr><td>Engineering Fundamentals (EF)</td><td rowspan="2">24</td></tr>
<tr><td>Professional Skill (PS)</td></tr>
<tr><td>Professional Core (PC)</td><td>48</td><td>Humanities & Social Science Elective (HSSE)</td><td>04</td></tr>
<tr><td>Management (M)</td><td>04</td><td></td><td></td></tr>
<tr><td>Humanities & Social Science (HSS)</td><td>08</td><td></td><td></td></tr>
<tr><td>Minor Project (P)</td><td>06</td><td></td><td></td></tr>
<tr><td>Industrial Practice (IP) (In Industry)/ Major Project (MP) (In University)</td><td>10</td><td></td><td></td></tr>
<tr><td>Sub-total</td><td>120</td><td>Sub-total</td><td>40</td></tr>
<tr><td>Grand Total</td><td>160</td><td colspan="2"></td></tr>
<tr><th colspan="4">Non-Credit Courses</th></tr>
<tr><td colspan="3">One Expert Lecture per semester for students (Mandatory).
(BSM-Ist year), (PC-2nd Year), (T&P-3rd Year)</td><td>Non-Credit</td></tr>
<tr><td colspan="3">Social work/Training of at least 60 hours during break after first/ second semester (Mandatory) (Dean of Extension, Field Outreach and Alumni Relations).</td><td>Non-Credit</td></tr>
<tr><td colspan="3">Industrial Training during the summer break after fourth semester (Mandatory).</td><td>Non-Credit</td></tr>
<tr><td colspan="3">One -week workshop during the winter break after fifth semester on professional/ industry/ Social/ entrepreneurial orientation (Mandatory) (Dean of Extension, Field Outreach and Alumni Relations).</td><td>Non-Credit</td></tr>
<tr><td colspan="3">Value Added Courses (VAC) / Audit Courses (AC)
Two of the Value-Added Courses / Audit Courses are compulsory.</td><td>Non-Credit</td></tr>
<tr><td colspan="3">Extracurricular Activities Courses (ECA)
Two compulsory courses from the following S. No (ii) to (v) non-credit courses:
(i) Induction Program (compulsory)</td><td>Non-Credit</td></tr>
</table>

(ii) Skill development (iii) Unity and Discipline (NCC or NSS) (iv) Sports, Cultural and Games (v) Personality Development	
Minor Degree (MD) from other Department and Micro Specializations (MS) from within the Department.	
• The total number of credits for graduation will be kept to a minimum of 160 and the additional 18-20 credits are required for Minor Degree. • Micro specializations will be run by the department in order to align to industry careers or higher studies.	Offered as a Professional Electives (PE)

DEPARTMENT OF (ELECTRONICS AND COMMUNICATION ENGINEERING)
MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY
GORAKHPUR-273 010, UP, INDIA
SEMESTER WISE CREDIT STRUCTURE FOR B.TECH.

(ELECTRONICS AND COMMUNICATION ENGINEERING)

Category/Semesters	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Basic Sciences & Maths (BSM)	8	8	0/4	4/0					**20***
Humanities & Social Science (HSS)	4	4							**08***
Humanities & Social Science Elective (HSSE)						4			**04***
Management (M)					4				**04***
Engineering Fundamentals (EF)	4	4	8/4	0/4					**16***
Professional Skill (PS)	4	4							**08***
Professional Core (PC)			12	12	12	12			**48***
Professional Electives (PE)/ Open Electives (OE)				4-8	28-32				**36***
Minor Project (P)						0	6		**06***
Industrial Practice (IP) (in Industry)/ Major Project (MP) (In University)								10	**10***
Total Credit	**20***	**20***	**20***	**20-24***	**16*-32***	**16*-32***	**6-30***	**10-30***	**160***
	80-84*				**76-80***				
Total Courses Offered	**05***	**05***	**05***	**05*-06***	**04*-08***	**04*-08***	**00-06***	**00-05***	**36***

**Minor variation is allowed as per need of the respective disciplines.*

First Year, Semester I

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-110	Engineering Mathematics - I	3	1	0	4
2.	BSM	BSM-140 / 190	Environmental Science and Green Chemistry	3	0	2	4
3.	EF	BEE- 110 / BEE-160	Basic Electrical Engineering	3	0	2	4
4.	PS	BEC-106	Electronic Components Testing and Measurement	2	0	4	4
5.	HSS	BHS- 102/152	Technical Writing and Professional Communication (TW&PC)	2	1	2	4
			Total	**13**	**2**	**10**	**20**
6.	ECA-I		Induction Program	-	-	-	0

 # Group-1: CSE, IT, CH, CE; Group-2: ECE, ECE(IOT), ME, EE

First Year, Semester II

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-160	Engineering Mathematics - II	3	1	0	4
2.	BSM	BEC-131 / 181	Engineering Physics	3	0	2	4
3.	EF	BCS-110/160	Introduction to C Programming	3	0	2	4
4.	PS	BEC-157	Electronic Workshop	2	0	4	4
5.	HSS	BHS- 101/151	Universal Human Values (UHV)	3	1	0	4
			Total	**14**	**2**	**8**	**20**
6.	VAC/AC	BEC-170	Design Thinking in Electronics & Communication Engineering	0	0	2	0
7.	ECA-II			**-**	**-**	**-**	**0**

Second Year, Semester III

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-216	Applied Probability and Statistics	3	1	0	4
2.	EF	BEC-207	Digital Electronics	3	0	2	4
3.	PC	BEC-208	Network Theory: Analysis & Synthesis	3	1	0	4
4.	PC	BEC-209	Electronic Measurement & Instrumentation	3	0	2	4
5.	PC	BEC-210	Electronic Devices & Circuits Theory	3	1	0	4
			Total	**15**	**1-5**	**0-8**	**20**
6.	VAC	AUC101	Constitution of India	2	0	0	0

7.	AC	AUC-119	Fundamentals of Artificial Intelligence	2	0	0	0
8.	ECA-III			-	-	-	0

Second Year, Semester IV

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	EF	BEC-259	Electromagnetic Field Theory	3	1	0	4
2.	PC	BEC-260	Signal & Systems	3	1	0	4
3.	PC	BEC-261	Microprocessor and Applications	3	0	2	4
4.	PC	BEC-262	Analog Integrated Circuits	3	0	2	4
	Student may choose either PE-1 or PE-2 or Both PE-1 and PE-2.						
5.	PE		PE-1	3	1/0	0/2	4
6.	PE		PE-2	3	1/0	0/2	4
			Total	**15-18**	**0-6**	**0-12**	**20-24**
7.	VAC/AC	AUC108	Intellectual Property Right	2	0	**0**	0
8.	ECA-IV			-	-	-	0

Third Year, Semester V

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	PC	BEC-309	Microwave Theory & Techniques	3	0	2	4
2.	PC	BEC-310	Modern Control Systems	3	1	0	4
3.	PC	BEC-311	Analog & Digital Communication	3	0	2	4
4.	M	BMS-301	Principles of Industrial Management	3	1	0	4
	Student may choose maximum up to 04 courses from the list of PE category courses (PE-1 to PE-9)						
5.	PE		PE-1	3	1/0	0/2	4
6.	PE		PE-2	3	1/0	0/2	4
7.	PE		PE-3	3	1/0	0/2	4
8.	PE		PE-4	3	1/0	0/2	4
9.	PE		PE-5	3	1/0	0/2	4
10.	PE		PE-6	3	1/0	0/2	4
11.	PE		PE-7	3	1/0	0/2	4
12.	PE		PE-8	3	1/0	0/2	4
13.	PE		PE-9	3	1/0	0/2	4

			Total	**12-24**	**1-8**	**0-16**	**16-32**
14.	ECA-V			-	-	-	0

Third Year, Semester VI

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	PC	BEC-357	Embedded System and Microcontroller	3	1	0	4
2.	PC	BEC-358	Optical and Wireless Communication	3	0	2	4
3.	PC	BEC-359	Digital Signal Processing	3	0	2	4
4.	HSSE	BHS 301/351	Engineering and Managerial Economics	3	1	0	4
5.	P	BEC-441	Minor Project-1	0	0	0	0
6.	Student may choose maximum up to 04 courses from the list of PE category courses (PE-1 to PE-9)						
7.	PE		PE-1	3	1/0	0/2	4
8.	PE		PE-2	3	1/0	0/2	4
9.	PE		PE-3	3	1/0	0/2	4
10.	PE		PE-4	3	1/0	0/2	4
11.	PE		PE-5	3	1/0	0/2	4
12.	PE		PE-6	3	1/0	0/2	4
13.	PE		PE-7	3	1/0	0/2	4
14.	PE		PE-8	3	1/0	0/2	4
15.	PE		PE-9	3	1/0	0/2	4
			Total	**12-24**	**1-8**	**0-16**	**16-32**
16.	ECA-VI			-	-	-	0

Final Year, Semester VII

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	P	BEC-442	Minor Project-2	0	0	12	6
	Student may choose maximum up to 06 courses from the list of PE category courses (PE-1 to PE-9)						
2.	PE		PE-1	3	1/0	0/2	4
3.	PE		PE-2	3	1/0	0/2	4
4.	PE		PE-3	3	1/0	0/2	4
5.	PE		PE-4	3	1/0	0/2	4
6.	PE		PE-5	3	1/0	0/2	4
7.	PE		PE-6	3	1/0	0/2	4
8.	PE		PE-7	3	1/0	0/2	4
9.	PE		PE-8	3	1/0	0/2	4
10.	PE		PE-9	3	1/0	0/2	4
			Total	**0-18**	**0-6**	**12-30**	**6-30**

11.	ECA-VII			-	-	-	0

Final Year, Semester VIII

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	IP	IEC-415	Industrial Practice (IP)	0	0	20	10
	Without Industrial Practice (IP)						
2.	MP	IEC-416	Major Project (MP)	0	0	20	10
	Student may choose maximum up to 05 courses from the list of PE category courses (PE-1 to PE-9)						
3.	PE		PE-1	3	1/0	0/2	4
4.	PE		PE-2	3	1/0	0/2	4
5.	PE		PE-3	3	1/0	0/2	4
6.	PE		PE-4	3	1/0	0/2	4
7.	PE		PE-5	3	1/0	0/2	4
8.	PE		PE-6	3	1/0	0/2	4
9.	PE		PE-7	3	1/0	0/2	4
10.	PE		PE-8	3	1/0	0/2	4
11.	PE		PE-9	3	1/0	0/2	4
12.			**Total**	**0-15**	**0-5**	**20-30**	**10-30**

List of Professional Electives

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	PE-1	EEC-101	Introduction to Space Technology	3	1	0	4
		EEC-102	Electronics Material, Devices and Circuits	3	1	0	4
2.	PE-2	EEC-201	Semiconductor Devices and Applications	3	1	0	4
		EEC-202	Fundamentals of Photonics	3	1	0	4
		EEC-203	Probability and Stochastic Process for Communication Engineering	3	1	0	4
		EEC-204	Fundamentals of Nanoelectronics	3	1	0	4
3.	PE-3	EEC-301	Launch Vehicle Systems and Technologies	3	1	0	4
		EEC-303	Digital Integrated Circuits and Computer Architecture	3	0	2	4

		EEC-304	RF Circuit Design	3	1	0	4
		EEC-305	Data Communication & Networks	3	1	0	4
4.	PE-4	EEC-401	Fundamentals of VLSI Design	3	0	2	4
		EEC-402	Advanced Photonics	3	1	0	4
		EEC-403	Information Theory Coding	3	1	0	4
		EEC-404	Fabrication and Characterization of Nanoelectronics Systems	3	1	0	4
5.	PE-5	EEC-501	Space Flight Mechanics and Attitude Dynamics	3	1	0	4
		EEC-503	Introduction to VLSI Fabrication Technology	3	1	0	4
		EEC-504	Radar Technology and its Applications	3	1	0	4
		EEC-505	Fundamentals of Software Defined Radio and Cognitive Radio	3	0	2	4
		EEC-506	Digital Image Processing	2	0	4	4
6.	PE-6	EEC-601	Digital Circuit Design using Verilog	2	0	4	4
		EEC-602	Photonics in Optical Fiber Technologies	3	1	0	4
		EEC-603	Antenna Design for Wireless Communication	3	0	2	4
		EEC-604	Introduction to Nano Transistors	3	1	0	4
7.	PE-7	EEC-701	Spacecraft System Engineering	3	1	0	4
		EEC-703	Testing and Verification of VLSI Circuits	3	1	0	4
		EEC-704	Internet of Things (IoT) Communication Systems	3	0	2	4
		EEC-705	Advanced Mobile Communication and 5G Systems	3	0	2	4
		EEC-706	Satellite Communication	3	0	2	4
8.	PE-8	EEC-801	Low Power VLSI Design	3	0	2	4
		EEC-802	Computational Photonics	3	1	0	4
		EEC-803	Introduction to Electromagnetic Interference and	3	1	0	4

			Electromagnetic Compatibility				
		EEC-804	Nano spintronics	3	1	0	4
9.	PE-9	EEC-901	Minor Project	0	0	8	4
		EEC-902	Minor Project	0	0	8	4

List of Value-Added Courses (VAC)/Audit Courses (AC)

S.No.	Subjects	Codes
1.	Constitution of India	AUC101
2.	Indian Culture and Heritage	AUC102
3.	Indian Architecture	AUC103
4.	Indian Festivals	AUC104
5.	Vedic Mathematics	AUC105
6.	Astronomy	AUC106
7.	Arts of India	AUC107
8.	Intellectual Property Rights	AUC108
9.	Human Rights	AUC109
10.	Logical Research	AUC110
11.	Professional Ethics	AUC111
12.	Environmental Law	AUC112
13.	Health Law	AUC113
14.	National Cadet Corps	AUC114
15.	Basics of Human Health and Preventive Medicines	AUC115
16.	Constitution Of India And Environmental Governance: Administration And Adjudication	AUC116
17.	Directive Principles Of State Policy And Fundamental Duties: Constitutional Imperative	AUC117
18.	Introduction To Intellectual Property To Engineers And Technologists	AUC118
19.	Fundamentals of Artificial Intelligence	AUC119
20.	Indian Knowledge Through Classical Languages	IKS101
21.	Indian Knowledge System: Concepts And Applications In Science	IKS102
22.	Indian Knowledge System: Concepts And Applications In Engineering	IKS103
23.	Indian Knowledge System	IKS104

Note:** Detailed syllabus of **Audit Courses (AC)** is attached **as Annexure-01.

List of Extra Curricular Activity (ECA) Courses

ECA-II						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-I	ECA-151	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)-I	ECA-171	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)-I	ECA-172	2	0
4.	Open to all Branches	ECA	Games & Sports-I	ECA-181	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-I	ECA-182	2	0
ECA-III						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/Week	Credit
1.	Open to all Branches	ECA	Skill Development-II	ECA-201	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)- II	ECA-221	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)-II	ECA-222	2	0
4.	Open to all Branches	ECA	Games & Sports-II	ECA-231	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-II	ECA-232	2	0
ECA-IV						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/Week	Credit
1.	Open to all Branches	ECA	Skill Development-III	ECA-251	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)- III	ECA-271	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)- III	ECA-272	2	0
4.	Open to all Branches	ECA	Games & Sports-III	ECA-281	2	0

5.	Open to all Branches	ECA	Cultural, Art & Literary-III	ECA-282	2	0

ECA-V

S. No.	Branch	Category	Subject Name	Subject Code	Hours/Week	Credit
1.	Open to all Branches	ECA	Skill Development-IV	ECA-301	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)- IV	ECA-321	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)-IV	ECA-322	2	0
4.	Open to all Branches	ECA	Games & Sports-IV	ECA-331	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-IV	ECA-332	2	0

ECA-VI

S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-V	ECA-351	2	0
2.	Open to all Branches	ECA	Games & Sports-V	ECA-381	2	0
3.	Open to all Branches	ECA	Cultural, Art & Literary-V	ECA-382	2	0

ECA-VII

S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-VI	ECA-401	2	0
2.	Open to all Branches	ECA	Games & Sports-VI	ECA-431	2	0
3.	Open to all Branches	ECA	Cultural, Art & Literary-VI	ECA-432	2	0

*****Note: Detailed syllabus of Extra Curricular Activity (ECA) Courses is attached as Annexure-04***

SKILLS-ENHANCEMENT COURSES FOR EXIT (ELECTRONICS & COMMUNICATION ENGINEERING):

2-Months internship for 6-Credits **OR** Two courses mentioned below of 4 to 6 credits.

A. After First Year: UG Certificate (Engg.).

The candidate should pass the following two additional courses (ITI Level) **OR** any two suitable skill- based courses to qualify for **UG Certificate (Engg.).**

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	Skill Enhancement	BEC-181	Introduction to Python Programming and Embedded Hardware Basics	2	0	2	3
2.	Skill Enhancement	BEC-182	Mini Project	0	0	6	3

OR

Equivalent skills-enhancement courses from MOOC/SWAYAM.

B. After Second Year: UG Diploma (Engg.).

The candidate should pass the following two additional courses **OR** any two suitable skill-based courses to qualify for **UG Diploma (Engg.).**

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	Skill Enhancement	BEC-281	Applied Analog and Digital Communication Systems	2	0	2	3
2.	Skill Enhancement	BEC-282	Mini Project	2	0	2	3

OR

Equivalent skills-enhancement courses from MOOC/SWAYAM.

C. After Third Year: B. Voc. (Engg.).

The candidate should pass the following two additional courses **OR** any two suitable skill-based courses to qualify for **B. Voc. (Engg.).**

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	Skill Enhancement	IEC-330	Industrial Training (Duration: 6/8 week)	0	0	12	6

OR

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	Skill Enhancement	BEC-391	VLSI and FPGA Based Digital System Design	2	0	2	3
2.	Skill Enhancement	BEC-390	Mini Project	0	0	6	3

OR

Equivalent skills-enhancement courses from MOOC/SWAYAM.

SYLLABUS

BSM-110		**Engineering Mathematics-I**
Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Use of basic differential operators in various engineering problems.
2. Understand the concepts of limit theory and nth order differential equations and their applications to our daily life.
3. Solve linear system of equations using matrix algebra.
4. Know about qualitative applications of Gauss, Stoke's and Green's theorem.
5. To know the applications of double and triple integration in finding the area and volume.
6. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I 9

Differential Calculus: Limit, Continuity and Differentiability, Mean value theorems. Leibnitz theorem, Partial derivatives, Euler's theorem for homogenous function, Total derivative, Change of variable. Taylor's and Maclaurin's theorem. Expansion of function of two variables, Jacobian, Extrema of function of several variables.

UNIT-II 9

Linear Algebra: Symmetric, Skew-symmetric matrices, Hermitian, Skew Hermitian Matrices, orthogonal and unitary matrices and basic properties, linear independence and dependence of vectors, Rank of Matrix, Inverse of a Matrix, Elementary transformation, Consistency of linear system of equations and their solution, Characteristic equation, Eigenvalues, Eigen-vectors, Cayley-Hamilton theorem, Diagonalization of matrices.

UNIT-III 9

Multiple Integrals: Double and triple integrals, change of order of integration, change of variables. Application of multiple integrals to surface area and volume. Beta and Gamma functions, Dirichlet integral.

UNIT-IV 9

Vector Calculus: Gradient, Divergence and Curl. Directional derivatives, line, surface and volume integrals. Applications of Green's, Stoke's and Gauss divergence theorems (without Proofs).

Books & References

1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers
2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.
4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.,

BSM-140/BSM-190	**Environmental Science and Green Chemistry**
Course category:	Basic Sciences & Maths (BSM)
Pre-requisite Subject:	NIL
Contact hours/week	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits:	4
Course Assessment methods:	Continuous assessment through home assignments, quizzes, minor tests, practical work, viva-voce, practical exam and major theory Examination
Course Objectives	Understanding the principles and concepts of Chemistry viz. Chemical Bonding, acidity and basicity, Atmospheric Chemistry & Water Chemistry, Spectroscopic analytical methods and Green Chemistry and solving industrial problems using solid foundation in Chemistry.
Course Outcomes:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To develop the concepts of basic chemistry.
2. To make the students aware of global environmental issues e.g. global warming & Greenhouse effect, Ozone depletion, pollution and its prevention and understand various aspects of atmospheric chemistry.
3. To understand the analytical and conceptual skills required for environmental chemistry research.
4. To understand water treatment for all types of uses and need to protect environment.
5. To understand the specifications of pure water and its purification techniques.
6. To develop the knowledge about Green Chemistry and Green Technology.

Unit 1: **9**

Basic Chemical Concepts

Periodic properties of elements, Ionization potential, electron affinity and electronegativity; mole concept, molarity and normality, Chemical Bonding – MO Theory, MO diagram of diatomic molecules, hydrogen bonding, electrophiles, nucleophiles, inductive effect and mesomeric effect. Reaction Mechanism. Acidity and basicity - Concept of ph.

Unit 2: **9**

Atmospheric chemistry & Water Chemistry

The atmosphere of Earth, layers of atmosphere and temperature inversion, Air pollution, Global warming and Greenhouse effect. Acid rain and Ozone layer depletion. Chemical and photochemical Smog. Sources of water, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Hardness of water, Softening of water by Zeolite process, Lime Soda process, Ion exchange process and Reverse osmosis.

Unit 3: **9**

Spectroscopic analytical methods

Absorbance, Transmittance and Beer-lamberts Law. Basic principles of UV-Visible spectroscopy, Fluorescence spectroscopy, Infrared spectroscopy, NMR Spectroscopy. Use of these instrumental techniques for monitoring of environmental pollution.

Environmental problems posed by the use of non-biodegradable polymers widely used in day-to-day life. Incineration as the key method for disposal of polymeric waste. Bio-degradable polymers.

Unit 4: **9**

Green Chemistry

Green Chemistry and Green Technology: New trends in green chemistry; Green Chemistry Methodologies-Microwave heating, ultrasound technique. Green Chemical Synthesis Pathways; Green reagents, green solvents.

Experiments:

1. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
2. Determination of alkalinity in the given water sample.
3. Determination of chloride content in the given water sample by Mohr's method.
4. Determination of percentage of available chlorine in bleaching powder sample.
5. Determination of iron content in the given sample using $K_3[Fe(CN)_6]$ as an external indicator.
6. Determination of Electrical conductivity/TDS of a given water sample using conductivity meter.
7. Determination of dissolved Carbon Dioxide of given water sample.
8. Determination of the biochemical oxygen demand of sewage influent.
9. To calculate the lambda max of the given compound by using UV-Visible spectrophotometer.
10. Determination of nickel / cobalt / copper solutions by UV–visible spectrometry.
11. Examples of Green Synthesis /Reactions.
12. Determination of Turbidity of Water
13. Iodoform test
14. Synthesis of a polymer Bakelite or Polyacrylic acid.

Books & References

1. A Text Book of Environment and Ecology, Shashi Chawla, Tata McGraw Hill
2. Environmental Studies, Raj Kumar Singh, Tata McGraw Hill
3. Engineering Chemistry, Wiley India
4. Engineering Chemistry, Tata McGraw Hill
5. Organic Chemistry, Morrison & Boyd, 6th edition, Pearson Education
6. Fundamentals of Environmental Chemistry, Manahan, Stanley E., Boca Raton: CRC Press LLC.
7. Environment and Ecology, R K Kandal, Wiley India
8. An Introductory Text on Green Chemistry: For Undergraduate Students, lndu Tucker Siddhani, Rakesh K. Sharma, Wiley
9. A text book of Green Chemistry, Shankar Prasad Deo and Nayim Sepay, Techno World Publication.
10. Introduction to Green Chemistry, John Andraos, Albert S. Matlack, CRC Press

BEE-110/ 160 : Basic Electrical Engineering

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	*:*	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credi*ts*	:	4
Course Assessment methods	*:*	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, Minor tests and One Major Theory & Practical Examination.

Course Objectives*:*

1. To demonstrate and understand the basic knowledge of electrical quantities such as current, voltage, power, energy, and frequency to understand the impact of technology in a global and societal context.

2. To demonstrate and understand the basic concepts of analysis of simple DC and AC circuits used in electrical engineering and apply the basic concepts in Electrical engineering for multi-disciplinary tasks.

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. Understand the basic properties of electrical elements, and solve problem based on basic electrical circuits & DC network theorems.
2. Understand the fundamental behaviour of AC circuits and solve AC circuit problems.
3. Apply the knowledge gained to explain the behaviour of the circuit at series & parallel resonance of circuit & the effect of resonance.
4. Classify different electrical measuring equipment's and understanding their principles.
5. Understand the basic concepts of magnetic circuits.
6. Explain construction and working principle of transformer.

Topic Covered

UNIT I **9** **9**

D C Circuit Analysis and Network Theorems:

Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem.

UNIT II **9**

Steady- State Analysis of Single-Phase AC Circuits: **9**

AC fundamentals: Sinusoidal, square, and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasor, phasor representation of sinusoidally varying voltage and current, Analysis of series, parallel and series-parallel RLC Circuits, Resonance in series and Parallel circuit

Three Phase AC Circuits: Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, three-phase power, and its measurement

UNIT III **9**

Measuring Instruments & Magnetic Circuit: **9**

Types of instruments, Construction and working principles of PMMC and Moving Iron type voltmeters & ammeters, Use of shunts and multipliers.

Magnetic circuit, concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis, and eddy current losses.

UNIT IV **9**

Single-Phase Transformers: **9**

Single Phase Transformer: Principle of operation, Construction, EMF equation, Power losses, Efficiency, O.C & S.C Test and Introduction to auto transformer.

EXPERIMENTS

1. Verification of Kirchhoff's Law.
2. Verification of Norton's Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Superposition Theorem.
5. Verification of Maximum Power Transfer Theorem.
6. Verification of Series R-L-C circuit.
7. Verification of Parallel R-L-C circuit.
8. Measurement of Power and Power factor of three phase inductive load by two wattmeter method.
9. To perform O.C. and S.C. test of a single-phase transformer.

Textbooks:

1. Fundamentals of Electric Circuits, C.K. Alexander and M.N.O. Sadiku; TATA McGraw-Hill.
2. Principles of Electrical Engineering, V. Del Toro; Prentice Hall International.
3. Electrical and Electronics Technology, Edward Hughes; Pearson.
4. Basic Electrical Engineering, D P Kothari, I.J. Nagarath; Tata McGraw Hill
5. Electrical Technology, B. L. Thareja and A. K. Thareja; S. Chand.

BEC-106 Electronic Component Testing and Measurement

Course category	:	Professional Skills (PS)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:2, Tutorial :0 , Practical: 4
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through attendance, assignments, quizzes, practical work, record, viva voce and two Test and One Major Theory & Practical Examination

Course Objectives

The objective of this course is to gain knowledge of basic electronic components and develop an understanding of the working principles of different electronic devices such as diode, transistor MOSFET, voltmeter, multimeter, CRO, etc. Also, to identify different electronic components & to develop an understanding of testing of different electronic components.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. Able to memorize the basic concept of electronic circuits using Diode, BJT (Bipolar Junction Transistor), FET (Field Effect Transistor), etc.
2. Able to execute and examine the general characteristics of electronic circuits.
3. Compute different parameters for characterizing different circuits like rectifiers, amplifiers, integrators, etc.
4. Examine the working principle of the digital voltmeter, and mustimeters using the block diagram approach.
5. Able to identify electronic components.
6. Discuss and calculate voltage, current, phase, and frequency using CRO.

Topics Covered

UNIT-I

Semiconductor Diode: Depletion layer, V-I characteristics, ideal and practical Diodes, Diode Equivalent Circuits, Zener Diodes breakdown mechanism (Zener and avalanche) 6

Diode Application: Diode Configuration, Half and Full Wave rectification, Clippers, Clampers etc.

Special Purpose Diodes: Light-Emitting Diodes, Photo Diodes etc.

UNIT-II

Bipolar Junction Transistor: Transistor Construction, Operation, Amplification action. Common Base and Common Emitter Configuration, input/output characteristics, Biasing of transistors-fixed bias and potential divider bias. 6

UNIT-III

Field Effect Transistor: Construction and working of JFETs. Transfer Characteristic and Output Characteristic of JFETs. MOSFET (MOS) (Depletion and Enhancement) Type, Transfer Characteristic and Output Characteristic of MOSFETs. 6

UNIT-IV

Operational Amplifiers and Electronics Instruments: Introduction, Op-Amp basic, Practical Op-Amp Circuits (Inverting Amplifier, Non-inverting Amplifier etc). Working principle of digital Storage Oscilloscope, CRO (its working with block diagram). 6

EXPERIMENTS

Note: Minimum eight experiments are to be performed:

1. To plot the forward / Reverse Characteristics of Si P-N junction diode.
2. To plot the forward/Reverse Characteristics of Zener diode.
3. Study and plot the characteristic of Zener diode as voltage regulator.
4. Study of half wave rectifier and draw the nature of input / output signal. Calculate the value of I_{dc}, I_{rms} and ripple factor.
5. Study of Full wave rectifier and draw the nature of input / output signal. Calculate the value of I_{dc}, I_{rms} and ripple factor.
6. Study of Bridge Rectifier and draw the nature of input / output signal. Calculate the value of I_{dc}, I_{rms} and ripple factor.
7. Draw input-output characteristic curve of n-p-n transistor in CE or CB or CC configuration.
8. Draw the drain and transfer curve of JFET.
9. Study of OP-AMP (741) and calculate the gain in (i) Inverting mode and (ii) non-inverting mode.
10. Study of OP-AMP as a (i) Summer (ii) Integrator (iii) Differentiator; and plot the nature of input & output waveform.
11. To identify the components which are used in electronic circuits. (R, L, C, diode etc).
12. To study the resistance, voltage, current measurement by using of mustimeter.
13. To get familiarization and to study the operation of a function generator instrument and visualize the types of waveforms produced by a function generator.
14. To study the DSO and to find the Amplitude, Time-period and Frequency of a sinusoidal waveform using DSO.
15. Study of Lissajous patterns and measurement of frequency through Lissajous patterns.
16. Measurement of time constant of RC circuit.
17. Measurement of unknown resistance using Wheatstone bridge.

Books & References

1. Electronic Devices and Circuits-Boylestad and Nashelsky, 6e, PHI, 2001
2. Electronic Devices and Circuits, A Mottershead, PHI,2000, 6e

3. Digital Computer Design, Morris Mano, PHI,2003
4. Electronic Instrumentation-H.S. Kalsi, 2e, TMH, 2007

BHS- 102/152 TECHNICAL WRITING AND PROFESSIONAL COMMUNICATION (TW&PC)

Course Category : HSS
Prerequisite subject : None
Number of Credits : 4
Contact Hours/Week : Lectures: 2, Tutorial: 1, Practical: 2
Course Assessment Methods : Continuous assessment through Two tests, teacher's assessment (quiz, tutorial, assignment, attendance), and One Major Theory Examination.

Course Objectives: The objectives of this course are to: -

1. To sensitize the students to understand the role and importance of communication for personal and professional success.
2. To enable the learners to enhance their writing skills in techno-cultural and professional echo-system.
3. To equip learners to differentiate technical writing from general writing.
4. To equip them with technical writing skills.
5. To enable learners to exhibit knowledge, skills, attitude and judgment in and around human communication that facilitate their ability to work collaboratively with others in an interpersonal environment.

Course Outcomes: The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course: -

1. Overcome the problems she/he shall faces in oral and written communication.
2. Acquire knowledge of and methods for using technical communication, such as reports, proposals, technical letters, etc.
3. Use and Practice compositions correctly.
4. Give presentations in different sessions and make self-appraisal.
5. Learn and understand the various facets of Communication Skills, such as (LSRW) Listening, Speaking, Reading, and writing, and identify, formulate, and solve real-life problems with a positive attitude; also inculcate, the habit of learning and developing communication and soft skills.

Unit 1: Language and Communication 6

Language Vs communication: Communication as coding and decoding – signs, symbols & pictograph – verbal and non–verbal symbols – Language & communication; Types of Communication- functional, situational, verbal, and non-verbal, interpersonal, group, interactive, public, Mass Communication. Thinking and Articulation, critical, creative aspects of articulation.
Skills of Language Acquisition: Natural Language Acquisition Skills: Listening, Speaking, Reading & Writing {LSRW}; Language Acquisition Through Training: Listening, Speaking,

Reading, Writing,Grammar & Vocabulary {LSRWGV}

Phrase, Clause & Sentence in Professional Drafting-Simplicity, Clarity and Conciseness of a Presentation, differentiating between Professional and Creative Writing, Blending of Artistic/Professional Writing, Avoiding gender, racial, and other forms of bias in Professional Writing.Pre-writing, Drafting, and Re-writing.

Unit 2: Towards Technical Writing 6

Technical Paper Writing: Professional Paper Elements-Front Matter of a Paper, Main Text of a Paper, End Matter of a Paper: Organizing References and Bibliography, Order of a thesis and Paper Elements, Concluding Remarks. **Methods of Research Paper Writing:** Identification of Author and His Writing-Author's name and Affiliation, Joint Authorship of a Paper, Identification of Writing- Title, Keywords, Synopsis, Preface and Abstract. Drafting Research Article & Methodology.

Thesis/Dissertation Writing: Thesis Elements-Front Matter of a Thesis, Main Text of a Thesis, End Matter of a Thesis, Specimen—Thesis and Research Paper, Chapters and Sections-Introductory

Chapters and Sections, Statement of the Problems, Plan and Scope, Core Chapters and Sections-Theoretical Analysis and Synthesis, Basic Assumption and Hypothesis.

Professional Presentation & Seminar Delivery Tools: Designing the Presentation; Establishing the Objectives. Making Professional PowerPoint Presentations, Signaling Structure of Presentation through Sentences and Crisp Phrases, Preparing Notes for Professional/Technical Presentation, Text Animation, White Board, Flip Charts, Diagrams, Preparing Cards. Seminar Presentations: Purpose modes and methods. Nascent Emerging Platforms for On-line Presentations viz. Zoom, Webex, Team& Meet etc.

Unit 3: Drafting Skills & Career Correspondence 6

Professional Drafting: Letters vs. e-mails, Formal and Informal emails, Parts of e-mails, Types of e-mails, Managing tone of E-mails and business Letters, Examples of Letters and E-mail, Professional Correspondence through E-mail, Job Applications and cover Letters. Introduction to DOs (Demi- Official Letters)

Career & Correspondence: Developing a Professional C.V, Bio Data & Resume. Report Writing, Kinds of Reports, Length of Report, Parts of a Report, Terms of Reference, Collection of Facts, Outlines of Report, Examples of Report, Technical Proposal, Elements of Proposal, Examples of Proposal, drafting of proposal.

Unit 4: Professional Practices with ICT Interface 6

Conducting Professional Meeting: Pre-meeting Preparation, During Meeting: Action Taken Report (ATR) & New Agenda Points, Post Meeting Follow ups. Notice, Circular, Agenda & Meeting Minutes.

Introduction to Generation–Z, Cyber Identity & Professional Netiquettes for Netizens: DraftingE-mails, Blogs on social media, Videoconferencing. Managing Profiles on social media. What to Write and Share on social media. Telephone Etiquettes & Phubbing.

List of Practical:

1. Introduction to Vowel and Consonant Sounds
2. Monophthongs and Diphthongs
3. Syllable, Word Stress & Intonation
4. Harnessing Non-verbal Communication Skills in Cross-Cultural Environment for the establishment of an ideal Ecosystem to ensure Professional Success
5. Developing Speech, and Proofreading the Same
6. Argumentative Skills & Group Dynamics
7. Preparing CV, Biodata & Resume
8. Types of Interview and Interview Skills
9. GD, PI & Telephonic Interview
10. Presentation Skills, Extempore, Debate and Video Conferencing
11. Netiquettes while Writing Blogs on social media.
12. Ethical Usages of Generative AI

Text / Reference Books

1. Acharya Anita. (2012) Interview Skills- Tips & Techniques. Yking Books, Jaipur.
2. Basu, B. N., (2008) Technical Writing. PHI Learning Pvt. Ltd.., New Delhi.
3. Chauhan, N. K & Singh, S. N. (2013) Formal Letters, Pankaj Publication International, New Delhi.
4. Chhabra T.N. (2018) Business Communication. Sun India Publication New Delhi.
5. Dubey Arjun et.al. (2016) Communication for Professionals. Alfa Publications, Delhi.
6. Gibaldi, Joseph (2021). The MLA Handbook for Writers of Research Papers. Ed. IXth, ModernLanguage Association of America, NY, US.
7. Gurumani, N. (2010) Scientific Thesis Writing and Paper Presentation, MJP Publishers, Chennai.
8. Hamilton Richard. (2009) Managing Writers. Penguin, India.
9. Mc Graw S. J. (2008) Basic Managerial Skills for All. Ed. 08th, Prentice Hall of India, New Delhi.

BSM-160		**Engineering Mathematics - II**
Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To solve the ordinary differential equations.
2. To solve the partial differential equations using Lagrange and charpit's method.
3. To solve and understand the properties of Bessel`s and Legendre`s differential equation.
4. Application of partial differential equation in real life problems
5. To solve ODE and PDE with the help of Laplace transform
6. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I 9

Ordinary Differential Equations I: Linear differential equations with constant coefficients $(n^{th} order)$, complementary function and particular integral. Simultaneous linear differential equations, solution of second order differential equations by changing dependent and independent variables, Method of variation of parameters, Applications of differential equations to engineering problems

UNIT-II 9

Ordinary Differential Equations II: Series solution of second order differential equations with variable coefficient (Frobeneous method). Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials.

UNIT-III 9

Partial Differential equations: Partial differential equations of the first order, Lagrange's solution, Charpit's general method of solution, Partial differential equations of the second order: Constant coefficient and reducible to constant coefficient, Classification of linear partial differential equations of second order.

UNIT-IV 9

Laplace Transform: Laplace Transform, Laplace transform of derivatives and integrals. Unit step function, Laplace transform of Periodic function. Inverse Laplace transform, Convolution theorem, Applications to solve simple linear and simultaneous differential equations and Partial Differential Equations.

Books & References

1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers
2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.
4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.
5. M.D. Raisinghania, Ordinary and Partial Differential Equations. S Chand Publications.

BSM 131/181		**ENGINEERING PHYSICS**
Course category	:	Basic Sciences and Maths (BSM)
Pre-requisite Subject	:	Physics at 12thStandard
Contact hours/week	:	Lecture: 3, Tutorial: 0 , Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and one Minor test and One Major Theory Examination
Course Objectives	:	Understanding of the principles and concept of Optics, Quantum Mechanics, Fiber Optics, Electrodynamics and Physics of Advanced Materials.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attributes after completing this course.

1. Understand the basics principles of Optics and its applications in Engineering and Technology.
2. Compare and understand the uses of various applications of interference and diffraction in the different fields of Engineering.
3. Know the knowledge of polarization and their applications in Photonics.
4. Understand the principles of Quantum Mechanics and their applications in Engineering and Technology.
5. Know the principles of Electrodynamics and their applications in Engineering and Technology.
6. Understand the basic properties of advanced materials and their engineering applications.

Topics Covered

UNIT-I: Optics **9**

Interference: Interference of light, Interference in thin films, Newton's rings. Refractive index and wavelength determination.

Diffraction: Fresnel and Fraunhofer class of diffraction. Resultant of n-hormonic waves, single, double and N- slit diffraction, Diffraction grating, Grating spectra, Dispersive power.

Polarization: Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Retardation Plate, Polarimeter.

UNIT – II: Quantum Mechanics **9**

Quantum Mechanics: de Broglie waves, Davisson-Germer experiment, Concept of Phase and Group velocities, Uncertainty principle and its applications, Derivation of time independent and time dependent Schrodinger wave equations. Postulates of quantum mechanics, Significance of wave function, Application of Schrodinger wave equation for a particle in one dimensional infinite potential well.

UNIT-III: Electrodynamics **9**

Scalar and Vector fields, Gradient, Divergence and curl, Concept of displacement current, Maxwell's equation in differential and integral forms, Physical significance of each equation.

Maxwell's equation in free space, Velocity of electromagnetic wave, Transverse nature of the electromagnetic wave, Poynting vector, Maxwell's equations in dielectric and conducting medium, and skin depth.

UNIT-IV: Physics of Advanced Materials **9**

Concept of energy bands in solids, Semiconducting materials, Concept of direct and indirect band gap in semiconductors, Carrier concentration and conductivity in semiconductors, Optoelectronic Materials, Superconducting Materials, Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, London Equations, BCS theory (Qualitative), Introduction of nanoscience, Nanotechnology and its applications.

EXPERIMENTS

1. To determine the specific resistance of a given wire using Carrey Foster's Bridge.
2. To determine the wavelength of sodium light using Newton's Ring experiment.

3. To determine the wavelength of spectral lines of white light using plane diffraction grating.
4. To determine the specific rotation of cane sugar solution using polarimeter.
5. To study the variation of magnetic field along the axis of current carrying circular coil.
6. To study the Hall's effect and to determine Hall coefficient in n type Germanium.
7. To study the energy band gap of Germanium using four probe method.
8. To determine the height of Tower by Sextant.

Books & References

1. Optics- Ajoy Ghatak, Tata McGraw-Hill
2. Optics- N. Subrahmanyam, Brij Lal, M.N. Avadhanulu, S. Chand
3. Quantum Mechanics: Theory and Applications- Ajoy Ghatak, Tata McGraw-Hill
4. Fiber optics and laser Principles and Applications-Anuradha De, New Age International
5. Optical Fibers and its application as sensors by R. K. Shukla, New Age International.
6. Introduction to Electrodynamics by David J. Griffiths, Pearson
7. Physics of Semiconductor Devices, by S. M. Sze, Wiley
8. Concepts of Modern Physics by Arthur Beiser, Tata MCGraw Hill.
9. Introduction to Solid State Physics by C. Kittel, Wiley.
10. Engineering Physics by B. K. Pandey and S. Chaturvedi, 3e Cengage Learning Pvt. Limited, India.
11. Engineering Physics by H. K. Malik and A. Singh Tata MCGraw Hill.
12. Advanced Practical Physics Vol. I and Vol. II by D. K. Dwivedi, Victorius Publishers, New Delhi.

BCS-110/160	**Introduction to C Programming**
Course category:	Engineering Fundamental (EF)
Pre-requisite Subject:	NIL
Contact hours/week:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits:	4
Course Assessment methods:	Continuous assessment through attendance, home assignments, quizzes, practical work, record, Viva-voce, one test and One Major Examination (T & P)

Course Objective: The course covers the basics of programming and demonstrates fundamental programming techniques, customs and terms including the most common library functions and the usage of the pre-processor. The salient features of course objectives are given below.

1. To develop C Programs using basic programming constructs
2. To develop C programs using arrays and strings
3. To develop applications in C using functions and structures

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Basic terminology used in computer programming.
2. Programs development in C Language by writing, compiling, and debugging.
3. Design of programs involving simple statements, conditional statements, iterative statements, array, strings, functions, recursion, structure, and union.
4. Difference between call by value and call by reference.
5. Dynamic memory allocations and use of pointers.
6. Basic operations on a file.
7. Basics of dynamic memory.

UNIT-I **9**

Basics of programming: Approaches to Problem Solving, Concept of Algorithm and Flow Charts, Types of Computer Languages: Machine Language, Assembly Language and High-Level Language, Concept of Assembler, Compiler, Linker, and Loader. Data types, Storage Classes: Auto, Extern, Register and Static. Operators, Expressions, Operator Precedence and Associativity.
Fundamentals of C Programming: Structure of C Program, Writing and Executing the First C Program, Components of C Language, Standard I/O, Formatted I/O. Conditional Program Execution: Applying if and switch Statements, Nesting if and else. Program Loops and Iterations: Use of while, do while and for Loops, Multiple Loop Variables, Use of break and continue Statements, goto Statement.

UNIT-II **9**

Arrays: One Dimensional, Multidimensional Array and Their Applications, Declaration and Manipulation of Arrays.
Strings: String Variable, String Handling Functions, Array of Strings.
Functions*:* Designing Structured Programs, Functions in C, User Defined and Standard Functions, Formal vs. Actual Arguments, Function Category, Function Prototype, Parameter Passing, Recursive Functions. Storage Classes revisited.

UNIT-III **9**

Pointers: Pointer Variable and its Importance, Pointer Arithmetic Pointers and Arrays, Pointer and Character Strings, Pointers and Functions, Array of Pointers, Pointers to Pointers.
Structure: Declaration and Initialization of Structures, Structure as Function Parameters, Structure Pointers.
Union: Declaration and Initialization of Unions, Union as Function Parameters, Union Pointers.

UNIT-IV **9**

Dynamic Memory Allocation: malloc, calloc, realloc, free functions.
File Management: Defining and Opening a File, Closing a File, Input/ Output Operations in Files. Pre-processor Directives, Macros. Command Line Arguments. Introduction to Graphics Programming.

EXPERIMENTS

1. Write programs to print statements in sequential order using simple printf, scanf input/output functions.
2. Write programs to implement if-else condition (simple as well as nested) on suitable problems.

3. Write a program to implement switch-case conditional logic on suitable examples.
4. Write programs to implement for, while and do-while loop control statements on suitable problems.
5. Write programs to implement 1D & 2D array concepts on suitable problems such as sorting of elements, searching of element, matrix addition, subtraction, multiplication etc.
6. Write programs to implement string related concepts such as sorting of a string, finding its length, reversing, concatenation, comparing two strings etc.
7. Write programs to implement concept of user defined functions (call by value, call by reference, recursive calling etc.) on suitable examples.
8. Write programs to implement concepts of pointer.
9. Write programs to implement the concept of structure and union.
10. Write programs to implement dynamic memory allocation functions (calloc, malloc, free, realloc)
11. Write programs to implement file handling concepts such as reading from a file, writing to a file using file related functions (fclose, fopen, sscanf, sprint, fread, fwrite, getc, putc, getw, putw etc.)

Textbooks

1. Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, 7th Edition, Pearson.
2. Schildt, Herbert, Complete Reference with C, Tata McGraw Hill.
3. Kerninghan and Ritchie, The C programming Language, 2nd Edition, Prentice Hall.
4. Richard Bird, Introduction to Functional Programming using Haskell, 2nd Edition, Prentice-Hall International, 1998.

Reference Books

1. Greg Michaelson, An Introduction to Functional Programming Through Lambda Calculus, Dover Edition, Addition Wesley Publication.
2. Samuel P. Harbison, and Guy L. Steele Jr., C-A Reference Manual, Fifth Edition, Prentice Hall, 2002.

BEC-157		**Electronic Workshop**
Course category	:	Professional Skills (PS-2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 2, Tutorial :0 , Practical: 4
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through attendance, assignments, quizzes, practical work, record, viva voce and two Test and One Major Theory & Practical Examination
Course Objectives		The objective of this course is to develop the skill and working of different circuit board & prototypes of the designed electronics circuits.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. To identify the circuit components and their application specially for electronics PCB design.

2. Understand the design processes and production methods used in the manufacturing of a printed circuit board.
3. Understand the use and application of chemical itching and drilling in the manufacture of an electronic circuit.
4. Be able to design and manufacture a prototype printed circuit board and use it to assemble and test an electronic circuit.
5. Able to design rectifier and filter and study their practical applications.
6. Able to have knowledge of these circuits using breadboard.

Topics Covered

Unit 1: Introduction to Electronics **6**

Overview of basic electronic components (resistors, capacitors, diodes, transistors, transformers, potentiometers etc.), Introduction to circuits (series, parallel, combination), Understanding Ohm's Law and Kirchhoff's Laws, Introduction to basic electronic tools (mustimeter, oscilloscope)

Unit 2: PCB Designing Basics **6**

Introduction to PCB (Printed Circuit Board) design, Understanding PCB layout and components placement, Introduction to PCB design software (e.g., Eagle, KiCad, Proteus), Hands-on practice in designing a simple PCB layout

Unit 3: Advanced PCB Designing **6**

Understanding PCB design considerations (trace width, spacing, vias, etc.), Signal integrity and noise reduction techniques, Designing for manufacturability (DFM) and design for testing (DFT), Advanced PCB design software features and techniques

Unit 4: Project-Based Learning **6**

Minor PCB design project, Presentations and demonstrations of the completed projects, Troubleshooting, Feedback and evaluation of the projects

EXPERIMENTS

Note: Minimum eight experiments are to be performed:

1. Winding shop: Step-down transformer winding of less than 5VA.
2. Soldering shop: Fabrication of DC regulated power supply.
3. Printing of circuits on PCB.
4. Design a PCB using Etching & drilling.
5. Coating of etched PCB to protect it from oxidation.
6. Convert the power supply circuit into PCB & simulates its 2D & 3D view.
7. Design a full wave center tapped rectifier & study the effect of capacitive filter & it's output on a virtual oscilloscope.
8. Design a RLC resonance circuit & verify the transient & phase response for different values of R, L&C.
9. Assemble electronic circuit/system on general purpose PCB, test and show the functioning. 10. Construct various electronic circuits on breadboard
11. Identify and test different types of ICs.

12. To study the specifications and working of a Transistor radio kit and perform measurements on it.
13. Study the working of Distortion Meter.
14. To study the working of Spectrum analyzer and determine the bandwidth of different signals.

Books & References

1. Electronics Components and Materials by SM Dhi, Tata McGraw Hill, New Delhi
2. Electronics Device and circuits by Millman and Halkias; McGraw Hill.

BHS- 101/151 Universal Human Values: Understanding Harmony

Course Category : HSS
Prerequisite subject : None
Number of Credits : 4
Contact Hours/Week : Lectures: 3, Tutorial: 1, Practical: 0
Course Assessment Methods : Continuous assessment through Two tests, teacher's assessment (quiz, tutorial, assignment, attendance), and One Major Theory Examination.

Course Objectives: The objectives of this course are to: -

1. Develop a holistic perspective in students based on self-exploration about themselves (human being), family, society and nature/existence.
2. Develop understanding (or developing clarity) in students about harmony in the human being, family, society and nature/existence.
3. Strengthen self-reflection in students.
4. Develop commitment and courage in students to act.

Course Outcomes:

The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course: -

1. Ability to understand the interconnectedness of humanity and nature as well as the importance of values in interpersonal relationships.
2. Ability to recognize their role as global citizens and understand the importance of actively contributing to the betterment of society through responsible actions.
3. Ability to engage in critical reflection on their own values and beliefs, challenging assumptions and biases to foster personal growth and development.
4. Ability to appreciate and respect diversity thereby promoting communication and conflict resolution skills, promoting dialogue and understanding in resolving interpersonal and intergroup conflicts.

Topics Covered

Unit 1 **9**

Introduction to Values: origin, definition, meaning, and types of values; Values in Education System; difference between Values, Morals, and Ethics; Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and 'Experiential Validation' as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic human aspirations; Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority; Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario; Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit 2 **9**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail; Programs to ensure Sanyam and Health.

Unit 3 **9**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust; Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit 4 **9**

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence; Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics.

Text & Reference Books:

1. Andrews, C. (2006). Slow is beautiful. New Society Publishers.
2. Gandhi, M. K. (1909). Hind Swaraj or Indian Home Rule. Navjeevan Trust.
3. Gandhi, M. K. (2009). An Autobiography or The Story of My Experiments with Truth (Mahadev Desai, Trans.). Navjeevan Mudranalay. (Original work published 1925).

4. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2010). A Foundation Course in Human Values and Professional Ethics. Excel Books.
5. Govindrajan, M., Senthilkumar, S., & Natarajan, M. S. (2013). Professional Ethics and Human Values. Prentice Hall India.
6. Kumarappa, J. C. (2017). Economy of Permanence. Sarva Seva Sangh Prakashan.
7. Naagarazan, R. S. (2022). A Textbook on Professional Ethics and Human Values. New Age International.
8. Rolland, R. (2010). Life of Vivekanad (4th Ed.). Advait Ashram.
9. Schumacher, E. F. (1973). Small is beautiful. A study of Economics as if people mattered. Blond & Briggs.
10. Suresh, J., & Raghavan, B. S. (2003). *Human Values and Professional Ethics*. S Chand.

Course Code: BEC-170 Design Thinking in Electronics & Communication Engineering

Course category : Audit Course (AC)

Pre-requisite Subject : NIL

Contact hours/week : Lecture: 0, Tutorial: 0, Practical: 2

Number of Credits :

Course Assessment methods : Continuous assessment through assignments, attendances, quizzes and practical exam tests.

Course Objectives :

- Inculcate the fundamental concepts of design thinking
- Develop the students as a good designer by imparting creativity and problem-solving ability
- Conceive, conceptualize, design and demonstrate innovative ideas using prototypes
- To propose a concrete, feasible, viable and relevant innovation project/challenge

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To expose the student with state-of-the-art perspectives, ideas, concepts, and solutions related to the design and execution of projects using design thinking principles.
2. To prepare the mindset and discipline of systemic inspiration driven by a desire to identify new sources of ideas, and new models especially outside their regular working atmosphere.
3. Demonstrate the critical theories of design, systems thinking, and design methodologies
4. Produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact.
5. Understand the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices

6. Conceive, organize, lead and implement projects in interdisciplinary domain and address social concerns with innovative approaches

Experiments:

1. Using David Kolb's Model, to identify Experiential Learning Cycle for VLSI design system.
2. To Study all stages in the Design Thinking Process and Prototype and examine any Digital circuit simulation process by Brainstorming prototype.
3. To study Problem Solving and Functional Fixedness and applied on IoT based agricultural system, also comparison Between Eco-Reps and Non-Eco-Reps .
4. By development of scenarios planning and evaluation tools, illustrate an experiment Interactive Drama for an AI based IoT system.
5. Via advanced communication system-based discussions in a group setting be used to assess residents' clinical skills.
6. With the help of Cognitive bias categories in Strengthen communication, to identify Complementary interviews.
7. By creating a Culture of Innovation, to develop different Strategies for Business Growth and Success of Microelectronics & VLSI Design system.
8. Depict an importance of Experimental Prototyping and to Construct a Prototype Experiment for an Electromagnetic Field theory and Antenna system.
9. To identify all Prototype Testing, Design, Test, and Implement Your Ideas with creation of Smart cities.
10. Design and experimentation of 3d printed pattern and wooden pattern for sand casting process.
11. To corelate an Ergonomics and sustainability in the design of everyday use products.
12. A Step-by-Step Guide to Build a Minimum Viable Product (MVP) in terms of Entrepreneurship for Silicon based IC.
13. Experimentation and startup performance /business ideas: Evidence from A/B testing
14. How to translate subjective customer needs into precise target specs? How could the team resolve.
15. What is creative problem-solving & why is it important?
16. How to Build a Functional Product Design Outstanding Feedback Loop in 7 Steps?
17. Individual Differences in Psychology: Everything You Should Know For UPSC CSE!

Text and Reference Books

1. E. Balaguruswamy (2022) Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage",Harvard Business Press , 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve– Apply", Springer, 2011

BSM-216		**Applied Probability and Statistics**
Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor tests and One Major Theory Examination
Course Objectives	:	The course is aimed to develop the basic statistical skills of engineering students that are imperative for effective understanding of engineering subjects.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand the basic concepts of probability and probability Distributions.
2. To understand the central tendency, correlation, and correlation coefficient and also regression.
3. To understand the fitting of various curves by method of least square
4. To apply the statistics for testing the significance of the given large and small sample data by using t- test, F- test and Chi-square test.
5. Application of probability and statistics in real life.
6. To inculcate the habit of statistical thinking and lifelong learning.

Topics Covered

UNIT-I

Basic Statistics: Frequency distribution, Mean, Median, Mode, Moments, Moment Generating function, Skewness, Types of Skewness, Measurement of Skewness, Kurtosis, and its types. Curve fitting: Method of Least Squares, Fitting of Straight lines, Fitting of Parabola of second degree. 9

UNIT-II

Applied Statistics: Correlation, Correlation coefficient, Spearman's rank correlation coefficient, Regression, Equation of regression lines, linear, and non-linear regression analysis. Relation between Regression Analysis and Correlation Analysis 9

UNIT-III

Probability: Random experiment, outcome, trial and event, Exhaustive events, favourable events, independent events, sample space, classical and empirical definition of probability, addition theorem of probability, multiplication theorem of probability, conditional probability, Baye's theorem. 9

UNIT-IV

Probability Distribution: Discrete and continuous random variable and their properties, distribution functions, Binomial, Poisson and Normal Distribution and evaluation of statistical parameter of these three distributions. **Test of significance:** sampling, large sample test for single proportion, difference of proportions, single mean, difference of means and difference of standard deviation, Chi-square test for goodness of fit. 9

Books & References

1. D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley.
2. J. L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning.
3. S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press; 5th edition
4. Robert V Hogg, Joseph McKean, Allen T Craig, Introduction to Mathematical Statistics, Pearson Edu.
5. Mood, Graybill and Boes, Introduction to the Theory of Statistics, Tata McGraw- Hill.

Course Code: BEC 207		**DIGITAL ELECTRONICS**
Course category	:	Engineering Fundamental (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, minor test and Major Theory & Practical Examination
Course Objectives	:	The course aims to provide knowledge of digital electronics, combinational and sequential circuits, state machines, and digital system design.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about basics of digital electronics and solving problems related to number systems and Boolean algebra.
2. Ability to identify, analyze and design combinational circuits.
3. Ability to identify, analyze and design sequential circuits.
4. To design, implement and evaluate various synchronous and asynchronous sequential circuits and applications.
5. Acquired knowledge about internal circuitry and logic behind digital systems.
6. Able to understand State machine design procedure with sequential PLDs.

Topics Covered

UNIT-I **9**

Digital system and Binary numbers: Signed binary numbers, Floating point number, Binary Codes, Cyclic codes, Error detecting and correcting codes, Hamming codes. NAND and NOR implementation, Minimization of circuit using K-map and Tabular method up to five variables, POS and SOP simplification, Logic family- TTL, DTL, ECL, CMOS, HMOS

UNIT-II **9**

Combinational Logic: Analysis and Design procedure for Combinational circuits, Binary adder/subtractor, Binary multiplier, Booth Algorithm, Magnitude comparator, Encoder/Multiplexer, Decoder/Demultiplexer.

UNIT-III **9**

Sequential logic: Sequential circuits, Latches, Flip-flops, Conversion of flip-flops, Analysis of clocked sequential circuits, State reduction and assignments. Registers and counters: Shift registers, Asynchronous counter, Synchronous counter, Sequential circuit analysis and design procedure, Circuit with latches, Hazards.

UNIT-IV **9**

Memory and programmable logic: Read only Memory, Read/Write Memory-SRAM and DRAM. Programmable Logic Devices, -PLAs, PALs and their applications; Sequential PLDs and their applications; State machine design with sequential PLDs: Introduction, to field programmable gate arrays (FPGAs).

LIST OF EXPERIMENTS

1. Design and verification of following arithmetic circuits using 74xx family ICs.
   i) Half adder and Full adder
   ii) Half subtractor and full subtractor
2. To perform the code conversion- binary to gray and gray to binary and its truth table verification.
3. To design a combinational logic circuit using 74xx family ICs and its truth table verification in both SOP and POS forms.
4. Realization of 2:4 decoders and 4:2 encoder circuit and verification of its truth table.
5. To design and verify the truth table of multiplexer and demultiplexer circuits.
6. To design a 1-bit comparator using 74xx family ICs and to study the performance of4- bit comparator IC7485.
7. Design and verification of basic Flip-Flops using 74xx family ICs and master-slave JK flip-flop using IC7476
8. To realize and verify the truth table of shift register-SIPO/SISO and PISO/PIPO.
9. Design and verification of asynchronous counter design and Mod-n counter.
10. To realize and verify the truth table of synchronous counter design

Books & References

1. Hill & Peterson, “Switching Circuit & Logic Design”,Wiley
2. Mano, M. Morris. Digital design. Pearson Educación, 2002.
3. Digital principle and applications Malvino and Leach-(TMH)

Course Code: BEC-208 **Network Theory: Analysis & Synthesis**

Course category : Professional Core (PC)

Pre-requisite Subject : NIL

Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, assignments, quizzes, minor test and major theory examination.
Course Objective	:	The course aims to develop skills in circuit analysis, Laplace transforms, network synthesis, and transfer function realization for electrical systems.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Able to apply the electric circuit concept and theorems with nodal and mesh on the complex RL, RC & RLC circuits in time and frequency domain.
2. Able to apply the concept of Laplace Transform to evaluate the system function for single and two port networks.
3. Able to synthesize the LC, RC & RL immittance networks using the Foster and
4. Cauer approaches.
5. Able to realize the synthesize the transfer functions of two port networks and active networks.

Topics Covered

UNIT-I

Signal and System analysis, Definition and basic circuits concepts, Mesh and nodal analysis, General characteristics of signals and wave forms: step, impulse, ramp, and gate function; Initial and final conditions in circuits, Network Theorem: Maximum Power Transfer Theorem, Milliman's Theorem; Solution of network equations: Transient Response &steady state response, Convolution Integral of basic signals. **9**

UNIT-II

Laplace Transform: Introduction, Region of Convergence, Laplace transform of common basic signals, Properties, Inverse Laplace Transforms, Application of Laplace Transform Techniques to Electrical Circuits analysis, Transform Circuits, Thevenin and Norton's Theorem, Initial and Final Value theorem. **9**

Two-Port Network functions: Introduction, Parameters, Condition for reciprocity and symmetry, Relation between port parameters, Interconnection of two ports networks.

UNIT-III

Element of Realizability: Concepts of Poles and Zeroes, Causality & Stability, Hurwitz polynomials, Positive real functions; Network Synthesis using Cauer and Foster: Properties of real immittance functions, synthesis of LC driving point immittances, Properties of RC driving point impedances, Synthesis of RC impedances or RL admittances, Properties of RL impedances and RC admittances. **9**

UNIT-IV **9**

Transfer function synthesis: Properties of transfer function, Zeroes of Transmission, Synthesis of Y_{21}& Z_{21} with 1-ohm termination, Introduction to Active network synthesis: Operation of filters, filter design, frequency scaling.

Textbooks

1. Franklin F. Kuo, 'Network Analysis and synthesis', 2nd Edition, Wiley India Pvt Ltd.
2. M.E. Van Valkenberg, 'Network Analysis', 2nd Edition, Prentice Hall of India Ltd.
3. M.S. Sukhija, T.K. Nagsarkar, 'Circuits and Networks' 2nd Edition, Oxford University Press.
4. S.P. Ghosh, A.K. Chakraborty, 'Network Analysis and Synthesis' McGraw Hill Education Pvt Ltd.

Course Code: BEC-209	**Electronic Measurement & Instrumentation**
Course category	: Professional Core (PC)
Pre-requisite Subject	: Nil
Contact hours/week	: Lecture: 3, Tutorial:0, Practical: 2
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor Test and Major Theory Examination
Course Objectives	Upon completion, students will be able to explain quality measurements, use digital display devices, solve circuit problems, illustrate transducer principles, and understand instrumentation and DAS applications.
Course Outcomes	: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Able to explain the quality measurements with electronic instruments.
2. Able to use the digital display devices in practical applications.
3. Able to solve and illustrate the numerical problem for DC/AC bridge-based circuits.
4. Able to illustrate the principles of various types of transducers and their applications.
5. Able to explain the construction, principle of operation, and applications of electromechanical and electronic instruments along with Data Acquisition System (DAS).
6. Able to articulate the range of measuring instruments.

UNIT-I **9**

Measuring Instruments: classification, absolute and secondary instruments, Performance Characteristics, Error in measurement, Sources of error, Arithmetic mean, Deviation from the mean,

Average deviation, Standard deviation, Limiting errors. PMMC instruments, Expression for the deflecting torque and control torque, Analog to digital (Linear and digital ramp method, successive approximation method) and Digital to analog (R-2R method) converters. Digital Display Devices: LED, LCD, Incandescent Display, LVD (Liquid Vapour Display)

UNIT-II **9**

DC/AC Bridges: General equations for bridge balance, Self-inductance measurement by Maxwell's bridge, Hay's bridge, Capacitance measurement by De Sauty bridge, Schering bridge and Wein Bridge, Method of measuring low, medium and high resistance: Kelvin's double bridge for measuring low resistance, Wheat-stone's bridge, measurement of high resistance, Basics of wattmeter and energy meter

UNIT-III **9**

Transducers: Introduction, Selection Parameters of Transducer, Type of Transducer, Resistive Transducer: Strain Gauges, Inductive Transducer: LVDT, Capacitive Transducer, Photo-electric Transducer: Photo conductor, Photodiode and Photo-Voltaic Cell, Thermoelectric Transducers: RTDs, Thermistor and Thermocouple, Piezoelectric Transducer, Digital Transducer.

UNIT-IV **9**

Electromechanical Instruments: Ammeter, Voltmeter and Ohmmeter, Extension of range using shunts and series resistance. Analog and Digital electronic Instruments: Emitter-follower voltmeters, operational amplifier voltmeter, Digital voltmeter system, Digital mustimeters, Digital frequency meter system. Data Acquisition System, Single and Multichannel DAS, Data Loggers: Block diagram, principle of operation.

LIST OF EXPERIMENTS

Radio Receiver Measurements

1. Study of half-wave and full-wave bridge rectifier using resistive load.
2. To design a series RLC circuit and study the condition of resonance.
3. Study of L.C.R. Bridge and determination of the value of the given components.
4. Study of the distortion factor meter and determination of the % distortion of the given oscillator.
5. Study of the transistor tester and determination of the parameters of the given transistors.
6. Measurement of resistance using the Wheatstone bridge.
7. Measurement of phase difference and frequency using CRO (Lissajous figure).
8. Measurement of low resistance using Kelvin's double bridge.
9. To measure the linear displacement using the LVDT trainer kit.
10. To design an IR sensor-controlled LED on a breadboard.

Optional Experiments

1. Measurement of capacitance by Schering Bridge.
2. To measure the value of an unknown inductance with the help of Anderson's Bridge.
3. Measurement of capacitance by Schering Bridge.
4. To measure the value of an unknown inductance with the help of Anderson's Bridge.

Text & Reference Books

1. H. S. Kalsi, "Electronic Instrumentation", 3rd Ed., McGraw Hill Education (India), 2015.

2. David A. Bell, "Electronic Instrumentation and Measurements", 3rd Ed., Oxford University Press, 2013.

Course Code: BEC-210	**Electronic Devices & Circuits Theory**
Course category	: Department Core (PC)
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture: 3, Tutorial : 1, Practical: 0
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through tutorials, attendance, home assignments, quizzes, and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	: The course aims to provide understanding of diodes, high-frequency applications, FET characteristics, high-power devices, and charge-transfer operations.
Course Outcomes	: The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to understand the basic operation and working of BJT.
2. Able to understand the small-signal operation and models of BJT.
3. To understand and use of the device models to explain and calculate the characteristics of the field effect transistors.
4. Able to understand the small-signal operation and models of MOSFET.
5. To be able to understand and analyze the feedback amplifiers.
6. Understand the basic principles of oscillators.

Topics Covered

UNIT-I **9**

BJT: Review of device structure operation and V-I characteristics, BJT circuits at DC, BJT as amplifier and switch, biasing in BJT amplifier circuit;

Small-signal operation and models, single stage BJT amplifier, BJT internal capacitances and high frequency model, frequency response of CE amplifier. Darlington pair, BJT differential pair, Cascode and Cascade amplifier.

UNIT-II **9**

FET: Review of device structure operation and V-I characteristics, FET Circuits at DC, FET as Amplifier and switch, Biasing in FET amplifier circuits; Small-signal operation and models, single stage FET amplifier, FET internal capacitances and
high frequency model, frequency response of CS amplifier

UNIT-III **9**

Feedback Amplifiers: The general feedback structure, properties of negative feed- back, the four basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, the shunt-shunt and shunt-series feedback amplifier.

UNIT-IV **9**

Oscillators: Basic principles of sinusoidal oscillators, RC Phase-shift Oscillator circuits, Resonant-circuit based LC oscillators.

Books & References

1. Milman, Halkias & Jit- Electronics Devices and Circuits- TMH
2. Donald ANeaman, "Semiconductor Physics and Devices Basic Principles", 3e, TMH India.

Course Code: BEC-259		**Electromagnetic Field Theory**
Course category	**:**	Engineering Fundamental (EF)
Pre-requisite Subject	**:**	Nil
Contact hours/week	**:**	Lecture: 3, Tutorial:1, Practical: 0
Number of Credits	**:**	4
Course Assessment methods	**:**	Continuous assessment through tutorials, attendance, assignments, quizzes, minor test and major theory Examination
Course Outcomes	**:**	Understand electromagnetic fields, wave propagation, transmission lines, impedance transformation, and solve problems using Smith charts.
Course Outcomes	**:**	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understanding the basic mathematical concept related to electromagnetic vector fields and principles of electrostatic.
2. Apply the principles of magneto statics to the solutions of the problem relating to magnetic field.
3. Apply Maxwell's equations to solutions of problems relating to uniform plane wave propagation.
4. Understand characteristics and wave propagation on high frequency transmission lines.

5. Carryout impedance transformation on transmission line.
6. Use smith chart to find the solution of various transmission line problems.

UNIT-I **9**

Electrostatics Fields: Various co-ordinate system, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gauss's Law – Maxwell's equation, Electric dipole and flux lines, Divergence Theorem, Poisson's and Laplace's equation, Energy density in electrostatic fields. Electric field in material space: Properties of materials, Convection and conduction currents, conductors, Polarization in dielectrics, Dielectric Constants, continuity equation and relaxation time, Boundary condition. Method of images.

UNIT-II **9**

Magneto-static fields, Biot-Savart's Law, Ampere's circuit law for a current element, magnetic scalar and vector potential, Magnetic dipole, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, Magnetic forces, materials and devices: Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole, Magnetization in materials, magnetic boundary conditions, Magnetic energy. Waves and applications: Faraday's Law, Transformer and motional electromotive forces, Displacement current, Maxwell's equations in differential and integral form.

UNIT-III **9**

Electromagnetic wave propagation: Derivation of wave equation and their general solution, Wave propagation in lossy dielectrics, Plane waves in lossless dielectrics, Plane wave in free space, Plain waves in good conductors, Poynting's theorem, Power and the Poynting vector, Reflection of a plane wave at normal and Oblique incidence.

UNIT-IV **9**

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

Text & Reference Books

1. W. H. Hayt and J. A Buck "Electromagnetic field Theory" 7th Ed. TMH

2. M. N. O. Sadiku, "Elements of Electromagnetics", 4th Ed, Oxford University Press

Course Code: BEC-260 **SIGNAL & SYSTEMS**
Course category : Professional Core (PC)
Pre-requisite Subject : NIL

Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor test and Major Theory & Practical Examination
Course Objectives	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to describe the signals and systems mathematically and understand how to perform mathematical operations on signals and systems.
2. Able to analyse spectral characteristics and system properties based on impulse response and Fourier analysis.
3. Apply the Laplace transform for analysing of continuous-time time signals and systems.
4. Apply the Z- transform for analysing of discrete-time signals and systems.
5. Able to apply the transformation tools (continuous and discrete) on the analysis of spectral densities, design of system function
6. Able to apply the transformation tools to design system function through its block diagram representation.

Topics Covered

UNIT-I **9**

Signals: Definition, types of signals and their representations: Continuous-time/discrete-time, Periodic/non-periodic, Even/Odd, Energy/Power, Deterministic/Random, One dimensional /Multidimensional, Commonly used signals (in continuous-time as well as in discrete-time): Unit impulse, Unit step, unit ramp (and their interrelationships), Exponential, Rectangular pulse, Sinusoidal; Operations on continuous-time and discrete-time signals (including transformations of independent variables).

Systems: Classification, Linearity, Time-invariance and causality, Impulse response, Characterization of linear time-invariant (LTI) systems, Unit sample response, Convolution summation, Step response of discrete time systems, Stability, Poles and zeros

UNIT-II **9**

Fourier Series (FS) and Fourier Transforms (FT): (i) Fourier series representation and some important properties (ii) Definition, conditions of existence of FT, properties, Magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT (iii) Discrete time Fourier transform (DTFT), Inverse DTFT, Convergence, Properties and theorems, Comparison between continuous time FT and DTFT

UNIT-III **9**

Laplace-Transform (LT) and Z-transform (ZT): (i) One-sided LT of some common signals, Important theorems and properties of LT, inverse LT, Solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC) (ii) One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, Solution of difference equations using one-sided ZT, s- to z-plane mapping

UNIT-IV **9**

Time and frequency domain analysis of systems: Convolution integral, Co-relations, Signal energy and energy spectral density, signal power and power spectral density, Properties of power spectral density, Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, System functions of CT systems, Block diagram representations; discrete-time system functions, block diagram representation, Illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter

Books & References

1. Chi-Tsong Chen, `Signals and Systems', 3rd Ed., Oxford University Press,2004
2. V. Oppenheim, A.S. Willsky and S. Hamid Nawab, 'Signals &System', PearsonEducation,2nd Ed.,2003
3. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi

Course Code: BEC-261		**Microprocessors and Applications**
Course category	:	Professional Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, assignments, quizzes, practical work, record, viva voce, minor and major theory & practical Examination
Course Objectives	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to understand the basic building blocks of Microprocessors.
2. Acquiring knowledge about 8085 Microprocessor and supporting devices.
3. Foster ability to write the assembly language programming using 8085 microprocessors.
4. Foster ability to understand 8086/8088 microprocessors
5. Foster ability to write the assembly language programming using 8086

microprocessors.

6. Foster ability to develop microprocessor-based system using different peripheral devices.

Topics Covered

UNIT-I **9**

Introduction to Microprocessors: Evolution of Microprocessors, Microprocessor Architecture and its operations, Memory devices, I/O Devices, 8-bit Microprocessor (8085): Introduction, Signal Description, Register Organization, Architecture, Basic Interfacing Concepts for Memory and I/O Devices

UNIT-II **9**

8085 Assembly Language Programming: Instruction Classification, Instruction Format, Addressing Modes, 8085 Instructions: Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, Flow Chart, writing assembly language programs, Programming techniques: looping, counting and indexing.

UNIT-III **9**

16-bit Microprocessors (8086/8088): Architecture, Physical address segmentation, memory 18 organization, Bus cycle, Addressing modes, difference between 8086 and 8088, Assembly Language Programming of 8086.

UNIT-IV **9**

Basic Peripherals & their Interfacing: DMA Controller (8257), Programable Peripheral Interface (8255), Programmable Interrupt Controller (8259), Programmable Interval Timer/ Counter (8253/8254).

LIST OF EXPERIMENTS

1. Write a program using 8085 Microprocessor for Decimal addition and subtraction of two numbers.
2. Write a program using 8085 Microprocessor for Hexadecimal addition and subtraction of two numbers.
3. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
4. To perform multiplication and division of two 8-bit numbers using 8085.
5. To find the largest and smallest number in an array of data using 8085 instructions set.
6. To write a program to arrange an array of data in ascending order.
7. Write a program to transfer blocks of data.
8. Write a program to find positive and negative numbers from a given series of data.
9. To interface 8253 programmable interval times to 8085 and verify the operation of 8253 in six different modes.
10. To interface 8255 with 8085 and verify the operation of 8255 in different modes.
11. To interface 8259 with 8085 and verify the operation of 8259.

Books & References

1. R. Singh and B. P. Singh: Microprocessor Interfacing and Application, New Age International Publishers, 2nd Edition.
2.D. V. Hall: Microprocessors Interfacing, TMH (2nd Edition).
3.R. S. Gaonkar: Microprocessor Architecture, Programming and Applications with

8085/8080, Penram Publication
4.Y.C. Liu and G.A. Gibson: Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design, PHI 2nd Edition,

Course Code: BEC-262 Analog Integrated Circuits

Course category	:	Professional Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through Viva voce, Practical work, attendance, minor test, major & practical examination
Course Objectives	:	The course aims to develop skills in op-amp characteristics, circuit design, linear/non-linear applications, feedback amplifiers, filters, and advanced integrated circuits
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Explain about the operational amplifiers and its characteristics as well as various types of ops- amps.
2. Acquire the ability to design and test practical circuits for amplifiers.
3. Able to implement the concept of Op-Amp to design Op-Amp based linear and non-linear applications.
4. Understand the operation of feedback amplifiers and oscillators.
5. Able to learn the basic functioning of filters, and advanced applications of OP- amp to design first and second order filter.
6. Able to design integrated circuits for advanced applications.

Topics Covered

UNIT-I 9

Introduction to Integrated Circuit Design

Review of electronics integrated circuits, Block diagram of Op-AMP, differential amplifiers, Current mirrors using BJT and MOSFETs, Base current compensated mirrors, Wilson current mirrors, Wilder current source, Basic OPAMP configurations and characteristics, OPAMP non-ideal ties,

UNIT-II 9

Op-amp circuits:

Amplifiers, summers, differentiators, integrators, and oscillators.

Linear and Nonlinear applications of Op-amp:

V-I and I-V converters, Log-antilog amplifiers, Precision rectifier, Peak detector, Sample and Hold Circuits, Analog multiplier and their applications, Op-amp as a comparator, Zero-crossing

detector, Schmitt trigger, stable and Monostable multivibrator using Op-Amp, Generation of triangular waveform.

UNIT-III 9

Filters:

Characteristics of filters, Classification of filters: LPF, HPF, BPF, BSF, APF Design of first and second order filter: Butterworth filters, Chebyshev filters, Bessel filters.

UNIT-IV 9

Advance Applications of integrated circuits:

Frequency Divider, PLL IC, 555 IC timer, Design of a stable and monostable Multivibrators using 555 Timer IC, VCO.

EXPERIMENTS

1. To Study the characteristics of inverting operational amplifier.
2. Design of an instrumentation amplifier.
3. Design and test an astable multivibrator for a given frequency.
4. Study the characteristics of integrator circuit.
5. Design of Analog filters.
6. Design of a Phase Locked Loop (PLL)
7. Realization of Schmitt trigger circuit.
8. Op-amp (741) as an integrator and realization of low pass filter, and op-amp as differentiator and realization high pass filter.
9. (a) Verify the operation of voltage comparator circuit.
   (b) Verify the operation of zero crossing detector circuit.

Books & References

1. Microelectronic Circuits, Sedra and Smith, 7th Edition, Oxford, 2017.
2. Behzad Razavi: Design of Analog CMOS Integrated Circuits, TMH.

BEC-309		**Microwave Theory and Techniques**
Course category	:	Professional Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, One minor test and one major theory Exam
Course Objectives		Understand microwave frequency spectrum and applications, Analyze microwave transmission lines and waveguides, Study microwave components and devices, Learn microwave measurement techniques and system concepts

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Analyze guided wave propagation on transmission lines and rectangular waveguides, including impedance, guide wavelength, cutoff, and dispersion for dominant and higher-order modes.
2. Explain principles and operating characteristics of microwave sources and solid-state devices (e.g., klystron, magnetron, Gunn diode, PIN/Schottky), and select suitable devices for specified RF power and frequency requirements.
3. Model and interpret S-parameters of two-port/three-port passive microwave components (attenuators, couplers, tees, isolators, circulators), and predict performance in simple networks.
4. Test standard microwave measurements on a test bench (frequency, wavelength, power, attenuation, VSWR, impedance), analyze uncertainty, and validate results against theory.
5. Design basic microstrip components or antennas and verify performance via EM simulation workflows (geometry, meshing, excitation, post-processing) using contemporary tools.
6. Simulate microwave components professionally, adhere to ethical practices, and collaborate effectively to present technical findings clearly.

Topics Covered

UNIT-I 9

Waveguides and Microstrip Lines: Rectangular Wave Guide: Field Components, TE modes, TM modes, Dominant TE10 mode, Field Distribution, Power, Attenuation, Circular Waveguides: TE, TM modes. Wave Velocities, Planar Transmission Lines: Microstrip line, Stripline, Coplanar strips

UNIT-II 9

Microwave Components: S-parameters: Scattering Matrix, Passive microwave devices: Microwave Hybrid Circuits: E-Plane Tee, H-Plane Tee, Magic Tee, Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Microwave Propagation in ferrites: Faraday Rotation, Isolators, Circulators

UNIT-III 9

Microwave Tubes & Devices: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Microwave Solid state devices: Tunnel Diode, Transferred electron devices: Gunn Diode, Avalanche Transit –time devices: IMPATT Diode, TRAPPAT Diode.

UNIT-IV 9

Microwave Measurements and Systems: General set-up of a microwave test bench, Slotted line carriage, VSWR Meter, microwave power measurements techniques, Crystal Detector, frequency measurement, wavelength measurements. Impedance and Refection coefficient, VSWR, Insertion and attenuation loss measurements

List of Ansys Electronics Desktop Tools based Experiments

1. Design of Rectangular Waveguide: Understand waveguide dimensions, cutoff frequency, and mode propagation

2. Waveguide E-Plane Tee (Series Tee): Analyze S-parameters and power division characteristics
3. Waveguide H-Plane Tee (Shunt Tee): Study impedance matching and phase relationships
4. Magic Tee (E-H Plane Tee): Verify combining properties of E-plane and H-plane tees
5. Waveguide Bend (E-plane & H-plane): Simulate bending effects on S-parameters and impedance

Books & References

1. Liao, S.Y. / Microwave Devices & Circuits; PHI 3rd Ed.
2. Collin, R.E. Foundations for Microwave Engineering; TMH 2nd Ed.
3. Rizzi, Microwave Engineering: Passive Circuits; PHI.
4. A Das and S.K. Das, Microwave Engineering; TMH.

Course Code: BEC-310 Modern Control Systems

Course category	:	Professional Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, and One Minor test and One Major Theory examination.
Course Objectives	:	This course is aimed to develop the concepts of control systems skills with introducing the components & their representation of control systems, analyzing the time & frequency response, and state variable analysis.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Describe the response characteristic and differentiate between the open loop and closed loop control system.
2. Compute the performance of basic control systems in time domain.
3. Analyze the response of a control system using poles and zeros to determine the response of a control system.
4. Determine the stability of a control system using Routh-Hurwitz method.
5. Evaluate the performance of basic control systems in frequency domain.
6. Able to derive mathematical models for simple electrical and mechanical systems using transfer function and state variable method.

Topics Covered

UNIT-I **9**

Basic components of a control system, Feedback and its effect, Sensitivity, Types of feedback control systems, Block diagrams: Representation and Reduction, Signal Flow Graphs, Modeling of physical systems: Electrical networks and Mechanical systems, Force-Voltage analogy, Force-Current analogy.

UNIT-II **9**

Time response of continuous data systems, Standard test signals for the time response, Unit step response and Time-Domain specifications, Time response of a first order and second order systems for different test signals, Steady state Error and Error constants, Error analysis for different types of systems, Control Actions: Proportional, Derivative, Integral and PID control. Introduction to Process control systems, Pneumatic hydraulics, Actuators.

UNIT-III **9**

Stability: Methods of determining stability, Routh Hurwitz Criterion, Root Locus, Frequency Domain Analysis: Resonant peak, Resonant frequency and Bandwidth of the second order system, Polar plot, Nyquist stability criterion, Bode Plot, Gain Margin and Phase Margin.

UNIT-IV **9**

State-Space Analysis of Control System: Vector matrix representation of state equation, State transition matrix, Relationship between state equations and high-order differential equations, Relationship between state equations and transfer functions, Block diagram representation of state equations, Decomposition Transfer Function, Kalman's Test for controllability and observability.

Books & References

1. Katsuhiko Ogata, "Modern Control Engineering", 3e, PHI Publication, 2000.
2. I. J. Nagrath & M. Gopal, "Control System Engineering", New Age International Publishers.
3. B. C. Kuo & Farid Golnaraghi, "Automatic Control Systems", 8e, John Wiley India, 2008.
4. William A. Wolovich, "Automatic Control Systems", Oxford University Press, 2010.

BEC-311	**Analog and Digital Communication**
Course category	: Professional Core (PC)
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture: 3, Tutorial: 0 , Practical: 2
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One minor test and one major theory & practical examination
Course Objectives	The objective of this course is to introduce the basic concepts of communication systems, study both analog

and digital modulation techniques, understand noise performance in communication systems, and expose students to practical aspects via laboratory experiments.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

CO1: Explain the fundamental principles of analog and digital communication.

CO2: Analyze various analog modulation and demodulation schemes.

CO3: Understand and evaluate digital modulation techniques and their performance.

CO4: Quantify the effect of noise on communication systems.

CO5: Compare performance of different modulation schemes.

CO6: Apply communication principles to design and analyze simple circuits.

Topics Covered

UNIT-I 9

Introduction to Analog Communication: Basics of Communication Systems: Amplitude Modulation (AM): Double-sideband full carrier (DSB-FC), Double-sideband suppressed carrier (DSB-SC), Single sideband (SSB), Vestigial Sideband (VSB), Generation and Demodulation of AM, DSB-SC, SSB, VSB, Power and Bandwidth calculations for various AM types, Frequency Modulation (FM) and Phase Modulation (PM), Modulation Index, Spectral Behavior, Frequency Mixing and Pre-emphasis/De-emphasis

UNIT-II 9

Noise in Communication Systems and Random Processes: Sources of Noise: Thermal, Shot, Inter-modulation, Noise Figure, Noise Temperature, Signal-to-Noise Ratio (SNR), Effective Noise Temperature, Noise in DSB, SSB, and FM Receivers, FM Threshold Effect, Noise Triangles, Figure of Merit for FM Systems, Random Processes: Stationary processes (WSS), Autocorrelation and cross correlation, Power Spectral Density, Gaussian process, White noise and bandlimited noise, Noise modelling in communication systems

9

UNIT-III

Digital Modulation Techniques: Introduction to Digital Communication, Pulse Code Modulation (PCM): Sampling, Quantization, Encoding, Differential PCM (DPCM), Delta Modulation (DM), Adaptive DM, Line Coding: NRZ, RZ, Manchester, Bipolar, Digital Modulation Schemes: ASK, FSK, PSK, QPSK, M-ary schemes and Matched Filter

9

UNIT-IV

Information Theory & Coding: Introduction to Information Theory: Entropy, Average Information, Source Coding: Shannon-Fano, Huffman Coding, Channel Capacity: Shannon's Theorem, Bandwidth-SNR trade-off, Error control coding, Block code, Hamming code, Cyclic codes

EXPERIMENTS

1. Generation of DSB-FC, demodulation using envelope detector.
2. DSB-SC Modulation & Coherent Detection
3. SSB Generation and Detection
4. Frequency Modulation (FM) Generation and Demodulation using VCO/PLL based FM trainer kit.
5. To construct a pulse amplitude modulation (PAM) and demodulation circuit and to observe the waveform.
6. To understand and implement Pulse Width Modulation (PWM) using IC 555 by varying the amplitude of the modulating signal and plot the relevant waveforms.
7. To understand and implement Pulse Position Modulation (PPM) using IC 555 and plot the relevant waveforms.
8. Study of delta modulation and demodulation and observing effect of slope overload DCL07.
9. Study of pulse data coding techniques for NRZ formats. Study of pulse data coding techniques for NRZ formats.
10. Data decoding techniques for NRZ formats. ST21067
11. To Study and implement of amplitude shift keying modulator and demodulator and to observe the waveform.
12. To Study and implement FSK modulator and demodulator and to observe the waveform.
13. Study of phase shift keying modulator and demodulator ST467.
14. Study of single bit error detection and correction using Hamming code. ST2103.

Books & References

1. Haykin, Simon, "Communication Systems", John Wiley, 4e.
2. Singh, R.P. &Sapre, S.D. "Communication Systems: Analog & Digital", Tata McGraw-Hill.
3. Lathi, B.P, "Modern Digital & Analog Communication Systems", Oxford University Press.
4. Taub& Schilling, "Principles of Communication Systems", Tata McGraw-Hill
5. Prokis J.J, "Digital Communications", McGraw Hill

BMS-301 Principles of Industrial Management

Course category	:	Management (M)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and one Minor Test and one Major Theory Examination.
Course Objectives		To enable students to develop operational skills and analyzing different situations in the industrial scenario having limited resources and obtain the optimal solution with and without constraints.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students should be able to become efficient and acquire acumen for more profitable business practices.

2. Students should be able to understand the importance of better customer service and product quality.
3. Students should be able to make work safer, faster, easier, and more rewarding.
4. Students should be able to help the industry in the production of more products that possess all utility factors
5. Students should be able to reduce costs associated with new technologies.
6. Students should be able to understand different principle of Industrial Management.

Topics Covered

UNIT-I

Introduction of Industrial Management: Definition, Nature and Scope of Management, Process of management, Elements of management, Definition of industrial management, Scope and Application of industrial management.

Plant Location and Layout: Factors affecting Plant Location, Objectives and Principles of Plant Layout, Types of Plant-Layout

UNIT-II

Work Analysis and Measurement: Design of work study, steps involved in work-study process, Definition and Concept of Method study, Procedure involved in Method study, Objectives and techniques of Work Measurement, worksampling and its application, Selection of Personnel and wage payment plans.

UNIT-III

Material Management: Meaning of Inventory management, Economic Order Quantity Model, ABC analysis, Just-in-time, Minimum Safety Stock

Industrial Safety: Occupational safety, safety programs; Safety aspects in work system design

UNIT-IV

Project Management: Meaning, Features, Project management life cycle, Project cost control System, Project planning and control, Project scheduling and techniques.

Text & Reference books:

1. Joseph Russell Smith, "The Elements of Industrial Management", Hard Press
2. Gavriel Salvendy, "Handbook of Industrial Engineering: Technology and Operations Management", John Wiley & Sons, Inc.
3. S. N. Chary, "Production and Operations Management", Tata McGraw Hill
4. R. Paneerselvam, "Production and Operations Management", PHI
5. E. S. Buffa and R. K. Sarin, Modern Production/ Operations Management, Wiley.

Course Code: BEC--357 Embedded Systems and Microcontrollers

Course category	:	Professional Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, one minor test and one major theory examination.
Course Objectives		This course is aimed at developing the concepts of microcontrollers and embedded systems.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Differentiate between an embedded system and a general computing system and their classifications.
2. Understand embedded system-related concepts and their characteristics.
3. Demonstrate the basic components of the 8051 microcontrollers, like memory, registers, Timers, Serial communication and interruptions.
4. Comprehend an assembly language program for 8051.
5. Acquired knowledge about Hardware-Software Co-design issues for microcontroller operation.
6. Knowledge about the Application and design of a typical embedded product design and development approach.

Topics Covered

UNIT-I 9

Introduction to Embedded Systems: Embedded Systems VS. General Computing Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Elements of an Embedded System, Core of the Embedded System: General Purpose and Domain Specific Processors, Application Specific Integrated Circuits (ASICs), Programmable Logic Devices (PLDs), Commercial off-the-shelf Components (COTS). Memory, Sensors and Actuators, Communication Interface: Onboard Communication Interfaces, External Communication Interfaces. Embedded Firmware and Other System Components.

UNIT-II 9

Characteristics of an Embedded System, Quality Attributes of Embedded Systems, Application-Specific Embedded System, Domain-Specific Embedded Systems, Designing Embedded Systems with 8-bit Microcontrollers—8051: Factors to be Considered in Selecting a Controller, Overview of the 8051 Microcontroller Family. 8051 Architecture: Hardware, Memory Organization, Registers, Oscillator Unit, Ports, Interrupts.

UNIT-III 9

The 8051 Interrupt System, Timer Units, Serial Port, Reset Circuitry, and Power Saving Modes. 8051 Assembly Language Programming: Structure of Assembly language, Assembling and running an 8051 program, Addressing modes: Direct Addressing, Indirect Addressing, Immediate addressing, Register Addressing and Indexed Addressing. Instruction set: Data Transfer Instructions, Arithmetic operations and Programs, Logical operations and Programs, Boolean Instructions, Program Control Transfer Instructions.

UNIT-IV 9

Fundamental Issues In Hardware Software Co-Design, Computational Models In Embedded Design: Data Flow Graph/Diagram (DFG) Model, Control Data Flow Graph Diagram (CDFG), State Machine Model, Sequential Program Model, Concurrent/Communicating Process Model, Object-Oriented Model, Unified Modelling Language (UML): UML Building Blocks, The UML Tools. Hardware Software Trade-Offs, Typical Embedded product design and development approach, Some Important Microcontroller Architecture: EPS32/EPS32-S3 Family, STM32F405RG family, and RP2350 family, PyBoard, raspberry pico 2 board, and Nano ESP32 Arduino board.

Textbooks & References

1. Introduction to Embedded Systems by K V Shibu, 2nd edition, 2017, McGraw-Hill

2. The 8051 Microcontrollers and Embedded Systems: Muhammed Ali Mazidi, 2nd edition, Pearson Education India.

3. Datasheets of EPS32, STM32F405RG, and RP2350.

BEC-358		**Optical and Wireless Communication**
Course category	:	Professional Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 0 , Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One minor test and one major theory & practical examination
Course Objectives		To introduce the fundamentals of optical and wireless communication systems. To develop understanding of guided and wireless transmission media and their characteristics. To study modulation, transmission, and reception techniques in optical and wireless systems. To expose students to performance analysis and design trade-offs in both optical fiber and wireless channels.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

CO1: Understand basic principles and components of optical and wireless communication systems.

CO2: Analyze optical fiber propagation, losses, dispersion, and fiber impairments.

CO3: Explain modulation techniques used in optical communications and evaluate link performance.

CO4: Understand wireless propagation mechanisms, path loss, fading, and multipath effects.

CO5: Apply modulation and multiple access techniques used in wireless systems.

CO6: Compare optical and wireless communication systems and their applications in modern networks.

Topics Covered

UNIT-I 9

Fundamentals of Optical Communication: Introduction to Optical Communication: advantages, applications, system block diagram, Optical fiber: structure, types (step-index, graded-index; single-mode, multimode), Optical fiber materials and fabrication, Modes and propagation: acceptance angle, numerical aperture, V-number, Fiber losses: absorption, scattering, bending losses

UNIT-II 9

Optical Sources, Detectors & Link Design: Optical sources: LEDs, Laser diodes – structure, characteristics, Optical detectors: PIN photodiodes, APDs – responsivity, quantum efficiency, Optical power budget and link design, Dispersion in fibers: chromatic dispersion, modal dispersion, polarization mode dispersion, Wavelength Division Multiplexing (WDM)

UNIT-III 9

Wireless Communication Fundamentals: Wireless propagation: free-space propagation model, path loss models, Reflection, diffraction, scattering; multipath propagation, Large-scale and small-scale fading, Doppler effect, Slow and fast fading, coherence bandwidth/time, Statistical models for fading: Rayleigh and Rician distributions

UNIT-IV 9

Wireless Modulation and Multiple Access Techniques: Wireless modulation techniques: ASK, FSK, PSK, QPSK, QAM, OFDM basics and advantages, Multiple access techniques: FDMA, TDMA, CDMA, OFDMA, Cellular concept, frequency reuse, cell splitting and sectoring, Introduction to 4G/5G: key technologies (Massive MIMO, mmWave, beamforming)

OPTICAL Practical:

1. To implement and plot the I-V and I-P characteristics of LED.
2. To implement and plot the I-V and I-P characteristics of LASER Diode.
3. To implement and plot the I-V and I-P characteristics of Photo Detector.
4. To implement, study and analyze numerical aperture and losses in optical fiber.
5. To study and analyze modes and power in optical fiber using software.
6. To implement and study FM and PWM through optical link.

7. To implement and study free space optics using LASER module.
8. To implement and find the BER and EYE Pattern.
9. To implement and study power margin and sensitivity of optical system.
10. Design and performance analysis of a single channel link using Optisystem.
11. Design and performance analysis of a WDM link using Optisystem.
12. Link budget and rise time budget analysis of a single channel optical link using Optisystem.

WIRELESS Practical:

1. Implement and simulate the various modulation schemes and analyze their performance
2. Implement and simulate M-PSK and M-QAM Modulation Techniques with the help of MATLAB software where M= 4, 8, 16, 32, 64.
3. To Simulate M-PSK and M-QAM Modulation Techniques using AWGN channel considering input as an Image with the help of MATLAB software. Plot SNR v/s BER where M= 4, 8, 16, 32, 64 and constellation as well.
4. To Simulate M-PSK and M-QAM Modulation Techniques using Rayleigh Fading channel considering input as an Image with the help of MATLAB software. Plot SNR v/s BER where M= 4, 8, 16, 32, 64 and constellation as well.
5. Implement and simulate Diversity techniques (frequency) and observe the improvement in the results with respect to previous practical.
6. Implement and simulate any one channel estimation and observe the improvement in the results with respect to previous practical.
7. Implement and simulate any one channel equalization and observe the improvement in the results with respect to previous practical.
8. Analyze the performance of various blocks of Mobile Phone Trainer.
9. To Simulate BPSK, QPSK Modulation Techniques with the help of COMMSIM simulator.
10. Develop the android application using 4G trainer kit
11. Study of Direct Sequence Spread Spectrum (DSSS) Modulation and Demodulation Process.
12. 11.1: Study of Spreading and Dispersing based on Spread Spectrum technique 11.2: Study of DSSS Modulation/Demodulation Using Analog Signal as an Input.
13. 11.3: Study of DSSS Modulation/Demodulation Using Digital Signal as an Input
14. To perform various AT commands for mobile communication

Books & References

1. Gerd Kaiser, "Optical Fiber Communication", McGraw Hill, 5th Ed., 2017.
2. Senior J. M., "Optical Fiber Communication - Principle And Practice", PHI, 3rd Ed., 2018
3. Govind P. Agrawal, “Fiber-Optic Communication Systems”, 5th Edition, 2021
4. C.S. Gupta, “Optical Fiber Communication and Its Applications”, PHI, 1st Ed., 2021
5. Gp Capt KS Mathur (Retd.), “Fiber Optics Fundamentals and Advances in Optical Communications”, Bluerose Publishers Pvt. Ltd., 1st Ed., 2021.

6. Dalal Upena," Wireless and Mobile Communication ", 1st Ed., Oxford University Press, 2016.
7. Lee William C. Y. "Mobile Cellular Telecommunications", 3rd Ed., McGraw-Hill, 2008.
8. Rappaport Theodore, "Wireless Communications - Principles and Practice", 2nd Ed., Pearson Education LPE, 2010.
9. Andreas F. Molisch, “Wireless Communications” 2nd Ed., Wiley, 2010.
10. Andrea Goldsmith, “Wireless Communication”, Cambridge University Press, reprint, 2011.

Course Code: BEC-359 Digital Signal Processing

Course category	:	Professional Core (PC)
Pre-requisite Subject	:	Digital Signal Processing
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, and One Minor test and One Major Theory
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to analyse signals using the discrete time Fourier transform (DTFT) and discrete Fourier transform (DFT),
2. Understand Z transforms and its utility in system representation and analysis.
3. Able design IIR filters using analog filters.
4. Able to understand the characteristics of IIR Filter and FIR filters.
5. Able to understand various windowing techniques and use it in the designing of FIR Filter.
6. Able to implement digital filters in a variety of forms: -Direct form I &II, Parallel, Cascade and lattice structure and understand the finite word length effects.

Topics Covered

UNIT-I 9

Discrete Fourier Transforms: Definitions, Relation between DTFT and DFT, Properties of the DFT, Circular Convolution, Linear Convolution, Fast Fourier Transform Algorithms-Radix-2 Decimation in Time (DIT) and Radix-2Decimation in Frequency (DIF), Computational Efficiency of DIT and DIF algorithms.

Z-Transform: Introduction and properties, inverse Z-transform, convolution, system transfer function, system stability, Sampling Theorem: sampling and reconstruction.

UNIT-II **9**

Introduction, properties of IIR digital filters, Design of IIR filters from continuous time

filters IIR Filter Design: Discrete time IIR filter design techniques: Impulse Invariance, Bilinear transformation, Approximation of derivatives, (LPF, HPF, BPF, BRF) filter design using frequency translation technique

UNIT-III 9

FIR Filter Design: Characteristics of FIR Digital Filters, Phase and Frequency Response; FIR Filter design using Fourier Series Method, Frequency Sampling Technique, Effect of Windowing, Windowing Techniques-Rectangular Window, Hamming Window, Hanning Window, Blackman Window, Kaiser Window

UNIT-IV **9**

Realization of Discrete Time Systems: FIR Systems: Direct form, cascade, parallel and lattice structures, Realization of Linear Phase FIR Systems; IIR systems: Direct form, cascade, parallel, Transposed Forms, ladder structure realization Finite Word length Effects: Rounding and Truncation Errors

List of experiments

1. Generation of Waveforms (Continuous and Discrete).
2. Verification of Sampling Theorem.
3. Time and Frequency Response of LTI systems (First and second order).
4. Linear Convolution, Circular Convolution and Linear Convolution using Circular Convolution.
5. To find the DFT and IDFT for the given input sequence.
6. To find FFT and IFFT for the given input sequence.
7. FIR and IIR filter design using Filter Design Toolbox.
8. FIR Filter (Low-pass, High-pass and Band-pass) design (Window Method).
9. IIR Filter (Low-pass, High-pass and Band-pass) design (Butterworth and Chebychev).
10. Study of sampling rate conversion (Decimation, Interpolation, Rational factor).
11. Filtering of noisy signals

Books & References

1. Digital Signal Processing, S. K. Mitra. TMH.
2. Digital Signal Processing, Oppenheim and Schafer, PHI, New Delhi.
3. John G Prokias, Dimitris G Manolakis, “Digital Signal Processing”, Pearson Education.
4. S. Salivahanan, “Digital Signal Processing” Mc Graw Hill Education

BHS 301/351 **Engineering and Managerial Economics**

Course category	:	HSSE
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination

Course Objective :

1. To make fundamentally strong base for decision making skills by applying the concepts of economics.
2. Educate the students on how to systematically evaluate the various cost elements of a typical manufactured product or service, with a view to determining the price offer.
3. Prepare engineering students to analyze profit/revenue data and carry out make economic analysis in the decision-making process to justify or reject alternatives/projects.
4. Be equipped with the tools necessary in forecasting product demand.
5. Understand and analyze the macro environment affecting the business decision making.
6. To make students understand basic elements of Indian Economy

Course Outcomes The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Students will acquire basic knowledge in Engineering & managerial economics, which allows students to gain theoretical and empirical skill of economics.
2. To make Engineering students prepared for economic empowerment so that they could manage their wealth, help them in starting their own business or during managerial period.
3. Students will develop Interdisciplinary skills which can help them to thrive in the life-long changing environment in various fields of Industry of Economics.
4. Students will acquire practical knowledge of economics, the kind of markets, costtheory, various issues of demand and other major economic concepts.
5. Able to explain succinctly the meaning and definition of managerial economics; elucidate on the characteristics and scope of managerial economics.
6. Able to describe the techniques of managerial economics.

Topics Covered

UNIT-I **9**

Introduction to the Managerial Economics- Economics and Managerial economics, Review of Economic Terms and Economic Rationality, Law of diminishing marginal utility, Theories of Profit, Decision making Process with reference to Managerial economics, Managerial Economics and its application in engineering perspective.

UNIT-II **9**

Theory of Demand: Law of Demand, Demand Function, Types of Demand, Demand Schedule, Demand Curve, Shift in Demand Curve, Factors affecting Demand, Elasticity of Demand, Theory of consumer behavior.

Theory of Supply: Law of Supply, Supply Function, Supply Schedule, Supply Curve, Factors, affecting Supply

UNIT-III **9**

Demand Forecasting: Meaning, significance and methods of demand forecasting, production function, Laws of returns to scale & Law of Diminishing returns scale. An overview of short and long run cost curves – fixed cost, variable cost, average cost, marginal cost, Opportunity cost.

UNIT-IV **9**

Market Structure: Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions. National Income, Inflation and Business Cycles: Concept of N.I. and Measurement. Meaning of Inflation, Type causes & prevention methods, Phases of business cycle

Books & References

1. Mote, Paul and Gupta, Managerial Economics, T M H, New Delhi.
2. H L Ahuja, Managerial Economics, S Chand & Co. New Delhi
3. P.L. Mehta, Managerial Economics, Analysis, Problems and Cases, Sultan Chand Sons, NewDelhi.
4. Prof. D.N. Kakkar, Managerial Economics for Engineering, PHI publication, New Delhi
5. Varshney and Maheshwari, Managerial Economics, Sultan Chand and Sons, New Delhi.

Syllabus for Professional Elective Courses

Course Code: EEC-101 **Introduction to Space Technology**

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:3, Tutorial:1, Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessments through teaching assessment, attendance, home assignments, quizzes, one minor test and one major theory examination.
Course Objectives	:	Familiarize students with the concepts of launch vehicles design and missiles and its various parameters required for mission trajectory design and launch. Space data products and services of Space technology will be communicated to the students.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Discuss concepts of launch vehicle design and missiles
2: Determine various parameters required for mission trajectory design and launch.
3: Use Space data products and services
4: Explain Space technology concepts
5: Able to understand interaction between EM Radiation and matter.
6: Develop prototype of satellite model.

Topics Covered

UNIT-I **9**

Basics of Launch Vehicle Design and Missiles GNC and Satellite Systems Engineering design. Fundamentals of structure and mechanisms. Introduction to launch facilities, launch vehicle assembly, integration and launch readiness. Communication with the ground stations and ground tracking in collaboration with foreign space centres.

UNIT-II **9**

Fundamentals of mission trajectory design Coordinate reference frames, space flight mechanics, satellite orbits, Kepler's laws; lunar and interplanetary missions. Attitude dynamics, Attitude parameterization: direction cosine matrix, Euler axis and angles, quaternions, Euler angles; attitude rates; attitude determination; Euler equations of motion and attitude dynamic**s**

UNIT-III **9**

Basics of Space data products and services including AI and ML Definition and Overview of Remote Sensing and Remote Sensing Systems: Electromagnetic Radiation, Laws of Radiation, EM Spectrum, Sources of EMR, Interaction between EM Radiation and matter, Reflection, Absorption and Transmission, Interactions between EM Radiation and Atmosphere, Atmospheric windows. Platforms: Types of platforms (Ground, Airborne and Space borne); Satellites for earth observation; Geostationary and UAV platforms.

UNIT-IV **9**

Space Technology Fundamentals of Digital Image Processing, Fundamentals of Photogrammetry, Cartography, space materials processing; Global Navigation Satellite System (GNSS)

Textbooks

1. Wie, B., Space Vehicle Dynamics and Control, 2nd ed., AIAA Education Series, 2008
2. Zarchan, P., Tactical and Strategic Missile Guidance, 6th ed., Progress in Astronautics and Aeronautics, 2007

References:

1. Joseph, G., Fundamentals of Remote Sensing, Universities Press, 2003
2. Fleeman, E. L., Missile Design and System Engineering, AIAA Education Series, 2012
3. Noton, M., Spacecraft Navigation and Guidance, Springer 1998
Farrell, J. A., Aided Navigation: GPS with High-Rate Sensor, McGraw-Hill 2008

Course Code: EEC-102 **Electronic Materials, Devices and Circuits**

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home Assignments, quizzes and one minor test and one major theory examination.
Course Objectives	:	The course is aimed at developing the concepts of electronic materials, devices & circuits skills of engineering students that are imperative for effective understanding of engineering subjects.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

CO1: Explain properties of semiconductor materials and carrier statistics.
CO2: Analyze carrier transport phenomena (drift, diffusion, mobility, recombination).
CO3: Describe operation and characteristics of PN junction diode.
CO4: Apply diode models in practical circuits and special diodes applications.
CO5: Analyze BJT operation, biasing and amplifier/switch behavior.
CO6: Explain MOSFET operation and design basic MOS amplifier circuits.

Topics Covered

UNIT-I 9

Types of materials, metals, insulators and semiconductors, Band gap, Crystal Structure of Silicon, Intrinsic and Extrinsic semiconductors, Density of states, Fermi–Dirac probability function, Intrinsic carrier concentration, Fermi level in intrinsic and Extrinsic semiconductors, Law of mass action, generation and recombination, Carrier drift under electric field, Mobility and conductivity, Carrier diffusion and diffusion coefficient, Einstein relation.

UNIT-II 9

PN junction formation, Energy band diagram of PN junction, Built-in potential, Depletion region, Depletion width, PN junction under equilibrium, forward bias, and reverse bias, Current–voltage characteristics of PN junction diode, diode capacitance, Diffusion and Transition capacitance, Varactor diode, Light Emitting Diode, Schottky diode, Solar Cell, Avalanche Breakdown, Zener diode. Diode clipping and clamping circuits.

UNIT-III 9

Fundamentals of BJT: Construction, basic operation, current components and equations, Region of operations: active, cut-off and saturation region. CB, CE and CC configuration, input and output characteristics, Early effect, Punch trough voltage, Breakdown in BJT. BJT capacitances, Biasing circuits of BJT, BJT as an amplifier, BJT as a switch, BJT as a resistor.

UNIT-IV 9

MOSFET: MOS capacitor, Accumulation, depletion and inversion mode, energy band diagram and fermi level in MOS capacitor, Flat Band voltage, Threshold voltage, CV characteristics of MOS capacitor, Enhancement MOSFET, operation and characteristics, Equations for NMOS and PMOS, transconductance, MOS amplifiers, CG, CD and CS configuration. MOSFET as a resistor.

Text and Reference Books

1. A.S. Sedra and K.C. Smith, Microelectronic Circuits
2. G. Streetman, and S. K. Banerjee, Solid State Electronic Devices, 7th edition, Pearson,2014.
3. D. Neaman, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
4. S. M. Sze and K. N. Kwok, Physics of Semiconductor Devices, 3rd edition, John Wiley & Sons, 2006.
5. C.T. Sah, ―Fundamentals of solid-state electronics, ‖ World Scientific Publishing Co. Inc, 1991.

Course Code: EEC-201 **Semiconductor Devices and Applications**

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:3, Tutorial:1, Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, Home Assignments, quizzes and one minor test and one major theory examination.
Course Objectives	:	The course is aimed at developing the concepts of electronic devices & circuits skills of engineering students that are imperative for effective understanding of engineering subjects.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Ability to understand the fundamentals of semiconductor materials, including energy band formation, effective mass, carrier statistics, and Fermi level concepts.
2. Able to understand the principles of carrier generation, recombination, and continuity equations.
3. To understand the structure, operation, and applications of various semiconductor diodes such as Zener, PIN, Schottky, Tunnel, LED, and Photodiodes.
4. Understand the operation of MOS capacitors and MOSFETs considering threshold voltage, short-channel effects, scaling limitations, and reliability parameters.
5. Understand the operational principles and design considerations of heterostructure devices, including MODFETs, HEMTs, and quantum well structures.

Topics Covered

UNIT-I 9

Importance of semiconductor devices, Concept of energy bands and how bands form. Effective mass of electrons, E-k diagram. Concept of Fermi-Dirac distribution. Semiconductor, Density of states, Doping and intrinsic carrier concentration, Equilibrium carrier concentration, Temperature-dependence of carrier concentration. High doping effects and incomplete ionization, Carrier scattering and mobility, velocity saturation, Drift-diffusion transport,

Shockley Read Hall recombination, lifetime, Excess carrier decay & recombination, Charge injection, Continuity equation, Quasi-Fermi level.

,

9

UNIT-II

p-n junction: p-n junction under equilibrium (Depletion region, built-in potential, electric field, Poisson's equation equilibrium, Depletion width, maximum electric field, high doping, built-in potential), p-n junction under forward & reverse bias (Current, drift-diffusion, carrier injection and recombination, minority carrier, diode equation, diffusion coefficient, long diode, Reverse saturation current, continuity equation, ideality factor, quasi-neutral), generation-recombination current (Generation-recombination, SRH recombination, defects and traps, mid-gap states, ideality factor, lifetime).

Zener and avalanche breakdown, Capacitance-voltage profiling, metal/semiconductor junction – Ohmic and Schottky contacts, Different diodes: Avalanche diode, LED, Photodiode, PIN diode, Schottky diode, Tunnel Diode, their working and applications.

UNIT-III 9

MOS capacitor: MOS introduction (Depletion, weak inversion, strong inversion, accumulation, band bending), capacitance voltage (Low-frequency, thermal generation, strong inversion, Debye Length, series capacitance), Oxide capacitance, fixed oxide charges, interface trapped charges, band bending, Flat-band voltage, threshold voltage, MOSFET, drain current, drain voltage.

9

UNIT-IV

Introduction to compound semiconductors & alloys, commonly used compound semiconductors, heterostructure band diagrams and basics of MODFET & HEMT. Advanced Semiconductor: FinFET, CNTFET, GNRFET and their working principles.

Text and Reference Books

1. Solid State Electronic Devices, by Ben Streetman and Sanjay Banerjee, Prentice Hall.
2. Milman, Halkias & Jit - Electronics Devices and Circuits-TMH
3. Donald A. Neaman, "Semiconductor Physics and Devices Basic Principles", TMH India
4. Introduction to Semiconductor Materials and Devices, by M. S. Tyagi, Wiley Publications

Course Code: EEC-202		**Fundamentals of Photonics**
Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, assignments, quizzes, one minor test and one major theory examination.
Course Objectives	:	This course is to equip students with foundational knowledge and analytical skills in the field of photonics and optics.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Interpret the concepts of optical electronics.
2. Analyse Plane Wave Solutions and explore photonics applications.
3. Study Absorption and Dispersion Phenomena.
4. Analyze the working principle of ME Theory, EO, and AO effects.

5. Examine the working mechanism of different types of Optical components, EO, and AO effects.
6. Illustrate the practical use of Optical components, EO, and AO effects.

Topics Covered

UNIT-I **9**

Fundamentals of Electromagnetic Wave Propagation and Photonics: Wave equation, Plane waves, Applications of photonics, Reflection and Refraction of plane waves, Fresnel Equations, Wave propagation in different mediums, propagation of Electromagnetic waves in Uniaxial and biaxial crystals, the dielectric constant tensor and the 'index ellipsoid'.

UNIT-II **9**

Optical Phenomena in Dielectric Media: Electromagnetic theory of light, Dielectric media, Monochromatic EM waves, Absorption and dispersion, Polarization of light, Jones Calculus, Poincare sphere. Polarizer's, Quarter, Half, and Full waveplates, Beam splitters: polarizing and non-polarizing, wavelength filters, dichroic mirrors, Lenses.

UNIT-III **9**

Electro-optics (EO): Pockel and Kerr effects, Electro-optic devices: modulators, switches, and scanners, EO effect in liquid crystals; LCDs and SLMs, Applications.

UNIT-IV **9**

Acousto-optics (AO): Strain waves in solids and liquids, the strain-optic tensor; theory of Raman-Nath and Bragg diffraction; small-angle and large-angle Bragg diffraction, AO devices: Modulators, deflectors, scanners, interconnections, and acoustooptic tunable filters.

Books & References

1. A. Yariv, P. Yeh, Photonics: Optical Electronics in Modern Communications, The Oxford Series in Electrical and Computer Engineering, 2006.
2. B. E. A. Saleh, M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2nd Ed. (2007)

Course Code: EEC-204		**Fundamentals of Nanoelectronics**
Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	**NIL**
Contact hours/week	:	Lecture:3, Tutorial:1, Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, one minor test and one major theory examination.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

Course Code: EEC-203 Probability and Stochastic Process for Communication Engineering

Course category	:	Professional Electives (PE-2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	3
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, and one Minor test and one Major Theory exam.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain fundamental concepts of probability theory and conditional probability for engineering applications.
2. Analyze random variables, their distributions, expectations, and transformations.
3. Model random processes and evaluate their temporal and statistical characteristics.
4. Apply correlation, power spectral density, and filtering concepts to random signals.
5. Analyze noise in communication systems using statistical tools.
6. Apply random process theory to wireless communication applications such as fading, modulation, and error probability.

Topics Covered

UNIT-I 9

Probability Theory and Random Variables: Introduction to probability: Sample space, events, axioms of probability. Conditional probability, independence, total probability theorem, Bayes' theorem. Random variables: Continuous and discrete types. Probability density function (PDF), cumulative distribution function (CDF). Common distributions: Bernoulli, Binomial, Poisson, Gaussian, Exponential, Rayleigh, Rician. Expectation, moments, variance, covariance, characteristic function

UNIT-II 9

Multiple Random Variables & Transformations: Joint, marginal, and conditional distributions. Joint PDFs/PMFs, functions of multiple random variables. Statistical independence; jointly Gaussian random variables. Correlation, covariance, linear estimation. Central Limit Theorem (CLT). Transformations of random variables and Moment Generating Functions (MGF). Random vectors and introduction to multivariate statistics. .

UNIT-III 9

Random Processes: Definition and classification of random processes. Stationary processes: Strict-sense and Wide-Sense Stationarity (WSS). Autocorrelation and cross-correlation functions. Properties of correlation functions; Ergodicity. Power Spectral Density (PSD), relation between PSD and autocorrelation (Wiener–Khinchin theorem). Filtering of random signals: Linear time-invariant filtering of random processes.

UNIT-IV 9

Textbooks & References

1. P. Z. Peebles, Probability, Random Variables & Random Signal Principles, McGraw-Hill.
2. H. Stark & J. Woods, Probability and Random Processes with Applications to Signal Processing, Pearson.
3. Simon Haykin, Communication Systems, Wiley.
4. A. Papoulis & S. U. Pillai, Probability, Random Variables, and Stochastic Processes, McGraw-Hill.
5. J. G. Proakis, Digital Communications, McGraw-Hill.

1. Understand the fundamentals of nanoelectronics and the difference between mesoscopic and nanoelectronics devices.
2. Understand the fundamentals of quantum mechanics in nanoelectronics.
3. Analyze the electronic properties of molecule and electron conduction.
4. Understand the fundamentals of MOSFET as a Ballistic and Diffusive Transport.
5. Analyze the effect of 1D and 2D electrostatics effects on nanoscale devices.
6. Familiarize the BJT, MOSFET, and CMOS from an electrostatics perspective.

Topics Covered

UNIT-I **9**

Introduction to nanoelectronics – device scaling, Fundamental differences in mesoscopic and nanodevices, Quantum mechanics in nanoelectronics, Introduction to quantum mechanics, Schrödinger equation, Free electron wavefunction, Particle/electron in a box, electrons in solids. Field effect transistors as a resistor, Conductance, Ballistic conductance, Ballistic resistance

UNIT-II **9**

Electrons Flow: Density of states, electrochemical potential, Energy window for current flow, Fermi function, Non-equilibrium: Two Fermi Functions, the Linear response at low bias conductance, Drude formula, Elastic resistors, current in elastic resistor, the conductance of long resistor, Degenerate, and Non-degenerate Conductors.

UNIT-III **9**

Ballistic and Diffusive Transport: Transit Times, Channels for Conduction. Conductance from Fluctuation, Current Fluctuations in an Elastic Resistor: One-level resistor, multi-level resistor. Energy Band Model: E(p) or E(k) Relation, Density of states, Number of Modes, Electron Density of n-type and p-type conductors. Conductivity of conductors.

UNIT-IV **9**

Devices, Circuits, and Systems: Introduction to MOSFET, 1D MOS Electrostatics, 2D MOS Electrostatics, Bipolar transistor, CMOS technology, MOSFET Current-voltage characteristics, Ultimate limits of devices.

Text and Reference Book

1. Supriyo Datta (2017). *Lessons from Nanoelectronics (Vol. 5)*. 2nd Edition, World Scientific Publishing Company.
2. Lundstrom, Mark S., and Jing Guo.(2010), *Nanoscale Transistors. 1st Edition,* Springer.
3. Griffiths, D., & Schroeter, D. (2018). *Introduction to Quantum Mechanics* (3rd ed.). Cambridge: Cambridge University Press.

Course Code: EEC-301 **Launch Vehicle Systems and Technologies**

Course Category **:** Professional Elective (PE)

Pre-requisite Subject	**:**	NIL
Contact hours/week	**:**	Lecture:3, Tutorial:1, Practical:0
Number of Credits	**:**	4
Course Assessment methods	**:**	Continuous assessments through teaching assessment, attendance, home assignments, quizzes, two minor tests and one major theory examination.
Course Objectives	**:**	Familiarize students with the Concepts of launch vehicle/missiles design and its subsystem through the dynamics of launch vehicle. Fundamentals of GNC loop, design problem and algorithms of navigation and its validation through testbeds and simulation setups will be communicated.
Course Outcomes	**:**	After completing this course, students will be able to show the following knowledge and skills.

1: Discuss concepts of launch vehicle design and missiles.

2: Explain Launch Vehicle Dynamics.

3: Apply Fundamentals of GNC loop, design problem and algorithms.

4: Implementation on testbeds and simulation setups.

5: Understanding various parameters of design of vehicle.

6**:** Able to explain the physics behind motion of vehicle.

Topics Covered

Unit I **9**

Launch Vehicles and Missiles and their subsystems Launch Vehicles and Missiles and their subsystems, Fundamentals and Types of Propulsion system: Solid / Liquid / Cryogenic / Semi-Cryogenic /Mono propellent, Bi-propellent and Electric propulsion systems (including green propulsion) Fundamentals of Structures and Mechanisms: Structural Dynamics /Vibration modes for Dynamics modelling.

Unit II **9**

Launch Vehicle Dynamics Gravity model, Point mass dynamics, Aerodynamics: Multi-strap-on Vehicles, its aerosurfaces, Fundamentals of Trajectories (Mission Design): Equations of Motion: short period / long period Model development, Slosh Dynamics analysis, Basic principles of inertial measurement units: Gyros, Fiber optic/ Laser Gyros and others, accelerometers, Actuators: Electrohydraulic, Electromechanical, Reaction Control Systems.

Unit III: **9**

Fundamentals of GNC loop, design problem and algorithms Basics of Guidance: Open Loop / Closed Loop: Implicit / Explicit Guidance schemes, Basics of Navigation: Nav algorithm, compensation schemes, multiple sensor fusion, Basics of Control (Autopilot): Linear / nonlinear design Techniques.

Unit IV: **9**

Validation Testbeds/ Simulation setups On-board computer in the loop simulations (OILS), Hardware in the loop Simulations (HLS), Actuators in Loop Simulations (ALS), Flight Software in Loop Simulations (SILS), reliability analysis, Satellite interface and satellite deployment with separation dynamics.

Text and Reference Book

Textbook:

1. Edberg, D., and Costa, W., Design of Rockets and Space Launch Vehicles, AIAA Education Series, 2020.
2. Kadam, N. V., Practical Design of Flight Control Systems for Launch Vehicles and Missiles, Allied Publishers, 2009

References:

1. Wiesel, W. E., Spacecraft Dynamics, 2nd ed, McGraw-Hill 1997.
2. Noton, M., Spacecraft Navigation and Guidance, Springer 1998.

Course Code: EEC-303		**Digital Integrated Circuits and Computer Architecture**
Course category	:	Professional Elective (PE-3)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through Viva voce, Practical work, attendance, one minor test, major & practical examination
Course Objectives	:	The course aims to develop skills in digital integrated circuits, circuit design, applications, non-ideal effects, hazards, and glitches in advanced integrated circuits and computer organization.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Understand the fundamentals of digital integrated circuits, including CMOS technology, fabrication processes, and device characteristics.
2. Analyze the operation and performance of basic digital IC building blocks such as inverters, logic gates, multiplexers, latches, and flip-flops.
3. Design and evaluate combinational and sequential digital circuits using CMOS logic, with emphasis on power, speed, and area trade-offs.
4. Apply timing analysis concepts, including propagation delay, setup and hold times, and clocking strategies in digital IC design.

5. Assess power consumption and reliability issues in digital integrated circuits, including dynamic and static power, noise margins, and scaling effects.
6. Use industry-standard CAD tools and design methodologies to model, simulate, and verify digital integrated circuits at the transistor and gate levels.

Topics Covered

UNIT-I **9**

CMOS & CMOS Digital Logic Circuits

Review of MOS transistor operation, PUN from the PDN, Power dissipation in CMOS, Static, dynamic, and short-circuit power, Propagation delay (Load capacitance and Load Resistance), Noise Margin, Rise time, Fall time Complementary CMOS Design; CMOS Logic-Gate Circuits, Inverter (DC transfer characteristics, Dynamic VTC, and noise margins), CMOS inverter Switching, Power Consumption, Short-Circuit and Leakage Components, CMOS NOR gate, NAND gate, EX-OR and EX-NOR gate, etc., And-Or Invert and Or-And Invert logic, Boolean expression using CMOS, and Propagation delay calculation.

UNIT-II **9**

Design of Synchronous and Asynchronous Sequential Circuits

Static/Dynamic Combinational Circuit Design: Complementary CMOS, Ratioed Logic, Pass-Transistor Logic, Pass-Transistor for logic gates, Transmission gates, Dynamic Logic; Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design.

Sequential Circuit Design: Static Latches and Registers; The Bistability Principle, SR Flip-Flops, Multiplexer-Based Latches, Dynamic Latches and Registers.

Non-ideal effects. Transistor mismatch, Latch-Up, etc.

UNIT-III **9**

Hazards and Disturbances in DIC:

Interconnect Delays and Clock-Related Glitches: Introduction to Glitches and Glitch Formation. Clock skew, Clock jitter, Glitches in clock distribution networks, Glitch Power Consumption.

Disturbances in Combinational/Sequential Circuits: Types of Hazards, Hazard Analysis Using Timing Diagrams, Hazard Elimination Techniques, Effects of Glitches on Latches and Flip-Flops, Setup Time and Hold Time Violations, and Metastability Due to Glitches.

UNIT-IV **9**

Computer Organization and Addressing

Machine instructions and addressing modes, ALU, data-path, and control unit, instruction pipelining, Memory and I/O Organisation, Memory allocation, Memory addressing, and Capacity.

EXPERIMENTS

Note: Minimum seven experiments are to be performed:

1. MOSFET I-V characteristics and parameter extraction.
2. Design and extract the Power, Delay, Rise time, and fall time in a CMOS inverter.
3. Simulate of CMOS XNOR and XOR Gate and plot the dynamic characteristics.
4. Simulate and analyse the characteristics of Universal Gates using a pass transistor.
5. Design and analyse the characteristics of a Multiplexer (2:1) using pass transistors.
6. Perform and analyse the behaviour of a Multiplexer (2:1) using transmission gates.

7. Perform and analyse the behaviour of a CMOS latch and flip-flop.
8. Analyse the Timing analysis of sequential circuits.
9. Analyse the transistor sizing in CMOS logic circuits.

Books & References

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolić, Digital Integrated Circuits: A Design Perspective, 2nd Edition, Pearson.
2. Neil H. E. Weste & David Harris, CMOS VLSI Design: A Circuits and Systems Perspective, Pearson.
3. Computer Architecture and Organization, Morris Mano Pearson

Course Code: EEC-401		**Fundamentals of VLSI Design**
Course category	:	Professional Elective (PE-4)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One minor test and one major theory & practical examination
Course Objectives		Understand VLSI design flow and semiconductor fabrication basics, Learn MOS transistor operation and CMOS logic design, Study layout design rules and verification, Introduce timing, power and scaling issues in VLSI
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

Course Code: EEC-304 RF Circuit Design

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial: 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One minor test and one major theory examination
Course Objectives		Understand RF circuit behavior at high frequencies, learn impedance matching and RF network design, Study RF active and passive circuit building blocks, Understand RF system level performance parameters
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Analyze RF circuits using S-parameters and high-frequency models.
2. Design impedance matching networks using Smith chart techniques.
3. Design and evaluate RF amplifiers and oscillators.
4. Analyze RF noise and linearity performance parameters.
5. Design RF filters and passive components.
6. Use simulation tools for RF circuit design and optimization.

Topics Covered

UNIT-I 9

RF Circuit Fundamentals: RF frequency spectrum and applications, Lumped vs distributed circuit behavior, Transmission line basics, Scattering parameters (S-parameters), RF measurement basics, Smith Chart applications

UNIT-II 9

RF Passive Circuit Design: Impedance matching networks, Single stub and double stub matching, Quarter-wave transformer, RF filters (Low pass, Band pass), RF power dividers and couplers, RF PCB layout basics

UNIT-III 9

RF Active Circuit Design: RF transistor models, RF amplifiers (LNA, Power Amplifier basics), Stability and gain circles, Noise figure and noise matching, RF oscillator basics, Mixer fundamentals

UNIT-IV 9

RF System Design and Performance: RF system block diagram (Transmitter and Receiver), RF front-end design, non-linearity and distortion, Intermodulation distortion, Phase noise, RF system link budget basics

Books & References

1. David M. Pozar — Microwave Engineering, Wiley
2. Reinhold Ludwig & Pavel Bretchko — RF Circuit Design: Theory and Application
3. Guillermo Gonzalez — Microwave Transistor Amplifiers
4. Chris Bowick — RF Circuit Design
5. Thomas H. Lee — The Design of CMOS RF Integrated Circuits

Course Code: EEC-305 Data Communication Networks

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, one minor test and one major theory examination.
Course Objectives		This course is intended to develop an understanding of data communication networks concepts and its applications.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1- To describe communication protocols and layered network architectures used in data communication systems.
2- To explain conventional computer system interfacing standards, peer-to-peer communication models, line coding techniques, and transmission media.
3- To understand data link layer functions, error and flow control mechanisms, communication switching techniques, and related protocols.
4- To explain multiple access techniques and IEEE standards used in modern computer networks.
5- To describe the functions of the network layer and transport layer, including routing, congestion control, and networking devices.
6- To analyze the fundamentals of computer networks and evaluate their performance in real-world communication systems.

Topics Covered

UNIT-I 9

Introduction to Networks & Data Communications: characteristics and component of data communication, The Internet Protocols & Standards, Channel capacity for data Communication, Need for layered/modular architecture, Layering concept, OSI reference model, TCP/IP model. Line Coding Review, Transmission Media: Guided and unguided Media Review.

UNIT-II 9

Switching: Datagram Networks, Virtual Circuit Networks, Structure of a switch, Ethernet Physical Layer, Data Link Layer: Error detection and Correction Data Link Control: Framing, Flow and Error Control Protocols, Noiseless and Noisy Channel Protocols, HDLC, Point-to-Point Protocol.

UNIT-III 9

Multiple Access: RANDOM, CDMA, ALOHA, CSMA, Collision free, limited contention, CSMA/CA and Ethernet, Channelization Wired LANs: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11, Bluetooth IEEE 802.16.

UNIT-IV 9

Network layer: Network layer: Design Issues. Routing Algorithms. Congestion control Algorithms, IPV4Addresses, Connecting Devices, IPV6 Addresses, Transport Layer Protocol: UDP and TCP. Application Layer & Protocol: SIP, DNS, FTP, HTTP, SMTP and SNMP and Connecting Devices.

Books & References

1. Behrouz A. Forouzan (2006), Data communication and Networking, Tata McGraw-Hill, India.
2. A.S. Tanenbaum, Computer Networks (2003), 5 ed, Pearson Education/ PHI. New Delhi, India.

1. Explain VLSI design flow and IC fabrication processes.
2. Analyze MOS transistor characteristics for digital design.
3. Design CMOS combinational and sequential circuits.
4. Apply layout design rules and verification techniques.
5. Analyze power, delay and scaling effects in VLSI circuits.
6. Implement basic VLSI circuits using EDA tools.

Topics Covered

UNIT-I 9

Introduction to VLSI Technology & MOS Devices: Evolution of VLSI, VLSI design flow, Moore's Law and scaling trends, IC fabrication steps, CMOS fabrication overview, CMOS process integration, CMOS transistor scaling, MOS transistor characteristics and I-V equations

UNIT-II 9

CMOS Logic Circuits: CMOS Inverter: static and dynamic characteristics, DC transfer characteristics, noise margins, propagation delay, Power dissipation: static vs dynamic power, Combinational CMOS logic gates: NAND, NOR, XOR, XNOR, Complex logic gates and logic families, Ratioed logic, pseudo-NMOS, pass-transistor logic

UNIT-III 9

Sequential VLSI Circuits and Systems: Latches and Flip-Flops: static and dynamic storage elements, Transmission gate-based storage elements, Setup, hold time, and timing analysis, Clocking strategies and clock distribution, Introduction to finite state machines (FSMs), Registers and counters

UNIT-IV 9

VLSI Design Methodologies and Physical Design: VLSI design automation: design rules and layout considerations, Stick diagrams, EX-OR based layout examples, Layout metrics: area, delay, power, Physical design cycle: partitioning, floor planning, placement, routing, Introduction to design for testability (DFT), Overview of modern VLSI CAD tools and design verification

Experiments:

1. CMOS inverter design and DC analysis
2. Transient analysis of CMOS inverter
3. Power dissipation analysis of CMOS inverter
4. CMOS NAND gate design and simulation
5. CMOS NOR gate design and simulation
6. Transmission gate implementation
7. Stick diagram drawing for CMOS circuits
8. Layout design of CMOS inverter
9. Layout design of NAND / NOR gate
10. Design rule check (DRC) verification
11. LVS verification
12. Delay and power analysis using EDA tools
13. Simple combinational circuit layout and simulation

Books & References

1. John D. Joannopoulos, Steven G. Johnson, Joshua N. Winn, and Robert D. Meade, Photonic Crystal: Melding Light Flow of Light, Princeton University Press, 2008.
2. Graham T. Reed and Andrew P. Knights, Silicon Photonics: An Introduction, John Wiley and Sons Ltd, 2004
3. Metamaterials: Physics and Engineering Explorations, Nader Engheta Richard W. Ziolkowski, Wiley and Sons,2006

Course Code: EEC-402		**Advanced Photonics**
Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, assignments, quizzes, one minor test and one major theory examination.
Course Objectives	:	This course is to introduce students to the fundamental principles and advanced concepts of nanophotonic, and focusing on the interaction of light with nanostructured materials.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Familiarization to the concept of Metamaterials.
2. Examine Surface Plasmon Resonance.
3. Analyze Photonic Bandgap Crystals in different dimensions.
4. Evaluate the size and properties of band gaps in different lattice types.
5. Understand evanescent waves and their role in surface plasmon resonance.
6. Understanding the Importance of Silicon Photonics and Its Applications.

Topics Covered

UNIT-I **9**

Low-Dimensional Structures: Photons and electrons, Quantum confinement effects, 2D, 1D, 0D structures, their growth and properties.

UNIT-II **9**

Metamaterial in Optics: Optical Properties of Metal-Dielectric composites, Optical Magnetism, Negative-refractive Index, Perfect lens and Cloaking objects.

UNIT-III **9**

Photonic band gap crystals: Photonics Band-Gap: Introduction to Photonics crystal, Photonic Band Structures, One-dimensional, Photonic crystal: Origin of Photonics Band Gap, Size of the band gap, Evanescent Modes in Photonics Band gaps, Two-dimensional Photonic crystal: Two-dimensional Bloch States, Square Lattices (Dielectric Columns and Veins), Three-dimensional Photonic crystal: Three-dimensional lattices.

UNIT-IV **9**

Surface Plasmon Resonance: Evanescent waves, Surface Plasmon dispersion equations, resonance, excitation of surface plasmons, surface plasmon properties, SPR spectroscopy, Applications of SPR.

Books & References

1. John D. Joannopoulos, Steven G. Johnson, Joshua N. Winn, and Robert D. Meade,Photonic Crystal: Molding Light Flow of Light, Princeton University Press, 2008.
2. Graham T. Reed and Andrew P. Knights, Silicon Photonics: An Introduction, JohnWiley and Sons Ltd, 2004
3. Metamaterials: Physics and Engineering Explorations, Nader Engheta Richard W. Ziolkowski, Wiley and Sons,2006

Course Code: EEC-403 **Information Theory and Coding**

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, One minor test and one major theory exam.
Course Objectives		Understand fundamental limits of data compression and transmission, learn mathematical basis of information measurement, Study source coding and channel coding techniques, Analyze error detection and correction mechanisms
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Apply information measures such as entropy and mutual information.
2. Analyze communication channel capacity and theoretical limits.
3. Design and evaluate source coding techniques.
4. Apply error control coding techniques for reliable communication.
5. Analyze performance of coded communication systems.
6. Solve numerical problems related to coding efficiency and error probability.

Topics Covered

UNIT-I 9

Information Theory Fundamentals: Information and uncertainty, Self information, Entropy and properties, Joint entropy and conditional entropy, Mutual information, Redundancy and information rate, Discrete Memoryless Source (DMS)

UNIT-II 9

Source Coding Techniques: Source coding theorem, Prefix codes, Kraft inequality, Shannon-Fano coding, Huffman coding, Run-length coding, Arithmetic coding (basic idea), Coding efficiency and redundancy

UNIT-III 9

Channel Capacity and Discrete Channels: Discrete Memoryless Channel (DMC), Binary symmetric channel (BSC), Binary erasure channel (BEC), Channel capacity, Shannon channel capacity theorem, Capacity of AWGN channel, Bandwidth vs SNR trade-off

UNIT-IV 9

Channel Coding and Error Control Coding: Linear block codes, Generator and parity check matrices, Syndrome decoding, Hamming codes, Cyclic codes, Convolutional codes, Viterbi decoding, Coding gain and performance analysis

Books & References

1. Simon Haykin — Communication Systems
2. B. P. Lathi — Modern Analog and Digital Communication Systems
3. Ranjan Bose — Information Theory, Coding and Cryptography, TMH

Course Code: EEC-404		**Fabrication and Characterization of Nanoelectronics Systems**
Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	**NIL**
Contact hours/week	:	Lecture:3, Tutorial:1, Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, one minor test and one major theory examination.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. To understand various chemical synthesis (Bottom-up) of diverse types of nanomaterials (0D, 1D and 2D).
2. To understand various physical methods (Top-down) of fabricating nanomaterials and nanostructures.
3. Decipher information on the various class of nanomaterials based on composition, shape and size (1D, 2D, 0D nanostructures).
4. To understand the application potential of nanomaterials based on their unique properties and importance of selecting appropriate synthesis methods that will suit the specific application.
5. To learn the fundamental principles of characterizing nanomaterials for their morphology, structure, chemistry.
6. To explore the different functionality of nanomaterials through diverse methods of microscopy, spectroscopy, scattering and diffraction.

Topics Covered

UNIT-I **9**

Synthesis of Nanomaterials

Synthesis of nanomaterials: Basic chemistry concepts, Inorganic, organic synthesis and analytical chemistry methods, concepts of precipitation reaction, mechanisms of nanocrystal growth, LaMer theory, Oswald ripening, coalescence

UNIT-II **9**

Synthesis Approaches in Nanomaterials

Bottom-up synthesis approaches – Nanoprecipitation reaction, synthesis of zero-dimensional metal, metal oxides, semiconductor nanoparticles by nanoprecipitation routes, high-pressure homogenization.

Top-down approaches: Fundamentals of nano–thin film Growth; Vapor phase deposition methods– Physical and chemical vapor phase methods; Langmuir-Blodgett Films; Electrochemical Deposition; laws of electrolysis and deposition

UNIT-III **9**

Synthesis in 1D and 2D nanomaterials

Sol-gel method, hydrolysis and condensation, Self-assembly, Kinetically Confined Synthesis of Nanoparticles, Template-based synthesis; Synthesis of one-dimensional nano systems by different routes – VLS and SLS methods, Synthesis of two-dimensional nano systems.

UNIT-IV **9**

Crystal Structure of Nanomaterials

Crystal structure, Lattice parameters, nanoparticle size by Debye-Scherrer's formula. Working principles of the Scanning electron microscope and Transmission electron Microscope, Atomic absorption and inductively coupled Plasma. Fundamental working principles of scanning probe microscopy (STM) Atomic Force Microscopy, confocal fluorescence microscopy.

Text and Reference Book

1. Nanomaterials – An introduction to synthesis, properties and applications, D. Vollath, Wiley-VCH, Second Edition 2013.
2. Cao, Nanostructures and Nanomaterials – Synthesis, Properties and Applications, Imperial College Press 2006.
3. Elements of X-ray Diffraction, B. D. Cullity and S. R. Stock (Pearson)
4. Physical Principles of Electron Microscopy, R.F. Egerton (Springer)
5. Scanning Probe Microscopy and Spectroscopy, D. A. Bonnell (Wiley)
6. Fundamentals of Molecular Spectroscopy, C. N. Banwell (McGraw Hill)

Course Code: EEC-501		**Spaceflight Mechanics and Attitude Dynamics**
Course Category	**:**	Professional Elective (PE)
Pre-requisite Subject	**:**	NIL
Contact hours/week	**:**	Lecture:3, Tutorial:1, Practical:0

Number of Credits	**:**	4
Course Assessment methods	**:**	Continuous assessments through teaching assessment, attendance, home assignments, quizzes, one minor test and one major theory examination.
Course Objectives	**:**	Familiarize students with concepts of spaceflight mechanics, ft attitude dynamics and its control system. Remote sensing and propulsion systems of spaceflight along with missile guidance will also be discussed.
Course Outcomes	**:**	By the end of this course, students will be able to understand and apply the skills and ideas listed below.

1: Discuss concepts of Spaceflight Mechanics
2: Determine various parameters required for Spacecraft Attitude Dynamics and control systems.
3: Explain remote sensing systems and various Propulsion Systems.
4: Describe Flight Mechanics and Missile Guidance.
5: Able to understand the concept of remote sensing mechanism.
6: Able to explain physics behind spaceflight mechanics.

Topics Covered

UNIT-I **9**

Spaceflight Mechanics ECI frame, Two-body Orbital dynamics, Integrals of motion, Classical Orbital parameters, Satellite Orbit perturbations, sun-synchronous satellites, geosynchronous, orbital maneuvers, orbit determination, orbit corrections and maintenance, relative motion in orbits, proximity operations.

UNIT-II **9**

Spacecraft Attitude Dynamics Attitude parameterization: direction cosine matrix, Euler axis and angles, Quaternions, attitude rates, Euler equations of rigid body attitude dynamics. Liquid propellant slosh effects. Attitude stabilization, spin stabilization of a rigid spacecraft and an energy-dissipating Spacecraft, active nutation control, momentum bias satellites, passive and active nutation damping, control with Thrusters.

UNIT-III **9**

Spacecraft Attitude Control Attitude control with three-axis reaction wheels, thrusters and magnets; Three-Axis Stabilization, Disturbing torques, effect of structural flexibility, antenna beam pointing accuracy. Various types of attitude sensors, attitude determination, Propulsion Systems, Liquid Propellant Thrusters, Electric Propulsion.

UNIT-IV **9**

Flight Mechanics and Missile Guidance

Re-entry Flight Mechanics, guided re-entry, feedback guidance, Lunar and interplanetary flights: Chandrayan and Mars missions. Missile guidance: Lambert, midcourse and endgame guidance; Tactical and strategic interceptors, zero-effort-miss guidance; Cruise missiles, Fundamentals of Space-based Navigation (GNSS)

Text and Reference Book

Textbook:

1. De Ruiter, A. H. J., Damaren, C. J., and Forbes, J. R., Spacecraft Dynamics and Control: An Introduction, Wiley 2013

2. Montenbruck, O., and Gill, E., Satellite Orbits: Models, Methods, Applications, Springer 2000
3. Sidi, M. J., Spacecraft Dynamics and Control, Cambridge University Press 1997
4. Wie, B., Space Vehicle Dynamics and Control, 2nd ed., AIAA Education Series, 2008

Reference

1. Chobotov, V. A., (Ed.), Orbital Mechanics, 3rd ed, AIAA Education Series 2002.
2. Wiesel, W. E., Spacecraft Dynamics, 2nd ed, McGraw-Hill 1997
3. Noton, M., Spacecraft Navigation and Guidance, Springer 1998
4. Farrell, J. A., Aided Navigation: GPS with High-Rate Sensor, McGraw-Hill 2008
5. Joseph, G., Fundamentals of Remote Sensing, Universities Press, 2003
6. Fleeman, E. L., Missile Design and System Engineering, AIAA Education Series, 2012
7. Zarchan, P., Tactical and Strategic Missile Guidance, 6th ed., Progress in Astronautics and Aeronautics, 2007

Course Code: EEC-503 Introduction to VLSI Fabrication Technology

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, One minor test and one major theory examination
Course Objectives		Understand IC fabrication process flow from wafer to packaging, Learn CMOS process technology and cleanroom practices, Study lithography, deposition, diffusion, implantation, and etching techniques, Analyze process integration issues in deep submicron technologies
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain semiconductor wafer preparation and crystal growth techniques.
2. Describe CMOS fabrication steps and process sequence.
3. Analyze photolithography, oxidation, diffusion, and ion implantation processes.
4. Evaluate thin film deposition and etching techniques used in IC fabrication.
5. Interpret process integration challenges in modern nanoscale VLSI.
6. Understand packaging, yield, and reliability issues in fabrication.

Topics Covered

UNIT-I 9

Semiconductor Materials and Wafer Preparation: Semiconductor materials: Si, Ge, GaAs, compound semiconductors, Electronic grade silicon purification, Crystal growth techniques: Czochralski method, Float-zone method, Wafer slicing, polishing, and cleaning, Cleanroom technology and contamination control

UNIT-II 9

Oxidation, Diffusion and Ion Implantation: Thermal oxidation (Dry and Wet oxidation), Diffusion fundamentals and Fick's laws, Ion implantation principles and equipment, Annealing and defect removal, Junction formation techniques

UNIT-III 9

Thin Film Deposition and Etching Techniques: Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD), Atomic Layer Deposition (ALD) – Introduction, Wet and Dry Etching, Plasma Etching and Reactive Ion Etching

UNIT-IV 9

CMOS Fabrication and Advanced Technologies: nMOS and pMOS fabrication steps, CMOS fabrication process flow, Layout rules and process design rules, Interconnect technology and metallization, Introduction to submicron and nanometer fabrication, Yield, reliability and packaging basics

Books & References

1. S. M. Sze & Kwok Ng — Physics of Semiconductor Devices, Wiley
2. Gary S. May & Simon M. Sze — Fundamentals of Semiconductor Fabrication, Wiley
3. Plummer, Deal & Griffin — Silicon VLSI Technology, Pearson
4. James D. Plummer — Integrated Circuit Fabrication Technology, McGraw Hill

Course Code: EEC-504 Radar Technology and its Applications

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, One minor test and one major theory exam
Course Objectives		Understand working principles of radar systems, learn basic radar signal processing concepts, Study common radar types used in defense, aviation and remote sensing, Analyze radar performance using simplified equations
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain radar principle and basic radar range equation.
2. Classify radar systems based on waveform and application.
3. Analyze radar detection in presence of noise and clutter.
4. Explain Doppler effect and moving target detection methods.
5. Describe radar subsystems (transmitter, receiver, antenna, display).
6. Identify modern radar applications such as tracking and surveillance.

Topics Covered

UNIT-I 9

Radar Fundamentals: Introduction to Radar: History and applications, Radar block diagram and working principle, Radar frequency bands and spectrum usage, Radar Range Equation, Radar Cross Section (RCS), Minimum Detectable Signal (MDS)

UNIT-II 9

Radar Waveforms and Radar Types: Continuous Wave (CW) Radar – Principle and limitations, Frequency Modulated CW (FMCW) Radar – Range measurement, Pulsed Radar – Range measurement and resolution, introduction to Doppler Radar, Introduction to MTI Radar

UNIT-III 9

Radar Signal Detection and Clutter Basics: Noise in radar receivers, Signal-to-Noise Ratio (SNR), Matched filter, Radar clutter – land, sea, weather clutter, Introduction to CFAR detection

UNIT-IV 9

Radar Systems and Applications: Radar antennas – reflector and phased array, Tracking radar basics – scan and track concept, Navigational radar and air-traffic radar, Weather radar and automotive radar, Introduction to modern radar (phased array, software radar – overview)

Books & References

1. M. I. Skolnik — Introduction to Radar Systems, McGraw Hill
2. Byron Edde — Radar Principles, Technology and Applications, Pearson
3. Merrill Skolnik — Radar Handbook
4. Mark A. Richards — Fundamentals of Radar Signal Processing

Course Code: EEC-505 Fundamentals of Software Defined Radio and Cognitive Radio

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, One minor test and one major theory examination
Course Objectives		Understand SDR architecture design, spectrum sensing, and dynamic spectrum access analysis used in wireless systems.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain the evolution, need, and architecture of Software Defined Radio and Cognitive Radio.
2. Analyze SDR transmitter and receiver architectures including RF front-end and digital baseband processing.
3. Evaluate spectrum sensing techniques and dynamic spectrum access algorithms.
4. Design adaptive wireless communication strategies using cognitive radio concepts.
5. Analyze performance issues such as interference, spectrum sharing, and regulatory constraints.

6. Implement SDR-based communication systems using modern tools/platforms (GNU Radio, USRP etc.).

Topics Covered

UNIT-I 9

Fundamentals of SDR and Cognitive Radio: Evolution of Radio Systems: Hardware radio → SDR → Cognitive Radio, SDR Concept and Architecture, RF Front-End and Digital Baseband Processing, I/Q Modulation, Sampling and Digital Signal Processing Role, RF Spectrum Characteristics and Regulations, Cognitive Radio Concept, Need and Benefits, Types of Spectrum Access (Licensed, Unlicensed, Opportunistic)

UNIT-II 9

Software Defined Radio Architecture and Implementation: SDR Transmitter and Receiver Architectures, Direct Conversion vs Superheterodyne SDR, ADC/DAC Selection and Constraints, FPGA/DSP/Processor-based SDR Implementation, SDR Platforms (USRP, RTL-SDR, HackRF Overview), Noise, Dynamic Range, Nonlinearity and RF Impairments, Link Budget and Receiver Sensitivity

UNIT-III 9

Cognitive Radio Technologies: Cognitive Cycle (Observe → Orient → Decide → Act), Spectrum Sensing Techniques: Energy Detection, Matched Filter Detection; Cyclostationary Detection, Cooperative Spectrum Sensing, Dynamic Spectrum Access (DSA), Spectrum Sharing and Spectrum Mobility, IEEE 802.22 and Cognitive Wireless Standards

UNIT-IV 9

Advanced Cognitive Radio Networks and Applications: Cross-layer Optimization, Adaptive Modulation and Coding, Machine Learning for Cognitive Decision Making, Interference Management and Avoidance. Cognitive Radio in 5G/6G and IoT, AI-enabled and Intelligent Radio Networks, Security Issues in Cognitive Radio

Books & References

1. Simon Haykin — Cognitive Radio: Brain-Empowered Wireless Communications
2. Huseyin Arslan — Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems
3. Markus Dillinger — Software Defined Radio: Architectures, Systems and Functions
4. Jeffrey Reed — Software Radio: A Modern Approach to Radio Engineering

Course Code: EEC-506 Digital Image Processing

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One minor test and one major theory & practical examination

Course Objectives The course objectives of Digital Image Processing (DIP) are to equip students with the fundamentals of digital image representation, acquisition, and processing techniques. It focuses on enhancing image quality, removing noise, compressing data for storage, and segmenting images for analysis to enable applications in computer vision, medical imaging, and industrial automation.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand digital image fundamentals and mathematical representation of images.
2. Apply image enhancement techniques in spatial and frequency domains.
3. Perform image restoration and compression using standard algorithms.
4. Analyze segmentation and feature extraction techniques.
5. Implement image processing algorithms using MATLAB/Python.
6. Apply image processing concepts to real-world applications like medical imaging, remote sensing, and surveillance.

Topics Covered

UNIT-I 9

Fundamentals of Digital Image Processing: Introduction to Digital Image Processing, Image Formation and Acquisition, Image Sampling and Quantization, Image Representation and Storage, Human Visual System Basics, Pixel Relationships and Connectivity, Introduction to Image Processing Applications

UNIT-II 9

Image Enhancement Techniques: Spatial Domain Methods: Gray Level Transformations, Histogram Processing and Equalization, Image Smoothing Filters (Mean, Median, Gaussian), Image Sharpening Filters (Laplacian, High Pass)

Frequency Domain Methods: Fourier Transform in Image Processing, Frequency Domain Filtering, Low Pass and High Pass Filters, Homomorphic Filtering

UNIT-III 9

Image Restoration and Compression: Image Restoration: Noise Models (Gaussian, Salt & Pepper, Speckle), Image Degradation Models, Inverse Filtering, Wiener Filtering

Image Compression: Coding Redundancy and Interpixel Redundancy, Lossless Compression (Huffman Coding, Run Length Coding), Lossy Compression (Transform Coding, JPEG Basics)

UNIT-IV 9

Image Segmentation and Feature Extraction: Thresholding Techniques, Edge Detection (Sobel, Prewitt, Canny), Region-Based Segmentation, Morphological Image Processing, Feature Extraction Techniques, Basics of Object Recognition

Experiments:

1. Image Read, Display and Basic Operations

2. Histogram Plotting and Equalization
3. Spatial Filtering (Smoothing and Sharpening)
4. Fourier Transform of Images
5. Frequency Domain Filtering
6. Noise Addition and Removal
7. Image Restoration using Wiener Filter
8. Edge Detection Techniques
9. Image Segmentation using Thresholding
10. Mini Project: Application-Based Image Processing System

Books & References

1. Rafael C. Gonzalez & Richard E. Woods — Digital Image Processing
2. Anil K. Jain — Fundamentals of Digital Image Processing.

Course Code: EEC-601 **Digital System Design using Verilog**

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 2, Tutorial: 0, Practical: 4
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One minor test and one major theory & practical examination
Course Objectives		The course objective of Digital System Design using Verilog is to enable students to design, model, simulate, and synthesize combinational and sequential digital circuits using Verilog HDL. It focuses on mastering RTL modeling, functional verification via test benches, and implementing designs on FPGAs, preparing students for VLSI industry roles.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand digital system design methodology and HDL-based design flow.
2. Write Verilog code for combinational and sequential digital circuits.
3. Design and simulate digital subsystems using Verilog HDL.
4. Implement digital systems using FPGA-based design tools.
5. Analyze timing, synthesis, and hardware mapping constraints.
6. Design complete digital systems using modular and hierarchical Verilog design.

Topics Covered

UNIT-I 6

Digital System Design Fundamentals and Verilog Basics: Digital Design Flow: Specification → Modeling → Simulation → Synthesis → Implementation, Introduction to Hardware Description Languages, Verilog HDL Overview and Applications, Structure of Verilog Module, Data Types and Operators, Gate Level Modeling, Data Flow Modeling, Behavioral Modeling Basics, Testbench Concepts

UNIT-II 6

Combinational Logic Design using Verilog: Modeling Combinational Circuits, Multiplexers, Encoders, Decoders, Adders and Subtractors (Half, Full, Carry Lookahead), Comparators, ALU Design using Verilog, Blocking vs Non-blocking Assignments, Timing Delays in Verilog, Case and If Statements

UNIT-III 6

Sequential Logic Design using Verilog: Flip-Flops and Latches Modeling, Registers and Shift Registers, Counters (Synchronous and Asynchronous), Finite State Machines (Moore and Mealy), State Encoding Techniques, Clocking and Reset Strategies, Race Conditions and Timing Issues

UNIT-IV 6

Synthesis & FPGA Implementation: RTL Design Concepts, Synthesis Process and Constraints, FPGA Architecture Basics (CLB, LUT, Interconnects), Introduction to FPGA Design Flow, Timing Analysis and Setup/Hold Violations, Low Power Design Concepts,

Introduction to System-on-Chip (SoC) Design, Verification Basics and Introduction to SystemVerilog (Overview)

Experiments:

1. Introduction to Verilog Simulation Tools (ModelSim / Vivado)
2. Verilog Code for Basic Logic Gates
3. Verilog Implementation of Adders
4. Multiplexer / Decoder Design using Verilog
5. ALU Design using Verilog
6. Flip-Flop and Register Design
7. Counter Design using Verilog
8. FSM Design and Simulation
9. FPGA Implementation of Digital Circuits
10. Mini Project: Digital System using Verilog

Books & References

1. Samir Palnitkar — Verilog HDL: A Guide to Digital Design and Synthesis
2. Stephen Brown & Zvonko Vranesic — Fundamentals of Digital Logic with Verilog Design.
3. Michael D. Ciletti — Advanced Digital Design with Verilog HDL
4. Charles Roth — Digital Systems Design Using Verilog

Course Code: EEC-602		**Photonics in Optical Fiber Technologies**
Course category	**:**	Professional Electives (PE)
Pre-requisite Subject	**:**	NIL
Contact hours/week	**:**	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	**:**	4
Course Assessment methods	**:**	Continuous assessment through tutorials, attendance, assignments, quizzes, one minor test and one major theory examination.
Course Objectives	**:**	This course is to provide students with a comprehensive understanding of optical fiber technology, including the physical principles, design, and performance of optical fiber communication systems.
Course Outcomes	**:**	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Understand the basics concepts of Fiber Optic Communication.
2. Understand all the sub-components of Fiber Optics.
3. Examine the working mechanism of Fiber Optics.
4. Illustrate the practical implementation of Fiber Optic Communication
5. Compare the main types of fiber amplifiers in terms of their and typical applications.
6. Describe the operating principle of Fiber Bragg Grating (FBG) sensors, including the

formation of periodic refractive index modulation.

Topics Covered

Unit I **9**

Optical Fibers: Light Propagation in Optical Fibers, Optical fiber Modes and Configurations, Mode Theory for Circular waveguides, SM and GI Fibers, Fiber Materials, Photonic Crystal fibers, Fiber fabrication.

Optical Fibers Characteristics: Fiber Attenuation, Absorption losses, scattering losses, Radiation losses, Bending losses, Measurement of losses, Dispersion in fibers, Effect of dispersion in the communication link, Dispersion reduction, and compensation techniques.

Unit II **9**

Power Launching and Coupling: Source to Fiber launching and Launching Schemes for Coupling Improvements. Fiber to Fiber joints, Laser coupling to SM fiber, Fiber splicing, Optical Fiber Connector.

Optical Receivers: Basic Concepts, Common Photodetectors, Receiver Design Receiver Noise, Coherent Detection, Receiver Sensitivity, Sensitivity Degradation, Receiver bandwidth, and Performance.

Unit III **9**

Fiber Amplifier: Optical Amplification in rare-earth-doped fibers, Types of Fiber Amplifiers, EDFA, Amplifier Noise, Optical SNR, System Application, Raman Amplifiers, Wideband Optical Amplifier

Unit IV **9**

Optical Fiber Sensors: Introduction, Classification and Types of Optical Fiber Sensors, Sensor Modulation Techniques, Fiber Bragg Grating Sensors: Principle and Applications.

References Textbooks:

1. A.K. Ghatak & K. Thyagarajan, Introduction to Fiber Optics, Cambridge University Press 1998
2. G. Kaiser, Optical Fiber Communication, 4th Edition, Tata McGraw Hill 2008
3. K.T.V. Grattan & B.T. Meggitt, Optical Fiber Sensor Technology, Vol. 2, 1988

Course Code: EEC-603 **Antenna Design for Modern Wireless Communication**

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 0 , Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One minor test and one major theory & practical examination

Course Objectives : This course aims to provide students with knowledge of antenna fundamentals, radiation characteristics, antenna array theory, and microstrip antenna design techniques required for contemporary wireless communication technologies.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain antenna fundamentals, radiation mechanisms, and important performance parameters.

2. Classify different types of antennas and analyze their operating principles and characteristics.

3. Analyze antenna impedance, radiation patterns, and transmission behavior in wireless links.

4. Apply antenna array theory and beamforming techniques to achieve directional radiation and beam steering.

5. Design microstrip patch antennas and antenna arrays using suitable feeding techniques.

6. Simulate, analyze, and evaluate antenna performance using electromagnetic simulation tools for wireless applications.

Topics Covered

UNIT-I 9

Antenna Fundamentals: Basics of Antennas and Working Principles, Bandwidth, Radiation Intensity, Beam Efficiency, Directivity and Gain, Return Loss, VSWR, Antenna Aperture, Effective Height, Radio Communication Link, Antenna Impedance, Radiation mechanism and Friis Transmission Equation.

UNIT-II 9

Classification of Antennas and Performance: Types of Antennas, Wire Antennas, Dipole Antenna, V-Antenna, Rhombic Antenna, Helical Antenna, Yagi-Uda Antenna, Spiral Antenna, Log-Periodic Antenna, Horn Antenna, Parabolic Reflector Antenna, Monopole Antenna, MIMO Antenna.

UNIT-III 9

Antenna Arrays and Beamforming: Array fundamentals: Array factor, pattern multiplication. Linear, planar, and circular arrays. Array synthesis: Uniform, binomial, and Chebyshev arrays. Adaptive arrays and beam steering. Beamforming techniques: Analog, digital and hybrid beamforming.

UNIT-IV 9

Microstrip Antenna: Introduction to Microstrip Antennas, Transmission Line and Cavity Models, Design of Microstrip Patch Antennas, Feeding Techniques, Analysis Methods, Arrays of Microstrip Antennas, Bandwidth and Performance Enhancement and Advanced and Modern Applications.

EXPERIMENTS

1. Familiarization with the HFSS 3D modeler, assigning materials (e.g., PEC, FR4), defining radiation boundaries, and setting up frequency sweeps.

2. Half-Wave Dipole Antenna Design and simulation at a specific frequency (e.g., 1 GHz or 2.4 GHz) to determine reflection coefficients and E-plane/H-plane radiation patterns.
3. Modeling of Quarter-Wave Monopole Antenna over a finite ground plane and measuring its antenna parameters.
4. Designing a Rectangular Microstrip Patch Antenna for WLAN applications (typically 2.4 GHz) using different feeding techniques like probe feed or microstrip line feed.
5. Simulation and analysis of a circular patch to compare performance with rectangular designs.
6. Design and analysis of an aperture antenna (e.g., Pyramidal Horn) to study high-gain radiation characteristics.
7. Designing a 2x2 or N-element microstrip patch array to observe beamforming and gain enhancement.
8. Simulation of a Bow-Tie or Conical antenna to analyze bandwidth characteristics.
9. Design and analysis of a square or circular loop antenna for specific resonant frequencies.

Books & References

1. C. A. Balanis, Antenna Theory: Analysis and Design, Wiley.
2. R. Garg et al., Microstrip Antenna Design Handbook, Artech House.
3. T. K. Sarkar, Smart Antennas, Wiley.
4. W. L. Stutzman & G. A. Thiele, Antenna Theory and Design, Wiley.
5. Andrea Goldsmith, Wireless Communications, Cambridge University Press.

Course Code: EEC-604 Introduction to Nano Transistors

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	**NIL**
Contact hours/week	:	Lecture:3 , Tutorial:1, Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, one minor test and one major theory examination.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Understand basic concepts of Quantum mechanics, density of states, Modes, and transport of MOSFET.
2. Introducing the characteristics and associated parameters of nano-transistors.
3. Understand the ballistic transport at nonequilibrium conditions.
4. Analyze various nanowire field effect transistors.
5. Understanding of carbon nanotube field effect transistor.
6. Concept of Molecular and Single Electron Transistor.

Topics Covered

UNIT-I **9**

Basic Concepts: Quantum mechanics in nanoelectronics, KP model: Origin of energy bands in solids, Brillouin Zones, Density of states: 1D, 2D, and 3D Conductors, Fermi function, Modes in a conductor:1D, 2D Conductors, Diffusive and Ballistic transport, Transport theories: BTE and NEGF.

UNIT-II **9**

Nano-transistor: Current-voltage Relation, Saturation current, Role of Charging: Quantum capacitance, Electrostatics rectifiers, Extended Channel Model: Diffusion equation, Self-consistent solution, Diffusion Equation for Ballistic Transport. Non-equilibrium Electrochemical Potentials.

UNIT-III **9**

Boltzmann Equation: BTE from Newton's Laws, Diffusion Equation from BTE, Concept of two Potentials, Quasi-Fermi Levels: Landauer Formulas, Buttiker Formula, Hall Effect, PN junction contacts: Current-voltage characteristics, Spin Potentials: spin volve, spin voltage measurement, spin momentum locking. Nanowire Field Effect Transistors: Silicon nanowire MOSFETs.

UNIT-IV **9**

Carbon Nanotubes: Band-structure of carbon nanotube, Carbon nanotube FETs, Carbon nanotube MOSFETs, Schottky barrier carbon nanotube FETs.

Transistors at the Molecular Scale: Electronic conduction in molecules, General model for ballistic nano-transistors, MOSFETs with OD, ID, and 2D channels, Molecular transistors, Single electron transistors.

Text and Reference Book

1. Supriyo Datta (2017). *Lessons from Nanoelectronics (Vol. 5)*. 2nd Edition, World Scientific Publishing Company.
2. Lundstrom, Mark S., and Jing Guo.(2010), *Nanoscale Transistors. 1st Edition*, Springer.
3. Griffiths, D., & Schroeter, D. (2018). *Introduction to Quantum Mechanics* (3rd ed.). Cambridge: Cambridge University Press.

Course Code: EEC-701		**Spacecraft Systems Engineering**
Course Category	**:**	Professional Elective (PE)
Pre-requisite Subject	**:**	**NIL**
Contact hours/week	**:**	Lecture:3, Tutorial:1, Practical:0
Number of Credits	**:**	4
Course Assessment methods	**:**	Continuous assessments through teaching assessment, attendance, home assignments, quizzes, two minor tests and one major theory examination.
Course Objectives	**:**	Familiarize students with the fundamentals of spacecraft configurations and satellite subsystems through its Structures and thermal control system. The principles of satellite communication and basics of remote sensing satellites will also be communicated to the students.
Course Outcomes	**:**	The students are expected to be able to demonstrate the

following knowledge, skills and attitudes after completing this course.

1: Fundamentals of Spacecraft Configurations and Satellite subsystems.

2: Spacecraft Structures and Thermal Control System.

3: Satellite Communication principles.

4: Basics of remote sensing satellites.

5: Understanding of Satellite working.

6: Able to be understanding the design aspect of satellite.

Topics Covered

Unit I: **9**

Spacecraft Configurations and Satellite subsystems Mission analysis and design, Space Environment and space weather, Disturbances acting on a satellite, Fundamentals of on-board computer and control electronics, on-board software development for attitude and orbit control, propulsion, electrical power, solar arrays, batteries, power control electronics, telemetry and telecommand, mechanism, radiation tolerance, electromagnetic compatibility.

Unit II: **9**

Spacecraft Structures and Thermal Control System

Introduction, Spacecraft Structural Configuration, Launch Loads, Stress-Strain Analysis, Matrix Methods of Structural Analysis, Finite Element Analysis, Instability of Structures, Dynamic Analysis, Multi-Degree-of-Freedom System, Random Excitation, Mode Synthesis, Materials, Structural Design Verification Tests, Introduction, Heat Transfer, Thermal Analysis, Thermal Control Techniques, Spacecraft Thermal Design, Thermal Testing.

Unit III: **9**

Satellite Communication

Basic Units and Definitions in Communications Engineering, Frequency Allocations and Some Aspects of the Radio Regulations, Electromagnetic Waves, Frequency, and Polarization Selection for Satellite Communications, Link Consideration, Communications Subsystem of a Communications Satellite, Some Common Modulation and Access Techniques for Satellite Communications, Satellite Capacity and the Sizing of Satellites, Advanced communication systems in LEO, MEO and GEO, Small satellites: engineering and applications.

Unit IV: **9**

Remote Sensing Satellites

Payloads of communication satellites, remote sensing satellites, navigation satellites, science mission satellites and missile detection. Optical, Quantum Satellite communication.

Text and Reference Books

1. Graham Swinerd, John Stark, Peter W. Fortescue, Spacecraft Systems Engineering, Wiley, 2011, 9781119978367
2. Robert Clark Moore, Vincent L. Pisacane, Fundamentals of Space Systems, Oxford University Press, 1994, 9780195074970

3. James F. Peters, Spacecraft Systems Design and Operations: Essential Subsystems for Manned and Unmanned Spacecraft, Kendall/Hunt Publishing Company, 2004, 9780757510007

EEC-703 Testing and Verification of VLSI Circuits

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial: 0 , Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, two minor tests and one major theory & practical examination
Course Objectives		To introduce the necessity and challenges of VLSI testing and verification. To understand fault models, test generation, and design-for-testability techniques. To study verification methodologies and simulation-based validation. To expose students to contemporary testing and verification practices used in industry.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. CO1: Explain the role of testing and verification in the VLSI design flow.
2. Identify and model faults in combinational and sequential circuits.
3. Apply test generation techniques and evaluate fault coverage.
4. Design and analyze scan-based and built-in self-test (BIST) architectures.
5. Understand functional verification concepts and HDL-based verification flows.
6. Analyze trade-offs among testability, area, performance, and power.

Topics Covered

UNIT-I 9

Fundamentals of VLSI Testing: need, objectives, challenges, VLSI design flow and role of testing & verification, Faults vs errors vs defects, Fault models: stuck-at faults, bridging faults, open faults, Single and multiple fault assumptions, Fault coverage and test metrics

UNIT-II 9

Test Generation and Design for Testability: Combinational circuit testing, Path sensitization concept, Automatic Test Pattern Generation (ATPG): D-algorithm, PODEM (overview), Sequential circuit testing issues, Scan design: full scan, partial scan

UNIT-III 9

Memory Testing and Built-In Self-Test (BIST): Memory fault models: stuck-at, coupling, transition faults, Memory testing algorithms: MARCH tests, Logic BIST: test pattern generators (LFSR), BIST architectures and test controllers, Pseudo-random vs deterministic testing, Introduction to delay and at-speed testing

UNIT-IV 9

Functional Verification and Verification Methodologies: Verification vs testing: differences and objectives, Functional verification flow, Simulation-based verification using HDL (Verilog/SystemVerilog concepts), Testbenches: stimulus generation, monitors, checkers, Coverage metrics: code coverage, functional coverage, Introduction to modern verification methodologies (UVM overview), Challenges in verification of large SoCs

EXPERIMENTS

1. Fault simulation of combinational circuits using HDL
2. fault coverage analysis (software tools)
3. Scan chain insertion and testing
4. LFSR-based pattern generation
5. Memory fault modeling and test implementation
6. Verilog testbench development
7. Functional and code coverage analysis
8. Mini project: Verification of a simple digital block

Books & References

1. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer.
2. Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, VLSI Test Principles and Architectures, Morgan Kaufmann.

Course Code: EEC-704 Internet of Things (IoT) Communication Systems

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, two minor tests and one major theory and one practical Exam
Course Objectives		Understand IoT system architecture and communication models, Learn IoT wireless communication technologies and protocols, Study IoT networking and cloud integration, Analyze IoT communication security and performance
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain IoT architecture and communication models.
2. Analyze IoT wireless communication technologies.
3. Design IoT communication networks using suitable protocols.
4. Evaluate IoT network performance and energy efficiency.
5. Understand IoT security and data management techniques
6. Implement IoT communication systems using hardware and software tools.

Topics Covered

UNIT-I 9

IoT Fundamentals and Architecture: Introduction to IoT and cyber-physical systems, IoT architecture layers, IoT communication models (Device-to-Device, Device-to-Cloud, etc.), IoT design constraints (Power, bandwidth, latency), IoT applications in smart cities, healthcare, agriculture, industry

UNIT-II 9

IoT Wireless Communication Technologies: Short range communication:Bluetooth / BLE, ZigBee, Wi-Fi; Long range IoT communication: LoRa / LoRaWAN, NB-IoT, LTE-M; RFID and NFC basics, IoT spectrum and coexistence issues

UNIT-III 9

IoT Networking Protocols and Data Communication: IPv6 for IoT, 6LoWPAN, MQTT protocol, CoAP protocol, REST architecture, Edge and fog computing basics, IoT gateway architecture

UNIT-IV 9

IoT Security and Advanced IoT Communication: IoT security threats and vulnerabilities, Lightweight cryptography basics, Authentication and secure data transmission, Energy efficient IoT communication, AI-enabled IoT communication (Intro), Integration with 5G IoT networks, Introduction to Industrial IoT (IIoT)

Experiments:

1. IoT sensor data transmission using Wi-Fi / BLE
2. MQTT communication using IoT broker
3. LoRa communication demo / simulation
4. IoT cloud data visualization
5. Secure IoT communication implementation

Textbooks & References

1. Arshdeep Bahga & Vijay Madisetti — Internet of Things: A Hands-On Approach
2. Olivier Hersent, David Boswarthick — The Internet of Things: Key Applications and Protocols.
3. Samuel Greengard — The Internet of Things

Course Code: EEC-705 Advanced Mobile Communication and 5G Systems

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, two minor test and one major theory & practical examination
Course Objectives		Understand evolution of cellular communication systems up to 5G, Study 5G architecture, air interface and enabling technologies, Learn advanced wireless techniques like

massive MIMO and beamforming, Understand emerging trends toward 6G communication systems

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain evolution of mobile communication from 2G to 5G and Understand role of AI and IoT in next generation wireless systems.
2. Analyze LTE and 5G NR architecture and protocols.
3. Evaluate advanced wireless technologies such as massive MIMO and beamforming.
4. Analyze millimeter wave communication challenges and solutions.
5. Explain 5G network slicing, virtualization and cloud RAN concepts.
6. Evaluate performance metrics of modern cellular networks.

Topics Covered

UNIT-I 9

Evolution of Mobile Communication Systems: Cellular communication fundamentals, Evolution from 1G → 2G → 3G → 4G → 5G, LTE and LTE-Advanced overview, OFDM and SC-FDMA fundamentals, Cellular network planning basics, Multiple access techniques overview

UNIT-II 9

5G NR Technology: 5G architecture and functional blocks, 5G NR frame structure, Flexible numerology, Massive MIMO concepts, Beamforming techniques, Millimeter wave communication fundamentals

UNIT-III 9

5G Network Architecture and Services: Cloud RAN (C-RAN), Software Defined Networking (SDN), Network Function Virtualization (NFV), Network slicing, Ultra-Reliable Low Latency Communication (URLLC), Massive Machine Type Communication (mMTC), Enhanced Mobile Broadband (eMBB)

UNIT-IV 9

Emerging Technologies and 6G Vision: AI and Machine Learning in wireless networks, IoT integration with 5G, Edge computing and mobile edge networks, Terahertz communication, Reconfigurable Intelligent Surfaces (RIS), 6G vision: AI-native networks, digital twin communication, holographic communication (overview)

Experiments:

1. OFDM system simulation
2. BER performance of 5G modulation schemes
3. Massive MIMO channel simulation
4. Beamforming algorithm simulation
5. mmWave path loss modelling

Books & References

1. Afif Osseiran et al. — 5G Mobile and Wireless Communications Technology, Cambridge
2. Erik Dahlman, Stefan Parkvall, Johan Skold — 5G NR: The Next Generation Wireless Access Technology, Academic Press
3. Theodore Rappaport — Wireless Communications
4. Jonathan Rodriguez — Fundamentals of 5G Mobile Networks

5. Saad, Bennis & Chen — Vision of 6G Wireless Systems

Course Code: EEC-706 Satellite Communication

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, two minor test and one major theory & practical examination
Course Objectives		Understand satellite communication system architecture, Study orbital mechanics and satellite link design, Learn satellite payload and subsystem design, Analyze satellite channel impairments and performance
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain satellite communication system architecture and working principles.
2. Analyze satellite orbits and satellite coverage.
3. Perform satellite link budget analysis.
4. Explain satellite payload, transponders and subsystems.
5. Analyze satellite channel impairments and mitigation techniques.
6. Evaluate modern satellite communication technologies and applications.

Topics Covered

UNIT-I 9

Satellite Communication Fundamentals: Introduction to satellite communication, Satellite communication system architecture, Frequency bands used in satellite communication, Satellite communication, Applications (TV, Navigation, Remote sensing, IoT), Basic space segment and ground segment overview

UNIT-II 9

Satellite Orbits and Launching: Kepler's laws, Orbital parameters, GEO, MEO, LEO satellite systems, Satellite look angles, Satellite visibility and coverage area, Launching of satellites (overview)

UNIT-III 9

Satellite Link Design and Subsystems: Satellite link budget analysis, Uplink and downlink design, Satellite transponders, Satellite antennas, Earth station design basics, Multiple access techniques (FDMA, TDMA, CDMA basics)

UNIT-IV 9

Satellite Channel and Modern Satellite Systems: Atmospheric effects (rain attenuation, ionospheric effects), Noise temperature and G/T ratio, Satellite communication modulation techniques, VSAT systems, Mobile satellite communication, Introduction to High Throughput Satellites (HTS), Basics of satellite constellations

Experiments:

1. Satellite link budget calculation using MATLAB
2. Satellite orbit simulation
3. Rain attenuation modelling
4. Satellite channel BER simulation
5. Antenna pointing calculation

Books & References

1. Timothy Pratt, Charles Bostian & Jeremy Allnutt — Satellite Communications, Wiley
2. Dennis Roddy — Satellite Communications, McGraw Hill
3. Wilbur Pritchard — Satellite Communication Systems Engineering

Course Code: EEC-801 Low Power VLSI Design

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, two minor tests and one major theory & practical examination
Course Objectives		To understand sources of power dissipation in VLSI circuits, To study low-power design techniques at circuit, logic, and system levels, To analyze trade-offs among power, performance, and area in CMOS designs, To introduce industry-relevant low-power methodologies used in modern SoCs.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Identify different components of power dissipation in CMOS VLSI circuits.
2. Analyze dynamic and static power consumption in digital CMOS circuits.
3. Apply circuit-level techniques to reduce power dissipation.
4. Implement logic-level and architectural low-power design techniques.
5. Evaluate low-power clocking and memory design strategies.
6. Analyze power–performance–area trade-offs in low-power VLSI systems..

Topics Covered

UNIT-I 9

Power Dissipation in CMOS Circuits: Introduction to low-power VLSI design, Sources of power dissipation in CMOS circuits: Dynamic power (switching power), Short-circuit power, Static/leakage power; Power dissipation models, Power-delay product and energy-delay product, Impact of technology scaling on power consumption

UNIT-II 9

Circuit-Level Low Power Design Techniques: Supply voltage scaling and its limitations, Transistor sizing and threshold voltage assignment, Multi-threshold CMOS

(MTCMOS), Power gating and sleep transistors, Body biasing techniques, Leakage reduction techniques in deep submicron CMOS

UNIT-III 9

Logic-Level and Architectural Low Power Techniques: Logic restructuring and logic minimization, Clock gating techniques, Operand isolation, Low-power FSM design, Memory power reduction techniques, Low-power bus encoding techniques (Gray coding, bus-invert coding)

UNIT-IV 9

System-Level Power Management: Dynamic Voltage and Frequency Scaling (DVFS), Power-aware scheduling and power management units (PMU), Low-power SoC design methodologies, Introduction to power-aware CAD tools, Power estimation, analysis, and optimization flow, Case studies of low-power processors and mobile SoCs

Experiments:

1. Power analysis of CMOS inverter using EDA tools
2. Dynamic vs leakage power measurement in logic circuits
3. Implementation of clock gating
4. Power gating with sleep transistors
5. Comparison of low-power encoding techniques
6. Power estimation using RTL and gate-level simulations
7. Mini-project: Low-power design of a digital block

Books & References

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolić, Digital Integrated Circuits: A Design Perspective, 2nd Edition, Pearson.
2. Gary Yeap, Practical Low Power Digital VLSI Design, Kluwer Academic Publishers.
3. Chandrakasan & Brodersen, Low Power Digital CMOS Design, Springer.
4. Kaushik Roy & Sharat Prasad, Low-Power CMOS VLSI Circuit Design, Wiley.
5. Neil H. E. Weste & David Harris, CMOS VLSI Design: A Circuits and Systems Perspective, Pearson.

Course Code: EEC-802		**Computational Photonics**
Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, assignments, quizzes, one minor test and one major theory examination.
Course Objectives	:	This course is to familiarize students with advanced computational techniques used in the modeling and simulation of photonic and optical devices.
Course Outcomes	:	The students are expected to be able to demonstrate the following

knowledge, skills and attitudes after completing this course.

1. Study on mode solution and beam propagation methods for photonic devices.

2. Explain the working principles and types of lasers and evaluate the performance of photodetectors and optical devices.

3. Study on FDTD method for photonics band gaps and understanding the recent advance in photonics devices.

4. Identify and explain the use of optoelectronic devices in practical applications.

5. Outline the key fabrication techniques for optical fibers (e.g., Modified Chemical Vapor Deposition (MCVD), Outside Vapor Deposition (OVD), Vapor Axial Deposition (VAD).

6.Explain the structure, unique properties (endless single-mode, high nonlinearity, tailored dispersion, air-hole cladding), and applications of Photonic Crystal Fiber (PCF).

T**opics Covered**

Unit I **9**

Beam Propagation Method: Theory and working of beam propagation method, Tutorials on MMI couplers, optical gratings, co-directional couplers or polarization converters, scattering boundary conditions.

Unit II **9**

Optical Fibers and Waveguides: Optical fiber structure and types (single-mode, multi-mode), Numerical aperture and V-number, Light propagation in fibers, Attenuation and dispersion, bending losses and coupling losses, Fabrication of optical fibers.

Unit III **9**

FDTD Method: Theory and working of FDTD method, Numerical techniques: FDM, FEM, and photonics band gap simulation: 2D and 3D of different crystal lattices, photonic crystal fiber simulation, simulation and modeling of single mode and multimode optical fiber using mode solver.

Unit IV **9**

Photonic Devices and Applications: Phototransistors, Fiber optic communication systems, Optical amplifiers: Erbium-Doped Fiber Amplifier (EDFA), Raman amplifier, Photonic integrated circuits, Applications in medicine, defense, and sensing, Photonic crystal fiber (PCF).

Reference Books:

1. S. Sujecki, Photonics Modelling and Design, CRC Press, 2015.
2. A. Taflove, Computational Electrodynamics: The Finite-Difference Time Domain Method. Norwood, MA: Artech House, 1995

Course Code: EEC-803 **Introduction to Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC)**

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one major theory Exam.
Course Objectives		The objective of this course is to focus on understanding interference sources, coupling paths, and design techniques to ensure systems meet regulatory standards and operate reliably.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Explain EMI and EMC concepts and their importance in electronic system design
2. Identify EMI sources and coupling mechanisms in practical circuits
3. Analyze conducted and radiated emissions in electronic systems
4. Apply EMI measurement techniques and interpret compliance results
5. Design mitigation techniques using shielding, grounding, and filtering
6. Interpret international EMC standards and regulatory requirements

Topics Covered

UNIT-I 9

Fundamentals of EMI / EMC: Introduction to EMI and EMC, Sources and victims of EMI, Natural and man-made interference sources, Conducted and radiated emissions, Susceptibility and immunity, Electromagnetic environment and spectrum usage, Case studies of EMI failures

UNIT-II 9

EMI Coupling Mechanisms: Conducted coupling, Radiated coupling, Capacitive coupling, Inductive coupling, Crosstalk in transmission lines, PCB-level EMI issues, Signal integrity and EMC relationship

UNIT-III 9

EMI Measurement and Testing: EMI measurement basics, Open Area Test Site (OATS), Anechoic chamber testing, TEM and GTEM cells, Conducted emission measurements, Radiated emission measurements, Electrostatic Discharge (ESD) testing, Electrical fast transient and surge testing

UNIT-IV 9

EMI Control and EMC Design Techniques: Shielding principles and materials, Grounding and bonding, EMI filters and suppression techniques, Cable shielding and connector EMC design, PCB layout for EMC, EMC standards (CISPR, FCC, IEC etc.), EMC compliance process

Textbooks & References

1. C. R. Paul — Introduction to Electromagnetic Compatibility, Wiley
2. Clayton R. Paul — Analysis of Multiconductor Transmission Lines, Wiley.

3. V. K. Prasad — Engineering Electromagnetic Compatibility, BSP
4. Christopoulos — Principles and Techniques of Electromagnetic Compatibility, CRC Press

Course Code: EEC-804 Nano spintronics

Course category	:	Professional Elective (PE)
Pre-requisite Subject	:	**NIL**
Contact hours/week	:	Lecture:3, Tutorial:1 , Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one major theory examination.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. To study the basics of low-dimensional materials.
2. To gain depth knowledge about the electronic properties of low-dimensional materials.
3. To study about magnetic semiconductors based on low-dimensional materials.
4. To address the magnetism in nanoscale materials.
5. To address the basics of spintronic behaviour in low-dimensional materials.
6. To understand the mechanism of spintronic devices based on low-dimensional materials.

Topics Covered

UNIT-I **9**

Basics of Materials

Free electron theory, Kronig-Penney Model, Crystal lattices: Periodic potential, Band theory, Tight binding, Classification of metals, insulators and semiconductors, Symmetry of energy bands, Density of state, Fermi surface.

UNIT-II **9**

Properties of low-dimensional materials

Introduction, Electronic structure: tunable band structure with thickness, Dielectric constant, Factors affecting 2D materials-defects, doping, alloying, Junction of 2D materials- 2D homostructures, 2D heterostructures.

UNIT-III **9**

Magnetic elements in Low-dimensional materials

2D Materials Based on Ferromagnetic Elements, Two-dimensional Ferromagnets, 2D Ferromagnetic Semiconductors- Transition metal chalcogenides, Transition metal chalcogenide halides, Magnetic Anisotropy, Gaint Magnetoresistance, Quantum Anomalus Hall effect,Magnetic Skyrmions, Multiferrocity, Modulation of Magnetism in 2D materials.

UNIT-IV **9**

Magnetism and Spintronics

Magnetic effects in atoms, Diamagnetism, Magnons, paramagnetism, Curie and Pauli, Ferromagnetic domains, Hysteresis, Nanoscale effects, Magnetic tunnel junctions, Magneto-resistance, Zero resistivity, The Meissner effect, BCS theory Spintronics: GMR, TMR, spin

injection and detection, magnetic tunnel junctions, dilute magnetic semiconductors and spintronic devices.

Text and Reference Book

1. A. V. Papavasileiou, M. Menelaou, K. J. Sarkar, Z. Sofer, L.Polavarapu, S. Mourdikoudis, "Ferromagnetic Elements in Two-Dimensional Materials: 2D Magnets and Beyond", Advanced Functional Materials, vol. 34, 2, 2024.
2. D. Kong, C. Zhu, C. Zhao, J. Liu, P. Wang, X. Huang, S. Zheng, D. Zheng, R. Liu, J. Zhou, Emerging two-dimensional ferromagnetic semiconductors, Royal Society of Chemistry, 53, pp. 11228-11250, 2024.
3. Solid-state Physics – An Introduction by P Hofmann, 2nd Edition, Wiley VCH (2015)
4. Introduction to Solid-State Physics by C. Kittel, 8th Edition, John Wiley and Sons (2005).

BHS-302/352		**Industrial Management**
Course category	:	HSSE
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes One Minor test, and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Students will become efficient and acquire acumen for more profitable business practices
2. Students will understand the importance of better customer service and product quality
3. Able to make work safer, faster, easier, and more rewarding
4. Able to help the industry in the production of more products that possess all utility factors
5. Reducing costs associated with new technologies
6. Determine sources of Finance for Industrial Enterprises

Topics Covered

UNIT I: Introduction to Modern Management and Plant Layout **9**

Introduction to Modern Management

Definition, Nature, and Scope of Management, Process of Management and its Elements, Understanding Industrial Management: Definition, Scope, and Application

Plant Location and Layout

Factors Affecting Plant Location, Objectives and Principles of Plant Layout, Types of Plant Layouts and their Significance

UNIT II: Work Analysis, Measurement, and Personnel Management 9

Work Analysis and Measurement, Designing Work Studies, Steps Involved in Work-Study Process, Method Study: Definition, Concepts, and Procedures, Work Measurement Techniques: Objectives and Methods, Application of Work Sampling, Personnel Selection and Wage Payment Plans

UNIT III: Organizational Structures and Financial Management 9

Organizational Structures

Types of Organizations, Functions and Objectives of Industrial Organizations, Ownership Structures: Proprietorship, Partnership, Joint-Stock Companies, Public and Private Undertakings, Co-operative Organizations

Financial Management

Sources of Finance for Industrial Enterprises, Overview of Types of Bank Accounts and Their Importance

UNIT IV: Material Management and Industrial Safety 9

Material Management

Understanding Inventory Management, Economic Order Quantity (EOQ) Model, ABC Analysis and its Application, Just-in-Time (JIT) Inventory System, Minimum Safety Stock Requirements

Industrial Safety

Importance of Occupational Safety, Safety Programs and Initiatives, Integrating Safety Aspects into Work System Design

Textbooks:

1. Principles of Management by Harold Koontz and Heinz Weihrich
2. Industrial Engineering and Management by O.P. Khanna
3. Financial Management: Theory and Practice by Prasanna Chandra
4. Industrial Safety and Health Management by C. Ray Asfahl and David W. Rieske

References:

1. Introduction to Industrial Engineering by Avinash K. Agarwal and A. B. Gupta
2. Modern Industrial Organization by Dennis W. Carlton and Jeffrey M. Perloff
3. Operations Management: Sustainability and Supply Chain Management by Jay Heizer and Barry Render
4. Material Management by R. Panneerselvam

SYLLABUS FOR SKILLS-ENHANCEMENT COURSES FOR EXIT

BEC-181		**Introduction to Python Programming and Embedded Hardware Basics**
Course category	:	Skill Enhancement
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 2, Tutorial:0, Practical: 2
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through assignments, quizzes, case studies, lab work, Viva-Voce, one minor test, and one major theory examination, One Practical Exam.
Course Objectives	:	Introduce programming fundamentals using Python, Develop problem solving and algorithmic thinking, Introduce embedded hardware ecosystem and microcontrollers, Enable students to interface basic sensors and actuators using Python-supported hardware
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Write basic Python programs using variables, operators and control structures.
2. Develop simple programs using functions, lists and file handling.
3. Explain basic embedded system architecture and hardware components.
4. Interface sensors and actuators using microcontroller development boards.
5. Acquire and process real-world data using Python-based embedded platforms.
6. Develop small hardware-software integrated mini projects.

Topics Covered

UNIT-I 6

Python Programming Fundamentals: Introduction to Programming Concepts, Python Installation and IDE Setup, Variables, Data Types and Operators, Input and Output Functions, Conditional Statements (if, if-else, nested if), Loops (for, while), Basic Program Development Examples

UNIT-II 6

Python Programming for Data Handling: Functions and Modules, Lists, Tuples and Dictionaries, String Handling, File Handling Basics, Exception Handling (Basic Idea), Introduction to Python Libraries for Hardware Interaction.

UNIT-III 6

Embedded Hardware Fundamentals: Introduction to Embedded Systems, Microcontroller vs Microprocessor, Development Boards Overview (Arduino / MicroPython Boards / Raspberry Pi Pico – concept level), Digital and Analog I/O Basics, Sensors and Actuators Basics, Serial Communication Basics (UART / I2C / SPI – Intro Level).

UNIT-IV 6

Python for Embedded Hardware Interfacing: Python-based Hardware Control Concept, GPIO Programming Basics, Sensor Data Acquisition using Embedded Boards, Controlling LEDs, Motors and Displays, Introduction to IoT Hardware Integration (Concept Level), Debugging and Testing Basics

Experiments

Section A: Python Programming:

1. Python Environment Setup and Basic Programs
2. Conditional and Loop-Based Programming
3. Functions and List Handling Programs
4. File Handling Program.

Section B: Embedded Hardware:

1. LED Interfacing and Blinking using Development Board
2. Digital Input Reading (Switch / Button Interface)
3. Temperature or Light Sensor Data Reading
4. Serial Communication Demonstration
5. Motor / Buzzer Control using GPIO
6. Mini Project: Sensor-Based Automation System.

Books & References

1. Reema Thareja — Python Programming Using Problem Solving Approach
2. Raj Kamal — Embedded Systems Architecture, Programming and Design.
3. Charles Severance — Python for Everybody
4. Michael J. Pont — Embedded C and Embedded Systems.

BEC-281		**Applied Analog and Digital Communication Systems**
Course category	:	Skill Enhancement
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 2, Tutorial:0, Practical: 2
Number of Credits	:	3

Course Assessment methods	:	Continuous assessment through assignments, quizzes, case studies, lab work, Viva-Voce, one minor test, and one major theory examination, One Practical Exam.
Course Objectives	:	Understand practical implementation of analog and digital communication systems, Analyze transmitter and receiver building blocks, Perform hardware/software based communication experiments, Correlate theory with real-time signal behavior.
Course Outcomes	:	After completing this course, students will be able to:

1. Explain practical analog communication system blocks.
2. Evaluate communication system performance metrics.
3. Implement modulation and demodulation using hardware/software tools.
4. Analyze digital communication performance using BER/SNR concepts.
5. Design and test basic communication subsystems.
6. Interpret real-time signals using measurement tools.

Topics Covered

UNIT-I 6

Analog Communication System Implementation: Review of communication system architecture, Practical AM generation and detection, Practical FM generation and detection, Superheterodyne receiver practical blocks, RF front-end basics, Noise in analog communication (practical viewpoint), Measurement of modulation index

UNIT-II 6

Digital Communication Fundamentals – Practical Perspective: Digital communication system model, Line coding techniques (NRZ, RZ, Manchester), ASK, FSK, PSK practical generation concepts, Symbol rate vs bit rate, Eye diagram interpretation, Noise and BER concepts, Introduction to channel coding.

UNIT-III 6

Transmitter and Receiver Subsystems: Oscillators and PLL basics in communication, Mixers and frequency conversion, Filters in communication systems, Power amplifiers and LNA overview, ADC/DAC role in modern communication, Software-based communication systems.

UNIT-IV 6

Modern Communication Implementation Concepts: SDR concept and block diagram, Introduction to wireless standards (conceptual level), Digital modulation performance comparison, Link budget basics, Signal quality measurements (SNR, EVM basics), Communication testing using modern tools.

EXPERIMENTS:

1. Study of communication trainer and signal flow
2. AM modulation and envelope detection
3. FM modulation and demodulation
4. Measurement of modulation index (AM/FM)
5. Study of superheterodyne receiver blocks
6. Generation of line coding schemes
7. ASK modulation and demodulation
8. FSK modulation and demodulation
9. PSK modulation demonstration (trainer/software)
10. Eye diagram analysis.
11. Noise effect analysis on communication signals
12. BER measurement using simulation tools
13. PLL frequency synthesis demonstration
14. Basic SDR demonstration using software tools
15. Mini communication link setup and testing

Textbooks & Reference Books

1. B.P. Lathi – Modern Digital and Analog Communication Systems
2. Simon Haykin – Communication Systems
3. Taub & Schilling – Principles of Communication Systems
4. Sklar – Digital Communications
5. Kennedy – Electronic Communication Systems

BEC-391	**VLSI and FPGA Based Digital System Design**
Course category	: Skill Enhancement
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture: 2, Tutorial:0, Practical: 2
Number of Credits	: 3
Course Assessment methods	: Continuous assessment through assignments, quizzes, case studies, lab work, Viva-Voce, one minor test, and one major theory examination, One Practical Exam.
Course Objectives	: Analog Communication Experiments, Understand VLSI design flow from specification to layout, Learn HDL-based digital system design methodology, Implement digital systems using FPGA platforms, Correlate ASIC design and FPGA prototyping approaches.

Course Outcomes : After completing this course, students will be able to:

1. Explain VLSI design flow
2. Understand fabrication constraints.
3. Design digital systems using Verilog/VHDL.
4. Implement and verify designs on FPGA platforms.
5. Analyze timing, power, and area trade-offs.
6. Develop system-level digital solutions using programmable logic..

Topics Covered

UNIT-I 6

VLSI Design Fundamentals: Introduction to VLSI and ASIC design methodology, Full custom, semi-custom and programmable logic design, VLSI design flow: Specification → HDL → Synthesis → Layout → Fabrication, CMOS logic design basics, Stick diagrams and layout concepts, Design rules and scaling issues, Interconnect effects and parasitics

UNIT-II 6

HDL Based Digital System Design: HDL design methodology, Verilog/VHDL design constructs, Combinational logic modeling, Sequential logic modeling, FSM design using HDL, Testbench development and simulation, Synthesis constraints and optimization.

UNIT-III 6

FPGA Architecture and Design Flow: FPGA architecture overview (CLB, LUT, Routing, IO blocks), FPGA vs ASIC comparison, FPGA design flow: Design entry → Simulation → Synthesis → Implementation → Bitstream, Timing analysis and constraint definition, Introduction to vendor tools: Xilinx.

UNIT-IV 6

Advanced Digital System Implementation: Pipelining and parallelism in digital design, DSP blocks in FPGA, Memory design using block RAM, High-speed IO basics, Low power design techniques, System-on-Chip (SoC) concept (intro level), Design verification and hardware debugging.

EXPERIMENTS:

1. Introduction to HDL simulation tools
2. Design of basic logic gates using Verilog/VHDL
3. Design of combinational circuits (MUX, Encoder, Decoder)
4. Design of sequential circuits (Flip-flops, Counters, Shift Registers)
5. FPGA tool flow familiarization
6. Combinational circuit implementation on FPGA board
7. Sequential circuit implementation on FPGA
8. UART / Serial communication module implementation
9. PWM generator design using FPGA
10. ALU design and FPGA implementation
11. Memory controller design
12. Digital filter implementation using FPGA DSP blocks
13. Timing analysis and optimization study
14. Mini project using FPGA platform
15. Mini communication link setup and testing

Textbooks & Reference Books

1. CMOS VLSI Design – Neil Weste & David Harris
2. Samir Palnitkar – Verilog HDL
3. FPGA Prototyping using Verilog / VHDL – Pong P. Chu
4. Digital Integrated Circuits – Jan Rabaey

Syllabus of Audit Courses

CONSTITUTION OF INDIA

Course Code: : **AUC 101** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes:

At the end of the course, learners should be able to

CO1- Student will Identify and explore the basic features and modalities about Indian constitution

CO2- Students will be able to differentiate and relate the functioning of Indian parliamentary system at the center and state level.

CO3- Student will be able to differentiate different aspects of Indian Legal System and its related bodies.

UNIT 1--Introduction and Basic Information about Indian Constitution: Historical Background of the Constituent Assembly, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System.

UNIT 2-Union Executive and State Executive: Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Powers and Functions of the Prime Minister, Judiciary.

UNIT 3- Introduction and Basic Information about Legal System: The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court).

UNIT 4- Intellectual Property Laws and Regulation to Information: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright, Information Technology Act, 2000. The Company's Act:

Reference:

1) G. Austin (2004) Working of a Democratic Constitution of India, New Delhi: Oxford University Press.
2) Basu, D.D (2005), An Introduction to the Constitution of India, New Delhi, Prentice Hall.
3) N. Chandhoke & Priyadarshini (eds) (2009) Contemporary India: Economy, Society, Politics, New Delhi: Oxford University Press.
4) N.G Jayal and P.B. Maheta, (eds) (2010) Oxford Companion to Indian Politics, New Delhi: Oxford University Press.

Indian Culture and Heritage

Course Code:	**:**	**AUC 102**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Unit-I

Indian Culture: An Introduction, Characteristics of Indian culture, Significance of Geography on Indian Culture, Society in India, Religion and Philosophy in India.

Unit-II

Indian Languages and Literature, Evolution of script and languages in India, Harappan Script and Brahmi Script, History of Buddhist and Jain Literature.

Unit-III

A Brief History of Indian Arts and Architecture, Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture. Indian Painting Tradition: ancient, medieval, modern Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

Unit-IV

Spread of Indian Culture Abroad, Causes Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia, India, Central Asia and Western World.

Recommended Readings:

1. Barua, B. 1934-37. Barhut Vol. I-III. Calcutta: Indian Research Institute.
2. Cunningham, Alexander 1966. The Bhilsa Topes. Varanasi: Indological Book Corporation.
3. Cunningham, Alexander 1965. The Stupa of Bharhut. Varanasi: Indological Book Corporation.
4. Dallapiccola, L.S.Z. Lallemant. 1980. The Stupa : Its Religious, Historical, and Architectural Significance. Wiesbaden: Franz Steiner Verlag.
5. Dehejia, Vidya 1972. Early Buddhist Rock Temples A Chronological Study. London: Thames and Hudson

Indian Architecture

Course Code:	**:**	**AUC 103**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course outcomes

CO1- This course will help student learn about the development of Indian architecture and its contextual and traditional aspects.

CO2- The learner will gain knowledge of the development of architectural forms with reference to technology, style and character in various aspects of Hindu architecture.

CO3- The students will comprehend and relate to the theoretical basis of Budhdhist and Jain Architectures.

UNIT 1; Indus Valley Civilization: Town planning principles, cultural ethos, economy exemplified. The Aryan civilization: With its emphasis on the Vedic town plan.
UNIT 2: Buddhist Architecture Typology of lats, eddicts, stupas, viharas, and chaityas, both in rock-cut or other wise. The Buddhist philosophy and its imprint

UNIT3; Hindu Architecture, Indo Aryan: The evolution of the temple form, evolution of the shikhara in north India. The three schools of architecture - the Gujarat, the Khajuraho, and the Orrisan styles, Introduction to Dravidian Hindu Architecture.

UNIT 4: Jain Architecture : The temple cities of Palitana, Mount Abu and Girnar. Jain Theory The Jain philosophy and its imprint in built form.

REFERNCE BOOKS

1. Stella Kramrisch, The Hindu temple, Volume 1 & 2, Motilal Banarsidass Publications, 1996.
2. Percy Brown, Indian Architecture (Buddhist and Hindu period), D.B.Taraporewala Sons & co Pvt. Ltd. 1965
3. Volwahsen, Andreas, Living Architecture
4. Satish Grover, The Architecture of India- Volume 2, Vikas, 1980.
5. Henri Stierlin, Anne Stierlin, Hindu India: from Khajuraho to the temple city of Madurai, Taschen, 1998.
6. James Fergusson, History of Indian & Eastern Architecture, 2007
7. C. Batley, Design Development of Indian Architecture, John murray, London, 1934.

Indian Festivals

Course Code:	**:**	**AUC 104**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	½ Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes:

CO1-Students will learn about rich cultural aspects associated with Indian religions

CO2-The course will give deep insight in to understand the importance of festivals.

UNIT 1; Indian Festivals: Introduction to major Indian festivals Bihu, Raksha Bandhan , Onam, Pongal, Holi, Dipawali, Dushehra, Easter, Good Friday, Christmas , Eid-ul-fitr and Eid-ul-Azha , Cultural aspects of festivals .

UNIT 2 ; **Characteristics of Indian festivals** ; Seasonal in nature, seasonal festival are Agro based, worships of animals.

UNIT 3; festivals observed at same time but with different names in different parts of country.

UNIT3 : Artificial or non religious festivals- like Jaisalmer desert festivals, Mango festivals in Delhi, Elephant festivals in India. Etc.

REFERENCE BOOKS

1) Discover India; Festival of India by Sonia Mehta

2) Hindu Festival : Origin, sentiments and Rituals by Mukuncharan Das.

VAIDIC MATHEMEATICS

Course Code:	**:**	**AUC 105**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course outcomes:

● Vedic mathematics methods are used in coding and VLSI implementation of encryption.
● Vedic mathematics method of division, exponentiation and multiplication are used in internet security and cryptographic algorithms for making these calculations faster than before.
● Arithmetic and logic unit (ALU) is responsible for all mathematical and logical calculations in computers. Some sutras like udharvtriyakbhyam and nikhilam are used for implementing multiplication methods.
● Digital Signal Processing (DSP) includes face recognition, text speech conversion, image processing and audio -video processing and also filtering of noise. In this area VM methods are very useful to improve the performance of DSP algorithms.

UNIT-I

Introduction & history of Vedic mathematics, Arithmetic and number, Vedic Maths Formulae, Addition and Subtraction: Addition - Completing the whole , Addition from left to right , Addition of list of numbers - Shudh method , Subtraction - Base method , Subtraction - Completing the whole, Subtraction from left to right

UNIT-II

Multiplication: Ekadhikenpurven method (multiplication of two numbers of two digits), Eknunenpurven method (multiplication of two numbers of three digits), Urdhvatiragbhyam method (multiplication of two numbers of three digits), Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits), Combined Operations

Division and Divisibility: Division, Nikhilam Navtashchramam Dashtaha (two digits divisor), Paravartya Yojyet method (three digits divisor)

Divisibility: Ekadhikenpurven method (two digits divisor), Eknunenpurven method (two digits divisor)

UNIT-III

Least Common Multiple **(LCM)** and Highest Common Factor **(HCF)**

Power and Root Power: Square (two digit numbers), Cube (two digit numbers).

Root: Square root (four digit number), Cube root (six digit numbers)

UNIT-IV

Contribution of Indian Mathematicians (In light of Arithmetic) , Aryabhatt , Brahmagupt , Mahaveeracharya , Bharti Krishna Tirtha

Reference Books:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Leelavati, Chokhambba Vidya Bhavan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.

ASTRONOMY

Course Code:	**:**	**AUC 106**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

UNIT-I

Historical introduction: Old Indian and western – astronomy – Aryabhatta, Tycho Brahe, Copernicus, Galileo – Olbers paradox – solar system – satellites, planets, comets, meteorites, asteroids.

Practical astronomy – telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.

Celestial mechanics – Kepler's laws – and derivations from Newton's laws.
Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

UNIT-II

Stellar astronomy: H-R diagram, color-magnitude diagram – main sequence – stellar evolution – red giants, white dwarfs, neutron stars, black holes – accretion disc – Schwartzchild radius – stellar masses Saha–Boltzman equation – derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables – Novae and Super novae. Binary and multiple star system – measurement of relative masses and velocities. Interstellar clouds – Nebulae.

UNIT-III

Transformations Generalized Coordinates, Canonical transformations, Conditions for canonical transformation and problem, Poisson brackets, invariance of PB under canonical transformation, Rotating frames of reference, inertial forces in rotating frames.

UNIT-IV

Relativity and Application Concept of Special Theory of Relativity, Lorentz Transformation, Length Contraction and time dilation, Relativistic addition of velocities, conservation of mass and momentum, Concept of General Theory of Relativity, Equivalence of mass and energy, Relativistic Doppler shift and aberration of light. Lagrangian and Hamiltonian of relativistic particles, Relativistic degenerate electron gas.

Reference Books:

1. "Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.
2. William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press ,1977
3. Bradley W.Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison-Wesley, 1996.
4. Bradley W.Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison Wesley Publishing Company,1996
5. 'Stellar Astronomy' by K. D Abhayankar.
6. 'Solar Physics' by K. D Abhayankar.

ARTS OF INDIA

Course Code:	**:**	**AUC 107**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes:

CO1- Students will be introduced to emergence and development of art traditions upto 6th century C.E. Monuments will be studied in their cultural context.

CO2-Students will able to understand the monuments in their religious, regional and stylistic context. Students will be able to prepare plans of the monuments.

Unit 1:

Introduction to traditions of Art and Architecture in India . Introduction to Art and Architecture and prelude to historical art. ii. Art of the pre-Mauryan period. iii. Art and Architecture of Mauryan Period iv. Sources of Inspiration of Mauryan Art and Architecture: Foreign and Indigenous.

Unit 2:

Emergence and Development of Structural Stupa Architecture . Origin of Stupa Architecture. ii. Stupa Architecture - Pre-Mauryan and Mauryan periods. iii. North India, Central India, Deccan and Gandhara iv. Structural monasteries and Chaityas.

Emergence and Development of Rock-cut Architecture. Origin of Rock-cut Architecture. ii. Eastern India, Western Deccan, Eastern Deccan, Central India.

Unit 3:

Unit 4: Emergence and Development of Temple Architecture (08 hrs) i. Origin of Temple Architecture- Theoretical aspects. ii. Concept and symbolism of Temple. iii. Archaeological remains of structural temples. iv. Temple Architecture during the Gupta period. v. Temple Architecture during the Vakataka period.

Unit 4:

Sculptural Art and Paintings - Emergence and Development (10 hrs) i. Sculptural Art and Paintings -Concept and Symbolism. ii. Terracottas, Ivories and Bronzes iii. Paintings iv. Stone sculptures-Gandhara, Mathura, Sarnath and Andhra schools of Art. v. Art during the Gupta-Vakataka period.

Recommended Readings:

1. Barua, B. 1934-37. Barhut Vol. I-III. Calcutta: Indian Research Institute.
2. Cunningham, Alexander 1966. The Bhilsa Topes. Varanasi: Indological Book Corporation.
3. Cunningham, Alexander 1965. The Stupa of Bharhut. Varanasi: Indological Book Corporation.
4. Dallapiccola, L.S.Z. Lallemant. 1980. The Stupa : Its Religious, Historical, and Architectural Significance. Wiesbaden: Franz Steiner Verlag.
5. Dehejia, Vidya 1972. Early Buddhist Rock Temples A Chronological Study. London: Thames and Hudson

INTELLECTUAL PROPERTY RIGHTS

Course Code: : AUC 108 Credits (0-0-0)
Course Category : Audit
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit
Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.
Course Outcomes: After the completion of the course the student will be able to
CO1: Create an understanding on Intellectual Properties and the importance of it.
CO2: Understand Trademarks and Trade secrets. To create awareness of unfair completion and methods of it.
CO3: Create awareness on the protection copyrights and patents. Understand the Ownership rights and transfer.
CO4: Create awareness of Cyber laws, Cyber Crime and get understanding of Privacy of Data.
CO5: To create awareness international aspects of IPR and the Emerging Trends in IPR.

Course Content

UNIT – I: Introduction to Intellectual property: Introduction, types of intellectual property—Patent, Trademarks, Copy rights, IPR and World Trade Organization, other international organizations, agencies and treaties, importance of intellectual property rights. Creating Intellectual Property. Intellectual Property Management. Emerging Issues in IPR. Research and Development in India.

UNIT – II: Fundamentals of Patent: Historical Overview of Patent Law; Concept of Patent; Patentable Inventions; Procedure for Obtaining Patent; Rights and Obligations of Patent Holder; Transfer and Infringement of Patent Rights, Geographical Indications, Case Study: Apple versus Samsung Patent Dispute.

UNIT – III: Trademarks: Purpose and function of trademarks, acquisition of trademark rights, protectable matter, selecting, and evaluating trademark, trade mark registration processes.

UNIT – IV: Copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Textbooks

- Textbook of Intellectual Property Rights, N.K. Acharya. Asia Law House, ed. 2021.

- Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
- Intellectual Property Rights–Pandey Neeraj, Dharni Khushdeep. PHI.
- Intellectual Property Rights: Text and Cases R. Radhakrishnan, S. Balasubramanian. Excel Books.

Reference Books

1) Intellectual property right – Unleashing the knowledge economy, Prabuddha Ganguli, Tate McGraw Hill ltd.

2) A short course in International Intellectual Property Rights – Karla C. Shippey, World Trade Press.

3) Intellectual Property Rights – Heritage, Science, & Society under international treaties – A. Subbian, - Deep & Deep Publications – New Delhi.

HUMAN RIGHTS

Course Code: : AUC 109 Credits (0-0-0)
Course Category : Audit
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes:

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

1. Simply put, human rights education is all learning that develops the knowledge, skills, and values of human rights.
2. Strengthen the respect for human rights and fundamental freedoms.
3. Enable all persons to participate effectively in a free society.
4. Learn about human rights principles, such as the universality, indivisibility, and interdependence of human rights.

UNIT-I

The Basic Concepts: Individual, Group, Civil Society, State, Equality, Justice, Human Values: Humanity, Virtues, Compassion.

UNIT-II Human Rights and Human Duties:

i) Philosophical and historical foundation of human rights and duties

ii) Theories of rights

iii) Concept and classifications of human rights and duties
iv) Human rights and duties

1. Correlation of rights and duties/responsibilities
2. Tensions between rights inter se, duties inter se, and rights and duties

UNIT-III

Society, Religion, Culture, and their Inter-Relationship: Impact of Social Structure on Human behavior, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

UNIT-IV

Social Structure and Social Problems: Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.

Books & References:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd), 2005.
2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

LOGICAL RESEARCH

Course Code:	**:**	**AUC 110**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination

Course outcomes: In this course you should develop the following competencies:

CO1: To understand about research methodology with its different aspects, about logical reasoning, and types of research.
CO2: It will also result in knowledge appraisal from data collection to data interpretation.
CO3: Mathematical reasoning will also help them to acquire several skills required for the placement.

Course Content

UNIT1- Research Methodology: meaning, characteristics, Types of research; Process of research; Research methods and Ethical issues in research.

UNIT2- Logical Reasoning: arguments, deductive and inductive research, quantitative and qualitative research, scientific research; logical approach in research - Venn diagram; Inferences; analogies.

UNIT3- Data collection, Organization of data, Data analysis and mapping, Parametric and non-parametric; Data Interpretation.

UNIT4- Mathematical Reasoning, number series, letter series, codes; relationships, classification.

References:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3.ResearchMethodology–C.R.Kothari
4. Marketing Research- G C Beri
5. Logical reasoning- R S Agarwal

PROFESSIONAL ETHICS

Course Code: : AUC 111 Credits (0-0-0)
Course Category : Audit
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit
Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes

Course Outcomes: After the completion of the course the student will be able to-
CO1: Understand the core values that shape the ethical behaviour of a professional.
CO2: Identify the multiple ethical interests at stake in a real-world situation or practice.
CO3: Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO4: Solve moral and ethical problems through exploration and assessment by established experiments.
CO5: Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Course Content

Unit I:

Understanding Professional Ethics and Human Values: Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment Empathy-Self Confidence -Social Expectations.

Unit II:

Ethics for Engineers: Ethics – its importance – code of ethics – person and virtues – habits and morals – 4 main virtues – ethical theories – Kohlberg's theory – Gilligan's theory – towards a comprehensive approach to moral behaviour – truth – approach to knowledge in technology.

Unit III:

Environmental Ethics and Sustainability: Problems of environmental ethics in engineering – engineering as profession serving people – engineer's responsibility to environment – principles of sustainability – industrial, economic, environmental, agricultural, and urban sustainability – Sustainable development. - Global Ethical Issues.

Unit IV:

Social Experimentation, Responsibility and Rights: Engineers and responsible experiments – safety and risk – confidentiality – knowledge gained confidentiality – experimental nature of engineering – Intellectual Property Rights – professional rights – employee rights – occupational crime.

Textbooks

- Mike W Martin, Roland Schinzinger, " Ethics in Engineering", Tata McGraw –Hill.
- Govindarajan M, Natarajan S, Senthil Kumar V S, "Engineering Ethics" PHI India.
- R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi.

Reference Books

- Aarne Vesblind, Alastair S Gunn, "Engineering Ethics and the Enviornment".
- Edmund G Seebauer, Robert L Barry, "Fundamentals of Ethics for scientists and engineers" Oxford University Press.
- B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

ENVIRONMENTAL LAWS

Course Code:	**:**	**AUC 112**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	

Number of Credits :

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes:

The course gives students the opportunity to grapple with contemporary legal debates in environment law. Therefore, the learning outcomes of this course can be encapsulated as follows:

1) The primary learning outcome is to sensitize the students towards human activities that adversely affect the environment and the need for regulation of such activities.
2) Students will develop a thorough understanding of practice and procedure followed by various environmental law enforcing agencies/bodies.
3) Students will be able to pursue environmental litigation before the National Green Tribunal and assist the Tribunal as a researcher or in any other capacity.
4) Students will be able to assist industries and projects in obtaining environmental clearance and compliances with other environmental laws.

UNIT-I

Development of Environmental Laws and Policies in India:

I. Concept of 'environment' and understanding scope of environmental law.
II. Two approaches towards environmental protection- 'Eco-centric approach' and 'Anthropocentric' approach.
III. Impact of IEL on environmental law in India.
IV. Significance of Environmental Protection in Five Year Plans.
V. Development of the 'Right to Environment' as a Fundamental Right and challenges.

UNIT-II **Judicial remedies and the role of National Green Tribunal:**

I. Civil Remedies i.e. Tortious remedy and Class Action
II. Criminal Law Remedies under relevant provisions of Indian Penal Code, 1860 and Criminal Procedure Code, 1973
III. Constitutional Law Remedies i.e. Writ Jurisdiction & Public Interest Litigation
IV. Statutory Remedies i.e. Remedies under Public Liability Insurance Act 1991, National Environment Tribunal Act, 1995, National Green Tribunal Act, 2010

UNIT-III

Statutory framework for Prevention of Environmental, Air and Water Pollution:

I. Water (Prevention and Control of Pollution) Act 1974 [Framework of the Act, Criminal Liability and Judicial relief under the Act, Constitutional Challenges of Restraining Orders under Section 33]

II. The Air (Prevention and Control of Pollution) Act 1981 [Framework of the Act, Criminal Liability and Judicial relief under the Act, Noise Pollution]
III. Environment (Protection) Act, 1986 [Framework of the Act, Enforcement mechanisms and Role of Pollution Control Boards, Environment Impact Assessment, Coastal zone regulations Notifications]
IV. Law on Waste Management and Handling
V. Procedural environmental rights under various environmental laws
- Right to Information
- Right to public consultation
- Right of access to justice

UNIT-IV

Statutory framework governing Forest, Wildlife and Biodiversity:

II. Statutory Framework on Forest Preservation [The Indian Forest Act, 1927; Forest (Conservation) Act, 1980; National Forest Policy, 1988; The Scheduled Tribe and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006]
III. Statutory Framework on Wildlife & Biodiversity Protection [The Wildlife (Protection) Act, 1972; Implementation and gaps and Judicial Perspective; Biological Diversity Act, 2002]

Books & References:

1) Shyam Divan & Armin Rosencranz, Environmental Law & Policy in India (2 nded, Oxford University Press, 2014)
2) P. Leelakrishnan, Environmental law in India (4th ed, LexisNexis, 2016)
3) Lavanya Rajamani and Shibani Ghosh, Indian Environmental Law: Key Concepts and Principles (Orient Blackswan, 2019)
4) Gitanjali Nain Gill, Environmental Justice in India: The National Green Tribunal (Routledge, 2017)
5) Patricia Birnie, Alan Boyle and Catherine Redgwell, International Law and the Environment (3rd ed., Oxford University Press, 2009)
6) Philippe Sands, Principles of International Environmental Law (2nd ed, Cambridge University Press, 2003)

HEALTH LAW

Course Code:	**:**	**AUC 113**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	½ Lecture : , Tutorial : , Practical:	

Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination

Course Outcomes: In this course you should develop the following competencies:

CO1: Knowledge and understanding of the values and policies underlying Health Law.

CO2: Knowledge and understanding of substantive law related to health care, health care insurance markets as well as related procedural law.

CO3: Written and oral communication in the legal context.

Course Content

UNIT-1 BASICS OF HEALTH LAW- Basic of Health and its provider, Origin & Evaluation, All Council Acts.

UNIT-2 NEED FOR HEALTH LAW -Fraudulence, Negligence and Abuse, Human Rights, Rights & Duties of Health Care Provider (Public & Private Activities).

UNIT-3 LEGAL ASPECTS OF HEALTH LAW- Role of Health Policy & Health Care Delivery, General Laws on Health Law (Medical Allied Agencies), Specific Laws on Health Law (NDT, PWD/etc.).

UNIT-4 MEDICAL INSURANCE –Introduction-Various types, Significance and Kind of Medical Insurance/Policies, Insurance & Assurance, General Principles of Law and Contract, Medical Insurance Regulations.

REFERENCES:

1)Jonathan Herring- Medical Law and Ethics
2)Mason and Mc Call Smith- Law and Medical Ethics
3)S. V. Jogarao- Current Issues in Criminal Justice and Medical Law

National Cadet Corps (NCC)

Course Code: : AUC 114 Credits (0-0-0)
Course Category : Audit
Pre-requisite Subject : NIL
Contact Hours/Week : ½ Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit

Course Outcomes: In this course you should develop the following competencies:

CO1: Imbibe the conduct of NCC cadets.

CO2: Respect the diversity of different Indian culture.

CO3: Perform his/her role in Nation Building

CO4: Do the social services on different occasions.

CO5: Practice togetherness and empathy in all walks of their life.

CO6: Do the asana and gain the physical& mental fitness

Course Content

UNIT 1

NCC General

History, Aims, Objective of NCC, NCC as Organization. Incentives of NCC, Duties of NCC Cadet, NCC Camps: Types & Conduct.

UNIT 2

National Integration & Awareness

National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security

UNIT 3

Social Service and Community Development

Celebration of Days of National & International Importance, Social Service and Community Development Activities to be conducted.

UNIT 4

Health & Hygiene:

Yoga- Introduction, Definition, Purpose, Benefits.

Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasana etc.

Textbooks:

1. R. Gupta, "NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations" 1st Edition (English, Paperback, RPH Editorial Board)

Basics of Human Health and Preventive Medicines

Course Code:	**:**	**AUC 115**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture: , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

UNIT- 1

Health- Definition, dimensions, concept of wellbeing, Physical quality of life index, Spectrum of health, Determinants of health.

Concept of disease- Epidemiological triad, Natural history of disease, Risk factors, risk group, Iceberg of disease, Disease control, Disease elimination, Disease eradication, **Monitoring and surveillance-** Concept of prevention, Primary, Secondary and Tertiary, Modes of Intervention.

UNIT- 2

Communicable diseases- Type of microorganisms, Mode of transmission, Prevention of infectious diseases, Vaccination/immunization**.**

Diarrheal diseases and dehydration- Prevention and role of ORS**.**

Fever- cause and how to deal with.
Respiratory problems and cough

UNIT - 3
Non communicable diseases/ Lifestyle related disorder- Risk factors, CAD, risk and prevention, Hypertension, Diabetes mellitus, Obesity, Cancer, Accidents.

UNIT – 4
Nutrition and health- Classification of food, Balance diet.
Occupational hazards
Mental health and substance abuse
Medical Emergencies- BLS and ALS.

Reference Textbook

1) K. Park – "Park's Textbook of Preventive and Social Medicine"
2) Yash Pal Bedi & Pragya Sharma– "Handbook of Preventive and Social Medicine, Seventeenth Edition, CBS Publication".
3) Sunder Lal, Adarsh, Pankaj – "Update on Textbook of Community Medicine Preventive and Social Medicine with Recent Advances" 5th Edition, Publication 2018.
4) Dr. B. Saha- "Preventive and Social Medicine Communicable Disease Hygiene".
5) Rabindra Nath Roy, Indernil Saha- "Mahajan and Gupta Textbook of Preventive and Social Medicine" 4th Edition, Japee

CONSTITUTION OF INDIA AND ENVIRONMENTAL GOVERNANCE: ADMINISTRATION AND ADJUDICATION

Course Code	**: AUC 116**	**Credits (0-0-0)**
Course Category	**: VAC (Audit)**	
Pre-Requisite Subject	**: NIL**	
Contact Hours/ Week	**: 1 / 2 Lecture, Tutorial, Practical**	
Number of Credits	**: 0 Credit**	
Course Assessment Method	**: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Voce, Attendance, Minor Tests and One Major Theory Examination.**	

COURSE OUTCOME
At the end of the course, learners should be able to:
CO1- Understand the fundamental principles of environmental governance.
CO2- Understand Constitutional perspectives of environmental governance in India.
CO3- Procedural compliance under environmental legislations and role of Judiciary and quasi-judicial bodies in environmental governance.
CO4- Develop an understanding of bio-diversity conservation, climate change, forest protection, waste management and other issues.

COURSE CONTENTS

UNIT-I: Foundations of Environmental Law and Governance
Principles and Legal Instruments of Environmental Governance
Emerging Trends in Environmental Law

UNIT- II: Constitution of India and the articles relating Environment
Pollution Control Laws and Administrative processes
Environment Protection Act and Administrative processes
Waste Management Laws and Role of Municipalities and other agencies

UNIT- III: Basics of Forest Management in India
Judiciary and its role
Biodiversity Laws and its Application; ABS Guidelines

UNIT- IV: Wildlife Protection and management in India
Adjudicatory Mechanisms- Supreme Court, High Court, National Green Tribunal

BOOKS AND REFERENCES

- Philippe Sands, Principles of International Environmental Law, Cambridge, 2018
- Indian Environmental Law: Key Concepts and Principles, ed. Shibani Ghosh, Orient BlackSwan (2019).
- NawneetVibhaw, Environmental Law: An Introduction, LexisNexis (2016).
- Shyam Divan and Armin Rosencranz, Environmental Law and Policy in India: Cases, Material & Statutes
- Justice T S Doabia (2010) Environmental and Pollution Laws in India, Lexis Nexis Butterworths Wadhwa. Chapters 10 and 11.
- S Ghosh, S Lele, N Henle, Appellate Authorities under Pollution Control Laws in India: Powers, Problems and Potential, LEAD 2018
- Ritwick Dutta and Bhupender Yadav (2012) Supreme Court on Forest Conservation, Universal Law Publishing. Introduction (The Court's Journey through Forests) and Chapter1.
- Gitanjali Gill, Environmental Justice in India: The National Green Tribunal, Routledge (2016)
- Abhayraj Naik and Parul Kumar, India's Domestic Climate Policy is Fragmented and Lacks Clarity, available at https://www.epw.in/engage/article/indias-domestic-climate-policy-fragmented-lacks-clarity
- Suggested Documentaries- Climate Change the Facts, BBC (April, 2019)

DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES: CONSTITUTIONAL IMPERATIVE

Course Code	**: AUC 117**	**Credits (0-0-0)**
Course Category	**: VAC (Audit)**	
Pre-Requisite Subject	**: NIL**	
Contact Hours/ Week	**: 1 / 2 Lecture, Tutorial, Practical**	
Number of Credits	**: 0 Credit**	
Course Assessment Method	**: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Voce, Attendance, Minor Tests and One Major Theory Examination.**	

COURSE OUTCOME

At the end of the course, learners should be able to:

CO1- Understand the fundamental concepts behind Directive Principles of State Policy.
CO2- Evolution and the adoption of the DPSP through the Constituent Assembly debates.
CO3- Learn how the three organs of the governance play role in shaping and achieving DPSP.
CO4- Understand the basics and relevance of Fundamental Duties.
CO5- Evaluate the relationship between Indian Knowledge System and Fundamental Duties.

COURSE LAYOUT

UNIT-I: Evolution and Concept of Directive Principles of State Policy, Incorporation of the Directive Principles of State Policy: Constituent Assembly Debates

UNIT-II: Salient Features of the Directive Principles of State Policy under the Indian Constitution, The Legislative, the Executive and the Judiciary on the Directive Principles of the State Policy

UNIT III: The Legislative, the Executive and the Judiciary on the Directive Principles of the State Policy (Cont.,), Evolution and Relevance of the Fundamental Duties

UNIT-IV: Relationship between Fundamental Duties and Indian Knowledge System, The Legislative, the Executive and the Judiciary on Fundamental Duties

BOOKS AND REFERENCES

- H.M. Seervai, Constitutional Law of India, Vol. I and 2, Universal Law Publishing (LexisNexis) 4th Edition, 2015
- Samaraditya Pal, India's Constitution: Origins and Evolution, Vol. 3, LexisNexis, 2015 Constituent Assembly Debates, Loksabha Secretariat
- Justice R C Lahoti, Fundamental Duties: A Forgotten Chapter of the Constitution, LexisNexis, 2015
- NCRWC, A Consultation Paper on Effectuation of Fundamental Duties of Citizens, 2001
- Granvile Austin, The Indian Constitution: A Cornerstone of a Nation, Oxford Clarendon Press, 1966.

INTRODUCTION TO INTELLECTUAL PROPERTY TO ENGINEERS AND TECHNOLOGISTS

Course Code	**: AUC 118**	**Credits (0-0-0)**
Course Category	**: VAC (Audit)**	
Pre-Requisite Subject	**: NIL**	
Contact Hours/ Week	**: 1 / 2 Lecture, Tutorial, Practical**	
Number of Credits	**: 0 Credit**	
Course Assessment Method	**: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Voce, Attendance, Minor Tests and One Major Theory Examination.**	

COURSE OUTCOME

After the completion of the course the learners should be able to:

CO1: Create an understanding on Intellectual Properties and the importance of it.

CO2: Learn basics of Patents, Trademarks and copyrights.

CO3: Create awareness on the filing, protection copyrights and patents and understand the Ownership rights and their transfer.

CO4: Understand trade secrets and able to compare their positives and negatives traits.

CO5:, Aware of emerging trends in IPR, and learn about IP management.

COURSE LAYOUT

UNIT -I: Introduction to Intellectual Property, Types of intellectual property—Patent, Trademarks, Copy rights, IPR and World Trade Organization, Other international organizations,

UNIT -II: Basics of Patent, Patent filing procedure, Obligations of Patent Holder, Basics of Copyright- Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration Industrial Design, Emerging issue

UNIT -III: Trademark basic, Purpose and function of trademarks, acquisition of trademark rights, protectable matter, selecting, and evaluating trademark, trade mark registration processes GI basic**,** IC Layout Design

UNIT –IV: Trade secret**,** Comparative analysis, IP management

BOOKS AND REFERENCES:

- THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW, William M. LANDES, Richard A. Posner, Harvard University Press, 2003.
- Intellectual Property and Development: Theory and Practice, Rami M. Olwan, Springer
- Narayanan, P (2006) Intellectual Property Law. 3rdedition. Eastern Law House
- Colston, C., Middleton, K. 2004 Modern Intellectual Property Law. 2nd Edition. Cavendish Publishing Ltd
- Cornish W, Llewelyn, D (2003) Intellectual Property: Patents, Copyrights, Trademarks and Allied rights. Fifth edition. Sweet and Maxwell.

- William M. Landes & Richard A. Posner, Indefinitely Renewable Copyright, 70 U. CHI. L. REV. Goldstein, Kitch and Perlman, 2006, Selected Statutes and International Agreements on Unfair Competition, Trademark, Copyright, and Patent
- Paul Goldstein, 2002, Copyright, Patent, Trademark and Related State Doctrines: Cases and Materials on Intellectual Property Law, Revised 5th edition, New York, NY: Foundation Press, 1025 pages.
- T.K.Bandyopadhyay and Saurabh Bindal, "Introduction to Intellectual Property" 1st edition Eastern Book Company, 2015

AUC119	:	**Fundamentals of Artificial Intelligence**
Course category	:	Audit Course
Pre-requisite Subject	:	Basic Programming Knowledge
Contact hours/week	:	Lecture: 2, Tutorial: 0, Practical:0
Number of Credits	:	0
Course Assessment methods	:	Continuous assessment through assignments, quizzes, tutorials, course-based project, one minor test and one major examination
Course Objectives	:	The course aims to: 1. Introduce fundamental concepts of Artificial Intelligence. 2. Develop basic Python programming skills for AI applications. 3. Build foundations in data analysis and preprocessing. 4. Provide understanding of machine learning concepts. 5. Expose students to AI use cases in various engineering domains.

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

CO1. Understand fundamental concepts of Artificial Intelligence and intelligent systems.
CO2. Apply Python libraries for data handling and visualization.
CO3. Perform data preprocessing and exploratory data analysis.
CO4. Understand basic machine learning concepts and evaluation metrics.
CO5. Identify and analyze AI applications in various engineering domains.
CO6. Develop simple AI-based solutions using data preprocessing, visualization, and basic machine learning models.

Topics Covered

UNIT I: Introduction to AI and Python Programming **6**

Overview of Artificial Intelligence: History, scope, types of AI, Applications of AI in modern technology, Python Basics: Data types, variables, operators, Control Structures: Conditional

statements, loops, Functions and Modules, Data Structures: Lists, tuples, dictionaries, sets, File Handling Introduction to NumPy, Pandas, Matplotlib.

UNIT II: Exploratory Data Analysis **6**

Types of Data: Numerical and Categorical**,** Steps in Exploratory Data Analysis**,** Descriptive Statistics**,** Data Visualization Techniques**,** Introduction to Data-driven Decision Making.

UNIT III: Data Preprocessing and Introduction to Machine Learning **6**

Data Cleaning and Deduplication, Handling Missing Data, Data Transformation: Normalization, Scaling, Binning, Introduction to Supervised and Unsupervised Learning (Conceptual Only), Model Evaluation Metrics: Accuracy, Precision, Recall, F1-score.

UNIT IV: AI Use Cases in Engineering 6

Predictive maintenance and fault detection in industrial systems using sensor data, Smart infrastructure monitoring, Process optimization, quality inspection, and automation in manufacturing environments, Intelligent decision support systems for healthcare, environmental monitoring, and cybersecurity applications.

TEXTBOOKS

1. **Aurélien Géron**, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly
2. **Wes McKinney**, *Python for Data Analysis*, O'Reilly
3. **Ethem Alpaydin**, *Introduction to Machine Learning*, MIT Press
4. **Jake VanderPlas**, *Python Data Science Handbook*, O'Reilly

REFERENCE BOOKS

1. **Ian Goodfellow, Yoshua Bengio, Aaron Courville**, *Deep Learning*, MIT Press
2. **Sebastian Raschka**, *Machine Learning with Python*, Packt
3. **Stuart Russell & Peter Norvig**, *Artificial Intelligence: A Modern Approach*, Pearson
4. **Andreas C. Müller & Sarah Guido**, *Introduction to Machine Learning with Python*, O'Reilly.

INDIAN KNOWLEDGE THROUGH CLASSICAL LANGUAGES

Course Code **: IKS 101** **Credits (0-0-0)**
Course Category **: VAC (Audit)**
Pre-Requisite Subject **: NIL**
Contact Hours/ Week **: 1 / 2 Lecture, Tutorial, Practical**
Number of Credits **: 0 Credit**

Course Assessment Method : Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Voce, Attendance, Minor Tests and One Major Theory Examination.

COURSE OUTCOME:

At the end of the course learners shall be able to:

CO1- Students will be able to read, understand, and interpret the core texts of Sanskrit, Pali, Prakrit, and other Indian languages.

CO2- Students will analyze the historical and cultural significance of Indian philosophy, science, art, and social practices.

CO3- Students will develop the ability to apply the principles of Indian scriptures and folk traditions to modern contexts.

CO4- Students will critically evaluate the contributions of the Indian Knowledge Tradition in fields like medicine, architecture, and science.

CO5- Students will be equipped to promote and preserve the Indian Knowledge Tradition through innovative and creative approaches.

COURSE CONTENTS

Unit I: Sanskrit Language-Based Indian Knowledge Tradition

Objective:

To understand the fundamental principles, philosophies, and their significance in the Indian Knowledge Tradition through the Sanskrit language and its literature.

Course Content:

1. Linguistics and Literature:
   - Introduction to Sanskrit language, its grammar (morphology, phonetics), and vocabulary (words, meanings, synonyms, and prosody).
   - Key texts: Vedas (Rigveda, Yajurveda, Samaveda, Atharvaveda), Upanishads, Mahabharata, Ramayana, Puranas, and their significance.
2. Philosophy and Religion:
   - Indian philosophical systems (Yoga, Vedanta, Nyaya, Vaisheshika, Mimamsa, Sankhya).
   - Core concepts of the Bhagavad Gita and Brahmasutra.
   - Jain and Buddhist philosophies (methods, principles, and statements).
3. Science and Mathematics:
   - Mathematics: Contributions of Aryabhata, Bhaskaracharya, and Shulba Sutras.
   - Architecture: Sushruta Samhita, Charaka Samhita.
   - Ayurveda and Rasashastra (Chemistry): Contributions to medical and chemical sciences.
4. History, Culture, and Society:
   - Elements of history and culture in Sanskrit literature.
   - Kautilya’s Arthashastra (practical approach).
   - Contributions of Kalidasa, Bhavabhuti, and Kabir.
   - Musicology: Gandharvacharya, Sangita Ratnakara.

Unit II: Pali Language-Based Indian Knowledge Tradition

Objective:
To understand the Buddhist perspective of the Indian Knowledge Tradition through the Pali language and its literature.

Course Content:
1. Linguistics and Literature:
   - Introduction to Pali language, its structure, grammar, and vocabulary.
   - Primary, secondary (various sutras, commentaries), and tertiary Pali literature.
2. Philosophy and Religion:
   - Buddhist philosophy: Truth and reality, the Eightfold Path, Nirvana.
   - Buddhist meditation practices and their psychological aspects.
3. Architecture and Art:
   - Buddhist architecture: Stupas (Sanchi, Amaravati), viharas, universities (Nalanda, Takshashila, etc.).
   - Buddhist art: Gandhara and Mathura styles, Buddhist iconography.

Unit III: Prakrit Language-Based Indian Knowledge Tradition

Objective:
To understand the Jain perspective of the Indian Knowledge Tradition through the Prakrit language and Jain literature.

Course Content:
1. Linguistics and Literature:
   - Introduction to Prakrit language, its dialects (Shauraseni, Magadhi, Ardhamagadhi).
   - Jain Agamas: Acharanga Sutra, Sutrakritanga, and other texts.
2. Philosophy and Religion:
   - Jain philosophy: Anekantavada (non-absolutism), Syadvada (relativity), and principles of religion.
   - Jain ethics and principles of non-violence.
3. Science and Mathematics:
   - Jain mathematics and cosmology.
   - Contributions of Jainism to astronomy and religion.
4. Culture and Art:
   - Jain architecture: Dilwara temples, Ranakpur.
   - Jain painting and sculpture.
   - Jain music and literary traditions.

Unit IV: Indian Knowledge Tradition Based on Other Indian Languages and Folk Traditions

Objective:
To understand the Indian Knowledge Tradition through Tamil, Telugu, Kannada, and other Indian languages, as well as folk traditions.

Course Content:

1. Linguistics and Literature:
   - Tamil and Telugu literature: Bhakti literature, Tirukkural, and Shaiva-Vaishnava poetry.
   - Folk literature: Kabir, Gita, and oral traditions.
2. Folk Culture and Traditions:
   - Folk arts: Madhubani, Warli.
   - Folk music and dance: Bihu, Garba, Lavani.
   - Folk festivals, rituals, and oral traditions.
3. Education and Technology:
   - Tamil Siddha medicine and traditional knowledge systems.
   - Traditional water management and folk practices.
   - Folk astronomy and meteorology.
4. Social and Economic Traditions:
   - Traditional occupations and practices.
   - Folk beliefs and community life.
   - Regional festivals and their cultural significance.

Resources:

- Primary texts: Vedas, Upanishads, Puranas, Jain Agamas, Buddhist texts.
- Modern reference books: Works on Indian culture, history, and traditions.
- Digital resources: Digital libraries and online resources for Indian languages.
- Regional manuscripts and traditional knowledge systems.

INDIAN KNOWLEDGE SYSTEM: CONCEPTS AND APPLICATIONS IN SCIENCE

Course Code	**: IKS 102**	**Credits (0-0-0)**
Course Category	**: VAC (Audit)**	
Pre-Requisite Subject	**: NIL**	
Contact Hours/ Week	**: 1 / 2 Lecture, Tutorial, Practical**	
Number of Credits	**: 0 Credit**	
Course Assessment Method	**: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Voce, Attendance, Minor Tests and One Major Theory Examination.**	

COURSE OUTCOME

At the end of the course, learners should be able to:

CO1- Understand the basic concepts of Science in Indian Knowledge Systems.

CO2- Get an overview of aspects in which ancient science played impactful role.

CO3- Develop an insight for utilizing the scientific knowledge into contemporary fields.

COURSE CONTENTS

UNIT -I: Indian Knowledge System – An Introduction

The Vedic Corpus- Vedas, Upanishads, Schools of philosophy

Buddhist Corpus- Tripitakas, Jataka Tales
Jaina Corpus- Agamas
Wisdom through the Ages

UNIT- II: Number Systems and Units of Measurement
Mathematics- Overview, Vaidic and Later age mathematics
Astronomy- Overview and contributions

UNIT-III: Knowledge Framework and classifications
Linguistics- Panini & Sanskrit, Pali and Prakrit

UNIT IV: Health Wellness and Psychology
Town Planning and Architecture

BOOKS AND REFERENCES:

Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

ADDITIONAL READINGS:

- Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
- Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.
- Acarya, P.K. (1996). Indian Architecture, MunshiramManoharlal Publishers, New Delhi.
- Banerjea, P. (1916). Public Administration in Ancient India, Macmillan, London.
- Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian .Institute of Advanced Study, Shimla, H.P
- Verma. Keshav Dev. (2012) Vedic Physics, Motilal Banarsidass Publishers.

INDIAN KNOWLEDGE SYSTEM: CONCEPTS AND APPLICATIONS IN ENGINEERING

Course Code	**: IKS 103**	**Credits (0-0-0)**
Course Category	**: VAC (Audit)**	
Pre-Requisite Subject	**: NIL**	
Contact Hours/ Week	**: 1 / 2 Lecture, Tutorial, Practical**	
Number of Credits	**: 0 Credit**	
Course Assessment Method	**: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Voce, Attendance, Minor Tests and One Major Theory Examination.**	

COURSE OUTCOME

At the end of the course, learners should be able to:

CO1- Understand the basic concepts of Engineering in Indian Knowledge Systems.
CO2- Get an overview of aspects in which ancient Engineering played an impactful role.
CO3- Develop an insight for utilizing the scientific knowledge into contemporary fields.
CO4- Understand the role of Engineering in town planning in ancient India.
CO5- Understand the interrelation of Astronomy and Architecture.

COURSE LAYOUT

UNIT-I: Indian Knowledge System – An Introduction
The Vedic Corpus

UNIT-II: Number System and Units of Measurements
Mathematics
Astronomy

UNIT-III: Engineering and Technology: Metals and Metalworking
Engineering and Technology: Other Applications

UNIT-IV: Town Planning and Architecture
Knowledge Framework and Classification
Linguistics

BOOKS AND REFERENCES:

Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

ADDITIONAL READINGS:

- Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
- Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.
- Bag, A.K. (1979). Mathematics in Ancient and Medieval India, Chaukhamba Orientalia, New Delhi.
- Datta, B. and Singh, A.N. (1962). History of Hindu Mathematics: Parts I and II, Asia Publishing House, Mumbai.
- Kak, S.C. (1987). "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), pp. 205–221.
- Subbarayappa, B.V. and Sarma, K.V. (1985). Indian Astronomy: A Source Book, Nehru Centre, Mumbai.
- Bag, A.K. (1997). History of Technology in India, Vol. I, Indian National Science Academy, New Delhi.
- Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
- Banerjea, P. (1916). Public Administration in Ancient India, Macmillan, London.
- Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.

INDIAN KNOWLEDGE SYSTEM

Course Code	**: IKS 104**	**Credits (0-0-0)**
Course Category	**: VAC (Audit)**	
Pre-Requisite Subject	**: NIL**	
Contact Hours/ Week	**: 1 / 2 Lecture, Tutorial, Practical**	
Number of Credits	**: 0 Credit**	
Course Assessment Method	**: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Voce, Attendance, Minor Tests and One Major Theory Examination.**	

COURSE OUTCOME

At the end of the course, learners should be able to:

CO1- Understand the history, nature and basic philosophy of Indian Knowledge System.

CO2- Develop basic understanding of ancient epistemological approaches.

CO3- Get an overview of literary and scriptural corpus of ancient India and its education system.

CO4- Develop an insight in scientific approaches relevant in contemporary times.

CO5- Understand ancient India's Governance and Public Administration.

COURSE LAYOUT

Unit 1- History of Indian Knowledge System

Genesis of Bhartiya Knowledge System
History of IKS
IKS: Nature, Philosophy and Character
India's Epistemology
Knowledge Frameworks & Classification

Unit 2- Literary Aspects of IKS

Ancient Scriptures
Ancient Education
Educating Sciences
Chandashastra (Prosody)
Bhasa Va Vyakarana (Language and Grammar)
Bharata's Natyashastra (Science of Drama, Dance and Music)
Khagol Vijnana (Astronomy)
Vastukala (Architecture)
Ayurveda
Krishi Vijnana (Agricultural) Practices

Unit 3- Scientific approaches of IKS & Torch-bearers

Dhatu Vijnana (Metallurgy)
Ganita: Mathematics in India
Yuddha Vidhya (Military Sciences)
Niyuddha Kala (Martial Arts)
Environmental Sciences

Unit 4- Governance in IKS & Way Forward

Science of Consciousness in Ancient India (Cognitive Science)
Anviksiki (Logic and Disputation)
Governance & Public Administration
IKS way forward

BOOKS AND REFERENCES:

- Introduction to Indian Knowledge System: Concepts and Applications, Archak, K.B. (2012). Kaveri Books, New Delhi.ISBN-13:978-9391818203
- Introduction To Indian Knowledge System: Concepts and Applications, Mahadevan, B.Bhat, Vinayak Rajat,Nagendra Pavana R.N.PHI, ISBN: 9789391818203
- Glimpse into Kautilya's Arthashastra Ramachandrudu P. (2010), Sanskrit Academy, Hyderabad ISBN:9788380171074
- "Introduction" in Studies in Epics and Purāṇas, (Eds.), KM Munshi and N Chandrashekara Aiyer Bhartiya Vidya Bhavan