BACHELOR OF TECHNOLOGY
CURRICULA & SYLLABI

Electronics& Communication Engineering Department

ABOUT THE DEPARTMENT

The Department of Electronics and Communication Engineering was established in the year 1973 with an intake of 20 and has been gradually increased to 120 from an academic session 2015-16. The department has made all round progress in the last three decades as a result of firm determination and constant efforts made by all concerned faculty members and staff of the department.

The Department offers full time M.Tech. in 'Digital Systems' and 'Communication Engineering' from the academic session 2003-2004 and 2012-2013, respectively. The department also offers regular Ph.D. programme through QIP & TEQIP/University schemes.

VISION

To prepare the students with state-of-art for emerging technologies, trends and applications in the field of Electronics and Communication Engineering to cater the global needs.

MISSION

1. Educate a new generation of Engineers to meet the challenges of the future by providing them with a firm foundation of both the theory and practical of Electronics and Communication Engineering at undergraduate levels.
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.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) OF B.TECH. PROGRAMME

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

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

PEO-III Exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in life-long learning.

PROGRAM OUTCOMES (POs) of B.Tech. PROGRAMME:

(a) An ability to apply knowledge of mathematics, science and engineering fundamentals to the conceptualization of engineering models.

(b) An ability to identify and formulate the techniques and tools related to electronics and communication engineering to analyze conflicting technical and engineering issues.

(c) An ability to design, implement and evaluate an electronics & communication engineering based system, components or processes to meet the desired needs within realistic constraints.

(d) An ability to design and conduct experiments, as well as to analyze and interpret data.

(e) An ability to use current techniques, skills and modern tools necessary for engineering practice.

(f) An ability to apply the engineering knowledge to assess societal, health, safety, legal and cultural issues to the professional engineering practice.

(g) An ability to understand the impact of electronics and communication engineering in societal and environmental context and demonstrate the knowledge for sustainable development.

(h) An ability to understand and commit to professional ethics, responsibilities and norms of engineering practice.

(i) An ability to function individually and on team to accomplish a common goal.

(j) An ability to communicate effectively and to prepare formal technical plans and detailed reports involving creative use of knowledge of engineering principles in novel ways.

(k) An ability to demonstrate a knowledge and understanding of management and business practices and understand their limitations.

(l) Knowledge of contemporary issues like increased use of portable devices, rising health care costs and etc. which influences engineering design, and an ability to engage in independent and lifelong learning.

Credit Structure for B.Tech. Electronics & Communication Engineering

(For newly admitted students from Session 2014-2015)

Category Semesters	I	II	III	IV	V	VI	VII	VIII	Total
Basic Sciences &Maths (BSM)	9	14	9	4	-	-	-	-	**36**
Engineering Fundamentals (EF)	12	7	7	2	-	-	-	-	**28**
Department Core (DC)	-	-	9	13	20	23	9	5	**79**
Management (M)	-	-	-	4	3	-	-	-	**7**
Humanities & Social Science Core (HSSC)	4	-	-	-	-	-	-	-	**4**
Project (P)	-	-	-	-	-	-	5	5	**10**
Programme Electives (PE)	-	-	-	-	-	-	8	9	**17**
Open Electives (OE)	-	-	-	-	-	-	-	4	**4**
Humanities & Social Science Electives (HSSE)	-	3	-	-	-	-	-	-	**3**
Total	**25**	**24**	**25**	**23**	**23**	**23**	**22**	**23**	**188**

Curriculum for B.Tech. (Electronics & Communication Engineering)

Freshman Year, Semester: I

S.N.	Category	PaperCode	Subject	L	T	P	Credits
1.	BSM	BAS-02	Engineering Physics-I	3	1	2	5
2.	EF	BEC-01	Fundamentals of Electronics Engineering	3	1	2	5
3.	BSM	BAS-01	Engineering Mathematics-I	3	1	0	4
4.	EF	BEE-02	Electrical Circuits & Analysis	3	1	2	5
5.	HSSC	BAS-03	Professional Communication	3	1	0	4
6.	EF	BEC-10	Electronics Workshop & PCB	0	0	4	2
7.	AC	BAS-05	Environment and Ecology	2	1	0	-
			Total	**15**	**5**	**10**	**25**

Freshman Year, Semester: II

S.N.	Category	PaperCode	Subject	L	T	P	Credits
1.	BSM	BAS-08	Engineering Physics-II	3	1	2	5
2.	BSM	BAS-09	Engineering Chemistry	3	1	2	5
3.	BSM	BAS-07	Engineering Mathematics-II	3	1	0	4
4.	HSSE	BAS-**	Humanities & Social Science Electives	2	1	0	3
5.	EF	BCS-01	Introduction to Computer Programming	3	1	2	5
6.	EF	BCE-10	Engineering Graphics	0	0	4	2
7.	AC	MBA-HR6	Knowledge Management	2	1	0	-
			Total	**14**	**5**	**10**	**24**

Sophomore Year, Semester-III

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	BSM	BAS-21	Engineering Mathematics-III	3	1	0	4
2.	EF	BEE-16	Electromechanical Energy Conversion	3	1	2	5
3.	BSM	BAS-28	Solid State Physics	3	1	2	5
4.	DC	BEC-11	Network Analysis &Synthesis	3	1	0	4
5.	DC	BEC-12	Digital Electronics & Circuits	3	1	2	5
6.	EF	BAS-20	Communication Skills	0	0	4	2
7.	AC	BAS-22	Nano Technology	2	1	0	-
			Total	**15**	**5**	**10**	**25**

Sophomore Year, Semester-IV

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	BSM	BAS-23	Engineering Mathematics-IV	3	1	0	4
2.	DC	BEC-13	Signals & Systems	3	1	0	4
3.	DC	BEC-14	Electromagnetic Field Theory	3	1	0	4
4.	DC	BEC-15	Solid State Devices & Circuits	3	1	2	5
5.	M	MBA-03	Public Administration	3	1	0	4
6.	EF	BCS-19	Web Designing	0	0	4	2
7.	AC	MBA-01	Industrial Management	2	1	0	-
			Total	**15**	**5**	**6**	**23**

Junior Year, Semester-V

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	M	MBA-02	Engineering and Managerial Economics	2	1	0	3
2.	DC	BEC-26	Control Systems	3	1	2	5
3.	DC	BEC-27	Analog Integrated Circuits	3	1	2	5
4.	DC	BEC-28	Principles of Communication	3	1	2	5
5.	DC	BEC-29	Electronics Measurement & Instrumentation	3	1	2	5
6.	AC	BOE-03	Operation Research	3	1	0	-
			Total	**14**	**5**	**8**	**23**

Junior Year, Semester-VI

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	DC	BEC-31	Digital Communication	3	1	2	5
2.	DC	BEC-32	Microprocessors & Application	3	1	2	5
3.	DC	BEC-33	Data Communication Networks	3	1	0	4
4.	DC	BEC-34	Microwave Engineering	3	1	2	5
5.	DC	BEC-35	VLSI Technology	3	1	0	4
6.	AC	BEC-30	Seminar	0	0	6	-
			Total	**15**	**5**	**6**	**23**

Senior Year, Semester-VII

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	DC	BEC-41	VLSI Design	3	1	2	5
2.	DC	BEC-42	Digital Signal Processing	3	1	0	4
3.	PE1	BEC-**	Program Elective-1	3	1	0	4
4.	PE2	BEC-**	Program Elective-2	3	1	0	4
5.	P	BEC-40	Project Part-I	0	0	10	5
6.	AC	BEC-45	Industrial/ Practical Training	0	0	2	-
			Total	**12**	**4**	**12**	**22**

Senior Year, Semester-VIII

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	DC	BEC-43	Wireless Communication	3	1	2	5
2.	PE3	BEC-**	Program Elective-3	3	1	2	5
3.	PE4	BEC-**	Program Elective-4	3	1	0	4
4.	OE	BOE-**	Open Elective offered by other Department	3	1	0	4
5.	P	BEC-50	Project Part-II	0	0	10	5
			Total	**12**	**4**	**12**	**23**

Engineering Fundamentals & Department Core (Electronics & Communication Engineering)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
		Year-I					
1.	BEC-01	Fundamentals of Electronics Engineering	-	3	1	2	5
2.	BEC-10	Electronics Workshop & PCB	-	0	0	4	2
		Year-II					
3.	BEC-11	Network Analysis &Synthesis	-	3	1	0	4
4.	BEC-12	Digital Electronics & Circuits	-	3	1	2	5
5.	BEC-13	Signals & Systems	-	3	1	0	4
6.	BEC-14	Electromagnetic Field Theory	-	3	1	0	4
7.	BEC-15	Solid State Devices & Circuits	-	3	1	2	5
		Year-III					
8.	BEC-26	Control Systems	-	3	1	2	5
9.	BEC-27	Analog Integrated Circuits	-	3	1	2	5
10.	BEC-28	Principles of Communication	-	3	1	2	5
11.	BEC-29	Electronics Measurement & Instrumentation	-	3	1	2	5
12.	BEC-30	Seminar	-	0	0	6	3

13.	BEC-31	Digital Communication	BEC-28	3	1	2	5
14.	BEC-32	Microprocessors & Application	BEC-12	3	1	2	5
15.	BEC-33	Data Communication Networks	BEC-28	3	1	0	4
16.	BEC-34	Microwave Engineering	BEC-14	3	1	2	5
17.	BEC-35	VLSI Technology	-	3	1	0	4
		Year-IV					
18.	BEC-40	Project Part-I	-	0	0	10	5
19.	BEC-41	VLSI Design	BEC-35	3	1	2	5
20.	BEC-42	Digital Signal Processing	BEC-13	3	1	0	4
21.	BEC-43	Wireless Communication	BEC-28	3	1	2	5
22.	BEC-45	Industrial/ Practical Training	-	0	0	2	1
23.	BEC-50	Project Part-II	BEC-40	0	0	10	5

Programme Electives (Electronics & Communication Engineering)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
	PE1& PE2 (VII Semester)						
1.	BEC-51	RADAR Technology	-	3	1	0	4
2.	BEC-52	Biomedical Instrumentation	-	3	1	0	4
3.	BEC-53	Information Theory & Coding	BEC-31	3	1	0	4
4.	BEC-54	Advanced Semiconductor Devices	BEC-15	3	1	0	4
5.	BEC-55	Optoelectronics	-	3	1	0	4
6.	BEC-56	Electronics Switching	-	3	1	0	4
7.	BEC-57	Digital System Design	BEC-12	3	1	0	4
8.	BEC-58	Satellite Communications	-	3	1	0	4
	PE3 & PE4 (VIII Semester)						
9.	BEC-61	Microcontroller & Embedded Systems	BEC-32	3	1	2	5
10.	BEC-62	Optical Communications	-	3	1	2	5
11.	BEC-63	DSP Architecture & Applications	-	3	1	2	5
12.	BEC-64	Antenna Design	BEC-14	3	1	2	5
13.	BEC-65	Digital Image Processing	-	3	1	0	4
14.	BEC-66	ATM Networks and B-ISDN	BEC-33	3	1	0	4
15.	BEC-67	RF ICs	-	3	1	0	4
16.	BEC-68	Neural Networks	-	3	1	0	4

Subjects offered for other departments

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BOE-13	Industrial Automation & Robotics	-	2	1	0	3
2.	BOE-14	Industrial Electronics	BEC-01	2	1	0	3
3.	BOE-15	Electronic Product Design	BEC-01	2	1	0	3

Humanities & Social Science Electives

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BAS-10	Technical Writing	-	2	1	0	3
2.	BAS-11	Human Values & Professional Ethics	-	2	1	0	3
3.	BAS-12	Industrial Psychology	-	2	1	0	3

Electronics & Communication Engineering Department

Subjects Offered by the Department

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BEC-01	Fundamentals of Electronics Engineering	-	3	1	2	5
2.	BEC-10	Electronics Workshop & PCB	-	0	0	4	2
3.	BEC-11	Network Analysis &Synthesis	-	3	1	0	4
4.	BEC-12	Digital Electronics & Circuits	-	3	1	2	5
5.	BEC-13	Signals & Systems	-	3	1	0	4
6.	BEC-14	Electromagnetic Field Theory	-	3	1	0	4
7.	BEC-15	Solid State Devices & Circuits	-	3	1	2	5
8.	BEC-26	Control Systems	-	3	1	2	5
9.	BEC-27	Analog Integrated Circuits	-	3	1	2	5
10.	BEC-28	Principles of Communication	-	3	1	2	5
11.	BEC-29	Electronics Measurement & Instrumentation	-	3	1	2	5
12.	BEC-30	Seminar	-	0	0	6	3
13.	BEC-31	Digital Communication	BEC-28	3	1	2	5
14.	BEC-32	Microprocessors & Application	BEC-12	3	1	2	5
15.	BEC-33	Data Communication Networks	BEC-28	3	1	0	4
16.	BEC-34	Microwave Engineering	BEC-14	3	1	2	5
17.	BEC-35	VLSI Technology	-	3	1	0	4
18.	BEC-40	Project Part-I	-	0	0	10	5
19.	BEC-41	VLSI Design	BEC-35	3	1	2	5
20.	BEC-42	Digital Signal Processing	BEC-13	3	1	0	4
21.	BEC-43	Wireless Communication	BEC-28	3	1	2	5
22.	BEC-45	Industrial/ Practical Training	-	0	0	2	1
23.	BEC-50	Project Part-II	BEC-40	0	0	10	5
24.	BEC-51	RADAR Technology	-	3	1	0	4
25.	BEC-52	Biomedical Instrumentation	-	3	1	0	4
26.	BEC-53	Information Theory & Coding	BEC-31	3	1	0	4
27.	BEC-54	Advanced Semiconductor Devices	BEC-15	3	1	0	4
28.	BEC-55	Optoelectronics	-	3	1	0	4
29.	BEC-56	Electronics Switching	-	3	1	0	4
30.	BEC-57	Digital System Design	BEC-12	3	1	0	4

31.	BEC-58	Satellite Communications	-	3	1	0	4
32.	BEC-61	Microcontroller & Embedded Systems	BEC-32	3	1	2	5
33.	BEC-62	Optical Communications	-	3	1	2	5
34.	BEC-63	DSP Architecture & Applications	-	3	1	2	5
35.	BEC-64	Antenna Design	BEC-14	3	1	2	5
36.	BEC-65	Digital Image Processing	-	3	1	0	4
37.	BEC-66	ATM Networks and B-ISDN	BEC-33	3	1	0	4
38.	BEC-67	RF ICs	-	3	1	0	4
39.	BEC-68	Neural Networks	-	3	1	0	4

SYLLABI

BEC-01 FUNDAMENTALS OF ELECTRONICS ENGINEERING

Course category : Engineering Fundamentals (EF)
Pre-requisite Subject : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits : 5
Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to identify schematic symbols and understand the working principles of electronic devices, e.g., Diode, Zener Diode, LED, BJT, JFET and MOSFET etc.
2. Able to understand the working principles of electronic circuits e.g. Rectifiers, Clipper, Clamper, Filters, Amplifiers and Operational Amplifiers etc. also understand methods to analyse and characterize these circuits
3. Able to understand the functioning and purposes of Power Supplies, Test and Measuring equipments such as multimeters, CROs and function generators etc.
4. Able to rig up and test small electronics circuits.

Topics Covered

UNIT-I

Semiconductor materials and properties: electron-hole concepts, Basic concepts of energy bands in materials, concept of forbidden gap, Intrinsic and extrinsic semiconductors, donors and acceptors 9

impurities, Junction diode, p-n junction, depletion layer, v-i characteristics, diode resistance, capacitance, diode ratings (average current, repetitive peak current, non-repetitive current, peak-inverse voltage). Diode Applications in rectifier, filters, voltage multipliers, load regulators, clipper and clamper circuits, Breakdown mechanism (Zener and avalanche), breakdown characteristics, Zener resistance, Zener diode ratings, Zener diode application as shunt regulator

UNIT-II

Transistors(BJT and FET);Basic construction, transistor action, CB, CE and CC configurations, input/output characteristics, Biasing of transistors-fixed bias, emitter bias, potential divider bias, comparison of biasing circuits. Transistor Amplifier: Graphical analysis of CE amplifier, concept of voltage gain, current gain, h- parameter model (low frequency), computation of Ai, Av, Ri, Ro of single transistor CE and CC amplifier configurations. 9

Field Effect Transistors(JFET and MOSFET): Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristic equation CG, CS and CD configurations, fixed & self-biasing.

MOSFET: depletion and enhancement type MOSFET-construction, operation and characteristics. Computation of Av, Ri, Ro , of single FET amplifiers using all the three configurations

UNIT-III

Switching theory and logic design: Number systems, conversion of bases, Boolean algebra, logic gates, concept of universal gate, canonical forms, Minimization using K-map 9

Operational Amplifiers

Concept of ideal operational amplifiers, ideal op-amp parameters, inverting, non-inverting and nity gain amplifiers, adders, difference amplifiers, integrators

UNIT-IV

Electronics Instruments: Working principle of digital voltmeter, digital multimeter (block diagram approach), CRO (its working with block diagram), measurement of voltage, current, phase and frequency using CRO 9

EXPERIMENTS

Note: Minimum Eight experiments are to be performed

1. To Plot the forward/Reverse Characteristics of SiP-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. DrawinputoutputcharacteristiccurveofN-P-NtransistorinCEconfiguration
8. DrawinputoutputcharacteristiccurveofN-P-NtransistorinCBconfiguration
9. Draw the drain and transfer curve of JFET
10. Study of OP-AMP (741) and calculate the gain in (i) Inverting mode and (ii) Non inverting mode
11. Study of OP-AMP as a (i) Summer (ii) Integrator (iii) Differentiator; and plot the nature of

input & output waveform

12. Study of CRO and multi-meter measurement voltage, frequency, phase difference using CRO along with the testing of electronics component

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

BEC-10 ELECTRONICS WORKSHOP & PCB

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 4
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through three Viva voce, Practical work/record, attendance and Major Practical Examination
Course Outcomes	:	After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Understand the design processes and production methods used in the manufacture of a printed circuit board.
2. Understand the use of software techniques in the design and simulation of an electronic circuit.
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.

Topics Covered

Experiments

Note: Minimum FIVE experiments should be performed

1. Winding shop: Step down transformer winding of less than 5VA.
2. Soldering shop: Fabrication of DC regulated power supply.
3. Design a PCB using Etching &drilling.
4. Design a full wave centre tapped rectifier & study the effect of capacitive filter & its output on a virtual oscilloscope.
5. Design a RLC resonance circuit & verify the transient & phase response for different values of R, L & C.
6. Design a half adder using discrete components & verify the timing diagrams.
7. Convert the power supply circuit into PCB & simulates its 2D & 3D view.

8. Coating of etched PCB to protect it from oxidation.

BEC-11 NETWORK ANALYSIS & SYNTHESIS

Course category	:	Department Core (DC)
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 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 Thévenin, Norton, nodal and mesh analysis to express complex circuits in their simpler equivalent forms.
2. Able to apply linearity and superposition concepts to analyze RL, RC, and RLC circuits in time and frequency domains.
3. Able to analyze resonant circuits both in time and frequency domains.
4. Able to construct and make time and frequency domain measurements on elementary RL, RC, and RLC circuits.
5. Understand the fundamental concepts of network analysis and synthesis of two-port passive networks.

Topics Covered

UNIT-I

Signal analysis, Complex frequency, Network analysis, Network synthesis General characteristics and descriptions of signals, with associated wave forms, Unit step function, Unit impulse and ramp function. Introduction to network analysis, network elements, Initial and final conditions, Solution of network equations 9

UNIT-II

Review of Laplace transforms poles and zeroes, Initial and final value theorems, Transform circuit, Thevenin's and Norton's theorems, System function, step and impulse responses, Convolution integral. Amplitude and phase responses. Network functions, Relation between port parameters, Transfer functions using two port parameters, Interconnection of two ports 9

UNIT-III

Hurwitz polynomials, Positive real functions. Properties of real immittance functions, synthesis of LC driving point immittances, Properties of RC driving point impedances, Synthesis of RC 9

impedances or RL admittances, Properties of RL impedances and RC admittances.

UNIT-IV

Properties of transfer functions, Zeroes of transmission, Synthesis of Y21 and Z21 with 1Ω terminations, Introduction to active network synthesis; Foster, Cauer's etc. 9

Books & References

1. Franklin F. Kuo, "Network Analysis and synthesis", 2nd Edition, Wiley India Pvt Ltd.
2. Behrouz Peikari, "Fundamentals of Network Analysis & synthesis", Jaico Publishing House, 2006.
3. M.E. Van Valkenberg, "Network Analysis", 2nd Edition, Prentice Hall of India Ltd

BEC-12 DIGITAL ELECTRONICS & CIRCUITS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
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.
2. Acquired knowledge about solving problems related to number systems and Boolean algebra.
3. Ability to identify, analyze and design combinational circuits.
4. Ability to design various synchronous and asynchronous sequential circuits.
5. Acquired knowledge about internal circuitry and logic behind any digital system.

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: Introduction, Memory organisation, Classification and characteristics of memories, RAM, ROM, PLA, PAL.

EXPERIMENTS

1. Introduction to digital electronics lab- Nomenclature of digital ICs, specifications.
2. Verification of the truth tables of logic gates using TTL ICs.
3. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
4. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
5. Implementation and verification of Decoder/De-multiplexer and Encoder using logic gates.
6. Implementation of 4x1 multiplexer using gates.
7. Implementation of 4-bit parallel adder using 7483 IC.
8. Design, and verify the 4-bit synchronous counter and asynchronous counter.
9. Implementation of a 3-bit SIPO and SISO shift registers using flip-flops.
10. Design of Seven segment display driver for BCD codes.
11. BCD Adders & Subtractors.

Books & References

1. Hill & Peterson, "Switching Circuit & Logic Design", Wiley.
2. Digital principle and applications Malvino and Leach- (TMH)

BEC-13 SIGNALS & SYSTEMS

Course category	:	Department Core (DC)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to describe signals mathematically and understand how to perform mathematical

operations on signals.

2. Understand various signals and systems properties and be able to identify whether a given system exhibits these properties and its implication for practical systems.
3. Understand the process of convolution between signals, & able to solve differential equation using Laplace transforms techniques.
4. Understand the intuitive meaning of frequency domain and the importance of analyzing and processing signals in the frequency domain.
5. Able to compute the Fourier series or Fourier transform Z-transform, and further be able to use the properties and application in analysis to ideal filtering, amplitude modulation and sampling.
6. Able to analysis and design of linear time invariant systems used in engineering

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. Convolution integral, Co-relations, Signal energy and energy spectral density, signal power and power spectral density, Properties of power spectral density,

UNIT-II 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-III 9

Fourier Transforms (FT)

(i) 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 (ii) Discrete time Fourier transform (DTFT), Inverse DTFT, Convergence, Properties and theorems, Comparison between continuous time FT and DTFT

UNIT-IV 9

Time and frequency domain analysis of systems

Analysis of first order and second order systems, continuous-time (CT) system analysis using LT,

System functions of CT systems, Poles and zeros, 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', Pearson Education, 2nd Ed.,2003
3. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi

BEC-14 ELECTROMAGNETIC FIELD THEORY

Course category	:	Department Core (DC)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Apply vector calculus to understand the behavior of static electric fields in standard configurations.
2. Describe and analyze electromagnetic wave propagation in free-space.
3. Describe and analyze transmission lines.
4. Work in a small team using cooperative learning rules.
5. Communicate electromagnetic concepts both orally and in writing.

Topics Covered

UNIT-I 9

Electrostatics

Electrostatic fields, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses's Law – Maxwell's equation, Electric dipole and flux lines, 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. Electrostatic boundary value problems: Poisson's and Laplace's equations, General procedures for solving Poisson's or Laplace's

equations, Resistance and capacitance, Method of images

UNIT-II 9

Magnetostatics

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

UNIT-III 9

Electromagnetic wave propagation

Wave propagation in lossy dielectrics, Plane waves in lossless dielectrics, Plane wave in free space, Plain waves in good conductors, Power and the Poynting vector, Reflection of a plane wave in a normal incidence.

UNIT-IV 9

Transmission lines

Transmission line parameters, Transmission line equations, Input impedance, Standing wave ratio and power, The Smith chart, Coaxial lines and Waveguides.

Books & References

1. W. H. Hayt and J. A Buck "Electromagnetic field Theory" 7e, TMH
2. M. N. O. Sadiku, "Elements of Electromagnetics", 4e, Oxford University Press

BEC-15 SOLID STATE DEVICES & CIRCUITS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
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 different diodes like PIN, Varactor diode etc.
2. To understand the high frequency application of diodes.
3. To understand and use of the device models to explain and calculate the characteristics

of the field effect transistors.

4. To be able to understand and analyze the V-I characteristics of different high power devices.
5. Understand the operation of charge-transfer devices and charge storage device.

Topics Covered

UNIT-I 9

Crystal Properties and charge Carriers in Semiconductors, Elemental and compound semiconductor materials, crystal lattice structure, Bonding forces and energy bands in solids, charge carriers in semiconductors, Donor/Acceptor carrier concentrations, Mobility and Conductivity, drift of carriers in electric and magnetic fields, Potential variation within a graded semiconductor, p-n junction behavior, Charge control description of a diode.

Special Diodes: Varactor diode, Tunnel Diode, Schottky barrier diode, Light Emitting diode, Photo diode, Characteristics and applications.

UNIT-II 9

MOSFET: Review of device structure operation and V-I characteristics. Circuits at DC, MOSFET as Amplifier and switch, Biasing in MOS amplifier circuits, small-signal operation and models, single stage MOS amplifier, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier, MOS differential pair small signal operation.

UNIT-III 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-IV 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.

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

EXPERIMENTS

1. Study of JFET drain and transfer characteristics.
2. JFET biasing arrangement Graphical method.
3. Build and Test JFET CS amplifier. Find performance parameters for JFET amplifier - A_V, Ri, R_O.
4. Simulation of JFET CS amplifier using multisim/spice. Find performance parameters for JFET amplifier - A_V, Ri, R_O and compare with theoretical and practical results.
5. Input and Output Characteristics of BJT CE configuration. Find h parameters from characteristics.
6. Build and Test BJT in CE amplifier and find performance parameters - A_V, Ri, R_O, Ai
7. Simulation of BJT CE amplifier using multisim/spice.
8. Find performance parameters for BJT amplifier - A_V, Ri, R_O, Ai and compare with theoretical and practical results.

9. Comparison of CE, CC, CB configurations in terms of A_V, Ri, R_o ,Ai
10. Study of MOSFET drain and transfer characteristics
11. Frequency response - For BJT/ FET single stage amplifiers - Effect of unbypassed R_E and R_S.
12. Effect of coupling and bypass capacitors on low frequency cut-off.

Books & References

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

BEC-26 CONTROL SYSTEMS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
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 of a control system.
2. Derive mathematical model for simple electrical and mechanical systems using transfer function and state variable method.
3. Determine 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.

Topics Covered

UNIT-I 9

Basic Components of a control system, Feedback and its effect, 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

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

UNIT-III 9

Time response of continuous data systems, Different 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, Sensitivity, Control Actions: Proportional, Derivative, Integral and PID control.

UNIT-IV 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, Effect of adding a zero and a pole to the forward path, Nyquist Stability Criterion, Relative Stability: Gain Margin and Phase Margin, Bode Plot.

EXPERIMENTS

1. To determine transfer function of (Metadyne) cross-field generator set & study of various associated characteristics.
2. To study the synchros in various configurations from application point view
3. To study the D.C. Servo-position control system with P & PI configurations
4. To study the A.C. Servo motor and determine the Speed-Torque Characteristics.
5. To study 1st order and 2nd order system time response using MATLAB software.
6. To study Root Locus Plot using MATLAB software.
7. To study Frequency response Plot (Polar plot, Nyquist plot, Bode plot) using MATLAB software.

Books & References

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

BEC-27 ANALOG INTEGRATED CIRCUITS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical 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 be able to learn about the operational amplifiers and its characteristics as well as various types of op-amps.
2. Students will acquire the ability to design and test practical circuits for amplifiers, filters and oscillators.
3. Students will be able to analyze the operation of comparators, data convertors and implementation of the same.
4. Students will be able to learn the functioning of PLL, VCO, V-I, I-V converters, AGC, AVC and analog multipliers and implement them for suitable applications

Topics Covered

UNIT-I 9

Introduction to Integrated Circuit design: Power Supply configurations for Op-amp application, Various types of Op-amp, Current mirrors using BJT and MOSFETs, Base current compensated mirrors, Wilson current mirrors, Cascode current mirror, Widlar current source.

UNIT-II 9

Linear and Nonlinear applications of IC Op-amp: An overview 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, Astable and Monostable multivibrator, Generation of triangular waveform

UNIT-III 9

Filters: Characteristics of filters, Classification of filters, Butterworth filters, Chebyshev filters, Bessel filters, Low Pass and High Pass filters, Band Pass filters, Band reject filters, Notch filters, Self-tuned filters, KHN filters

UNIT-IV 9

Advanced applications of an Op-amp : Frequency Divider, PLL, AGC, AVC using op-AMP and analog multipliers, Integrated circuit Timer**:** 555 IC timer, Astable and Monostable Multivibrators using 555 IC, Standard Regulator ICs and their characteristics.

EXPERIMENTS

1. Study the characteristics of negative feedback amplifier
2. Design of an instrumentation amplifier
3. Design and test a stable multivibrator for a given frequency.
4. Study the characteristics of integrator circuit
5. Design of Analog filters – I
6. Design of Analog filters – II
7. Design of a self-tuned Filter
8. Design of a function generator
9. Design of a Voltage Controlled Oscillator
10. Design of a Phase Locked Loop(PLL)
11. Design and test an AGC system for a given peak amplitude of sine-wave output
12. Design of a low drop out regulator
13. Design of a switched mode power supply that can provide a regulated output voltage for a given input range using the TPS40200 IC

Books & References

1. Data Sheet: http://www.ti.com/lit/ds/symlink/tl082.pdf
2. Application Note: http://www.ti.com/lit/an/sloa020a/sloa020a.pdf
3. MPY634 Data Sheet: http://www.ti.com/lit/ds/symlink/mpy634.pdf
4. Application Note: http://www.ti.com/lit/an/sbfa006/sbfa006.pdf
5. ASLK Pro Manual: ASLK Manual
6. Ramakant A. Gayakwad, "Op-amps and Linear Integrated Circuits", PHI
7. Millman and Grabel, "Microelectronics", 2nd Ed., Mcgraw Hill
8. D. Roy Chudhary, "Linear Integrated Circuits", New Age International

BEC-28 PRINCIPLES OF COMMUNICATION

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
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 analog communication.
2. Acquired knowledge about AM transmission and reception.

3. Acquired knowledge about FM and PM transmission and reception.
4. Acquired knowledge about pulse modulation.
5. Acquired knowledge about noise.

Topics Covered

UNIT-I 9

Amplitude Modulation: Overview of Communication system, Communication channels, Need for modulation, Baseband and Pass band signals, Comparison of various AM systems, Amplitude Modulation: Double side-band with Carrier (DSB-C), Double side-band without Carrier, Single Side-band Modulation, SSB Modulators and Demodulators, Vestigial Side-band (VSB), Quadrature Amplitude Modulator.

UNIT-II 9

Introduction to Angle Modulation: Frequency modulation, Narrowband and Wideband FM, Generation of FM waves, Indirect FM and direct FM, FM modulators and demodulators, Phase locked loop, Angle Modulation by Arbitrary Message Signal, Sampling Theorem and its applications, Phase Modulation, Pre-emphasis and De-emphasis, Linear and Nonlinear Modulation, Comparison between Angle Modulation and Amplitude Modulation

UNIT-III 9

Noise: Source of Noise, Frequency domain, Representation of noise, Linear Filtering of noise, Noise in Amplitude modulation system, Noise in SSB-SC,DSB and DSB-C, Noise Ratio, Noise Comparison of FM and AM, Pre-emphasis and De-emphasis, Figure of Merit.

UNIT-IV 9

Pulse Modulation and Digital Transmission of Analog Signal: Concept of Pulse Amplitude Modulation, Pulse width modulation and pulse position modulation, PCM, Pulse Time Modulation, TDM and FDM. Line Coding, Quantizer, Quantization Noise, Compounding multiplexer

EXPERIMENTS

1. To study Amplitude modulation using a transistor and determine depth of modulation.
2. To study envelope detector for demodulation of AM signal and observe diagonal peak clipping effect.
3. To study frequency modulation using reactance modulator.
4. Study of frequency modulation using varactor modulator.
5. Narrow band FM generator using Armstrong method.
6. Study of Foster- Seely discriminator.
7. Generation of DSB-SC signal using balanced modulator.
8. Generation of single side band signal.
9. Study of phase locked loop and detection of FM signal using PLL.
10. Measurement of noise figure using a noise generator.
11. Study of superheterodyne AM receiver and measurement of sensitivity, selectivity & fidelity.
12. Study and demonstration of active filter (low pass, high pass, and band pass type).

Books & References

1. H. Taub, D L Schilling, Goutom Saha, “Principles of Communication”, 3e, Tata McGraw-Hill Publishing Company Ltd.

2. B.P. Lathi, "Modern Digital and Analog communication Systems", 3e, Oxford University Press, 2009.
3. Simon Haykin, "Communication Systems",4e, Wiley India.
4. H. P. HSU & D. Mitra, "Analog and Digital Communications", 2e, Tata McGraw-Hill Publishing Company Ltd.

BEC-29 ELECTRONIC MEASUREMENT & INSTRUMENTATION

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
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 operation of different instruments.
2. Able to describe different terminology related to measurements.
3. Understand the principles of various types of transducers and sensors.
4. Basic concept of instrumentation and its industrial application and working & performances of different kind of measuring instruments.
5. Ability to analyze performance characteristics of measuring instruments.
6. Ability to know, working principle & Performances of different electrical transducers.
7. Ability to understand construction, principle of operation, working and applications of waveform analyzers and spectrum analyzers, CRO and other display devices.
8. Ability to understand principle of operation of telemetry system and data acquisition system.
9. Ability to understand principle of operation of process control system and its various applications

Topics Covered

UNIT-I 9

Qualities Measurements and Digital Display Devices: Performance Characteristics, Error in Measurement, Sources of Error, Arithmetic Mean, Deviation from the Mean, Average Deviation, Standard Deviation, Limiting Errors.

Digital Display Device: LED, LCD, Gas Discharge Plasma Displays, Incandescent Display, LVD (Liquid Vapour Display), Pointers, Digital Voltmeters, Spectrum Analysis.

UNIT-II 9

Transducers: Introduction, Selection Parameters of Transducer, Resistive Transducer, Strain Gauges, Inductive Transducer, Differential Output Transducers, LVDT, Capacitive Transducer, Photo-electric Transducer, Photo cells, Photo-Voltaic Cell, Photo Transistors, Temperature Transducers, Mechanical Transducer (Flow, Pressure etc.), Digital Transducer.

UNIT-III 9

Data Acquisition and Conversion: Introduction, Objective of Data Acquisition System, Multi-channel DAS, A/D and D/A converters using Op-Amp, Data Loggers, Electromechanical A/D Converter, Digital Transducer, Data Transmission, Frequency Standards.

UNIT-IV 9

Measurement of Power and Frequency: Introduction, Power Measurement by Bolometer element, Bolometer Mount and Bolometer Bridge, Measurement of Power on a Transmission Line, Measurement of Microwave Frequencies, Resonant Coaxial Lines, Cavity Wave meter, Compact Data Logger, Digital Voltmeter.

EXPERIMENTS

1. Study of semiconductor diode voltmeter and its us as DC average responding AC voltmeter.
2. Study of L.C.R. bridge and determination of the value of the given components.
3. Study of distortion factor meter and determination of the % distortion of the given oscillator.
4. Study of the transistor tester and determination of the parameters of the given transistors.
5. Study of the following transducer (i) PT-100 transducer (ii) J- type transducer (iii) K-type transducer (iv)Pressure transducer.
6. Measurement of phase difference and frequency using CRO (Lissajous figure)
7. Measurement of low resistance using Kelvin's double bridge.
8. Radio Receiver Measurements

Books & References

1. David A. Bell, "Electronic Instrumentation and Measurements", 2nd Ed., PHI, New Delhi 2008.

BEC-30 SEMINAR

Course category	:	Audit Course (AC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 6
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through quality of material, presentation, quality & extent of external response of question asked and participation in other seminars (attendance)
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To acquire in depth study in a specialized area.

2. Acquaint the students of methods of carrying our literature survey on a given topic.

3. Derive a balance between the depth of the work and understanding of what has been learned in this process.

4. To be able to prepare seminar report and presentation and deliver it effectively.

BEC-31 DIGITAL COMMUNICATION

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Principles of Communication (BEC-28)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to compute the bandwidth and transmission power by analysing time and frequency domain spectra of signal required under various modulation schemes.
2. Able to apply suitable modulation schemes and coding for various applications.
3. Able to identify and describe different techniques in modern digital communications, in particular in source coding, modulation and detection, carrier modulation, and channel coding.
4. Able to analyze digital modulation techniques by using signal processing tools.

Topics Covered

UNIT-I 9

Sampling Theorem and PCM Overview of digital communication. Sampling Principles, Practical aspects of sampling and signal recovery, Nyquist Criterion, Baseband Binary transmission, Inter symbol Interference, Quantization and Quantization noise, PCM, Differential PCM, Delta modulation, Adaptive Delta Modulation. Line coding review, Pulse shaping

UNIT-II 9

Probability theory and Random Variables, Random variable, Statistical averages, Correlation, Sum of Random Variables, Central Limit Theorem, Random Process, Classification of Random Processes, Power spectral density, Multiple random processes, Gaussian Process, Probability Density function.

UNIT-III 9

Digital Modulation Techniques: Digital Modulation formats, Digital carrier system, Method of generation and detection of coherent & non-coherent binary ASK, FSK & PSK, Differential phase shift keying, quadrature modulation techniques. (QPSK and MSK), M-ary Digital carrier Modulation. Matched Filter, Spread spectrum systems, Frequency Hopping Spread Spectrum (FHSS) systems, Direct Sequence Spread Spectrum systems, Code Division Multiple Access , Multiuser Detection, OFDM Communications.

UNIT-IV 9

Information Theory and Coding: Information Measurement, Average information and information rate, Coding for discrete memory less source, continuous channel capacity, Maximum entropy, Huffman and Fano coding, Discrete channel capacity, Trade –off between S/N and bandwidth, Block code, Hamming code, Cyclic code, Convolutional code Tree diagram, State diagram, Trellis diagram, Viterbi encoder and decoder, Turbo Codes.

EXPERIMENTS

1. Study of Sample and hold circuit using Op-amp- ST2101
2. Study of PAM generation and detection and observe characteristics of both single and dual polarity pulse amplitude modulation.
3. Study of pulse width modulation and demodulation.
4. Study of pulse position modulation demodulation.
5. Study of delta modulation and demodulation and observe effect of slope overload DCL-07.
6. Study of pulse data coding techniques for NRZ formats.
7. Data decoding techniques for NRZ formats. ST2106-7.
8. Study of amplitude shift keying modulator and demodulator.
9. Study of frequency shift keying modulator and demodulator.
10. Study of phase shift keying modulator and demodulator ST-467.
11. Study of single bit error detection and correction using Hamming code. ST-2103.
12. Study of Pulse code modulation and demodulation

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

BEC-32 MICROPROCESSORS & APPLICATIONS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Digital Electronics & Circuits (BEC-12)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and

Three Minor tests and One Major Theory & Practical Examination

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 Microprocessors and its need.
2. Ability to identify basic architecture of different Microprocessors.
3. Foster ability to write the programming using 8085 microprocessor.
4. Foster ability to understand the internal architecture and interfacing of different peripheral devices with 8085 Microprocessor.
5. Foster ability to write the programming using 8086 microprocessor.
6. Foster ability to understand the internal architecture and interfacing of different peripheral devices with 8086 Microprocessor.

Topics Covered

UNIT-I 9

Introduction to Microprocessors: Evolution of Microprocessors, History of computers, Timing and control, memory devices: semiconductor memory organization, Category of memory, 8-bit Microprocessor (8085): Architecture, Instruction set, Addressing modes, Assembly Language Programming.

UNIT-II 9

Basic interfacing concepts, Interfacing output displays, Interfacing input devices, Memory mapped I/O, Flow chart symbols, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, Writing assembly language programs, Programming techniques: looping, counting and indexing.

16-bit Microprocessors (8086/8088): Architecture, Physical address segmentation, memory organization, Bus cycle, Addressing modes, difference between 8086 and 8088, Introduction to 80186 and 80286, Assembly Language Programming of 8086/8088.

UNIT-III 9

Data Transfer Schemes: Introduction, Types of transmission, 8257 (DMA), 8255 (PPI), Serial Data transfer (USART 8251), Keyboard-display controller (8279), Programmable Priority Controller (8259) Programmable Interval Timer/ Counter (8253/8254): Introduction, modes, Interfacing of 8253, applications. ADC and DAC

UNIT-IV 9

Advanced Microprocessors: Introduction to 32-bit and 64-bit microprocessors, Power PC, Microcontroller (8051): Introduction, Architecture, Instruction set.

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 instruction set.
6. To write a program to arrange an array of data in ascending order.
7. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.
8. To write a program to initiate 8251 and to check the transmission and reception of character.
9. To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
10. To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular waveforms.
11. Serial communication between two 8085 microprocessors through RS-232 C port.

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. Gaunkar: 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,

BEC-33 DATA COMMUNICATION NETWORKS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Principles of Communication (BEC-28)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to describe communication protocols and layered network architectures.
2. Able to explain conventional computer system interfacing standards and peer to peer data link communication protocols.
3. Able to design basic network systems and various components in a data communication system.
4. Able to describe how the physical, data link, and network layers operate in a typical data

communication system.

5. Able to understand the system design principles of data communication systems.
6. Able to understand, define and explain data communications networks concepts

Topics Covered

UNIT-I 9

Introduction to Networks & Data Communications The Internet, Protocols & Standards, Layered Tasks, OSI Model, TCP / IP, Addressing, 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: RANDOH, CDMA, CSMA/CD, CSMA/CA, Controlled Access, 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: Design Issues. Routing Algorithms. Congestion control Algorithms.IPV4 Addresses, Connecting Devices, Virtual LAN IPV6 Addresses, Internet Protocol, Hardware Addressing versus IP Addressing, IP Data Gram. Transport Layer Protocol : UDP and TCP, ATM, Cryptography, Network Security

Books & References

1. B. A. Forouzan, "Data Communications and Networking", MGH, 4th ed. 2007
2. A. S. Tanenbaum, "Computer Networks", PHI.
3. W. Stallings, "Data and Computer Communication", PHI.

BEC-34 MICROWAVE ENGINEERING

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Electromagnetic Field Theory (BEC-14)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
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 electromagnetic theory to calculations regarding waveguides and transmission lines.
2. Able to describe, analyze and design simple microwave circuits and devices e.g. matching circuits, couplers, antennas and amplifiers.
3. Able to describe and coarsely design common systems such as radar and microwave transmission links.
4. Able to describe common devices such as microwave vacuum tubes, high-speed transistors and ferrite devices.
5. Able to handle microwave equipment and make measurements.

Topics Covered

UNIT-I 9

Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant TE_{10} mode, Field Distribution, Power, Attenuation. Circular Waveguides: TE, TM modes. Wave Velocities, Micro-strip Transmission line (TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL, Microwave Cavities.

UNIT-II 9

Scattering Matrix , Passive microwave devices: Microwave Hybrid Circuits. , 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. S parameter analysis of all components.

UNIT-III 9

Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Solid state amplifiers and oscillators: Microwave Bipolar Transistor, Microwave tunnel diode, Microwave Field-effect Transistor, Transferred electron devices, Avalanche Transit –time devices: IMPATT Diode, TRAPPAT Diode.

UNIT-IV 9

Microwave Measurements: 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, measurement of antenna characteristics, microwave link design

EXPERIMENTS

1. Measurement of guide wavelength and frequency of the signal in a rectangular waveguide.
2. Measurement of VSWR using slotted line.
3. Study of mode characteristics of reflex Klystron and determination of mode number, transit time & electronic tuning sensitivity.
4. Study of characteristics of Gunn oscillator.
5. Study of Gunn diode as modulated source (PIN modulation) and determination of modulation depth.
6. Measurement of coupling coefficient and directivity of a directional coupler.

7. Study of insolation & coupling coefficient of a magic T.
8. Measurement of attenuation using substitution method and plot of attenuation versus frequency characteristics.
9. Study of waveguide horn and its radiation pattern and determination of the beam width.
10. Study of a ferrite circulator and measurement of isolation, insertion loss, cross coupling and input VSWR.
11. Measurement of microwave power using power meter

Textbooks & Reference books

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.

BEC-35 VLSI TECHNOLOGY

Course category	:	Department Core (DC)
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 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 fundamentals of CMOS VLSI and associated technologies.
2. Able to solve problems in the design of CMOS logic circuits, with particular reference to speed and power consumption.
3. Able to acquire hands-on skills of using CAD tools in VLSI design.
4. Able to appreciate the design process in VLSI through a mini-project on the design of a CMOS sub-system.
5. Able to explain basic operation principles of diodes and MOS transistors and their circuits level models
6. Able to design the fundamental blocks of a VLSI circuits, both by circuit schematic and physical layout

7. Able to analyze the influence of wires/interconnects on VLSI circuit performance.

Topics Covered

UNIT-I 9

Fundamentals of VLSI Technology

Introduction, Trends & Projections in microelectronics. Semiconductor materials and their merits and demerits. Monolithic chips trends. Advantages, limitations & classification of ICs.

Source of silicon

EGS and MGS, Single crystalline and Poly-crystalline crystal, SGS

UNIT-II 9

Fabrication Techniques

float zone method, Czocharalski method, Refining, Silicon Wafer Preparation & Crystal Defects. **Epitaxial Process:** Need of epitaxial layer; VPE, MBE, merits and demerits of various epitaxial processes.

Oxidation Techniques

Importance of oxidation, types of oxidation techniques, growth mechanism, factors affecting the growth mechanisms, silicon oxidation model, dry & wet oxidation.

Diffusion and Ion Implantation

Diffusion mechanisms; diffusion reactor; diffusion profile; diffusion kinetics; parameters affecting diffusion profile; Dopants and their behaviour, choice of dopants; Ion Implantation- reactor design, impurity distribution profile, properties of ion implantation, low energy and high energy ion implantation.

UNIT-III 9

Lithography

Basic steps in lithography; lithography techniques-optical lithography, electron beam lithography, x-ray lithography, ion beam lithography; resists and mask preparation of respective lithographies, printing techniques-contact, proximity printing and projection printing.

Etching

Performance metrics of etching; types of etching- wet and dry etching; dry etching techniques-ion beam or ion-milling, sputter ion plasma etching and reactive ion etching (RIE).

Metallization

Desired properties of metallization for VLSI; metallization choices; metallization techniques – vacuum evaporation, sputtering.

UNIT-IV 9

Fabrication steps of Diodes and Transistors, MOSFETs, CMOS, Resistors, Capacitors.

Books & References

1. S.M. Sze, “VLSI Technology”, TMH
2. S.K. Gandhi, “VLSI Fabrication Principles”, John Willey & Sons
3. D. Nagchoudhuri, “Principles of Microelectronics Technology” PHI
4. Botkar, “Integrated Circuits”, Khanna Publishers

BEC-40 PROJECT PART-I

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 10
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, preliminary project report, effort and regularity and end semester presentation
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding of electronics system requirement.
2. Defining the right architecture for right application that meets cost and performance constraints.
3. Designing and verifying the functional model of electronics system.
4. Analysis of the design on simulation software.
5. Trouble shooting the design circuits using various trouble shooting equipments.

BEC-41 VLSI DESIGN

Course category	:	Department Core (DC)
Pre-requisite Subject	:	VLSI Technology (BEC-35)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, quizzes and Three Minor tests and One Major Theory & Practical Examination
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 fundamentals of CMOS VLSI and associated technologies.
2. Able to solve problems in the design of CMOS logic circuits, with particular reference to speed and power consumption.
3. Able to acquire hands-on skills of using CAD tools in VLSI design.
4. Able to appreciate the design process in VLSI through a mini-project on the design of a CMOS sub-system.

5. Able to explain basic operation principles of diodes and MOS transistors and their circuits level models
6. Able to design the fundamental blocks of a VLSI circuits, both by circuit schematic and physical layout
7. Able to analyze the influence of wires/interconnects on VLSI circuit performance.

Topics Covered

UNIT-I 9

Introduction: Trends & Projections in VLSI Circuits, Flow diagram of VLSI Circuit Design and VLSI Design issues, Y-Chart.

UNIT-II 9

Electrical Characterization of MOS transistor: Energy-band explanation for MOS structure, Weak & strong Inversion Conditions, C-V characteristics of MOS Capacitor, Parameters affecting Threshold Voltage of MOSFET, Long-Channel and Short-Channel MOSFETs, Short-Channel effects, SPICE parameters of MOS transistor

UNIT-III 9

Basic VLSI Design Styles-NMOS, CMOS Process flow; n-MOS p-MOS and CMOS Inverter Design, Noise Margin, VTC curve, Delay computations, Power Dissipation and scaling in CMOS circuits. Combinational circuit design using CMOS, Stick Diagrams; Physical Design Rules; Layout Designing; Euler's Rule for VLSI Physical Design.

UNIT-IV 9

Dynamic CMOS circuits: Basic Principles of pass transistor and transmission gate, CMOS Transmission-Gate and Pass-transistor logic circuits, Domino CMOS Logic, NORA CMOS Logic, Zipper CMOS circuits, Semiconductor Memories, ROM, DRAM and SRAM Cell Design

EXPERIMENTS

1. Design Entry and Simulation of Combinational Logic Circuits
2. Design Entry and simulation of sequential logic circuit
3. Study of Synthesis Tools
4. Study of place and root annotation
5. Schematic Entry and SPICE Simulation
6. Layout of a CMOS Inverter
7. Design of a 10 bit number controlled oscillator
8. Automatic Layout Generation
9. Implementation of Flip-flops
10. Implementation of Counters
11. Implementation of Register

Books & References

1. S.M. Kang & Y. Leblibici, "CMOS Digital Integrated Circuits-Analysis & Design", TMH, Ed. 2003.
2. B.G. Streetman & S. Banerjee, "Solid State Electronic Devices", PHI.
3. K. Eshraghian & Pucknell, "Introduction to VLSI", PHI.
4. J.M. Rabaey, "Digital Integrated Circuits-A Design Perspective", PHI.

5. B. Razavi, “Design of Analog CMOS Integrated Circuits”, TMH

BEC-42 DIGITAL SIGNAL PROCESSING

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Signals and Systems (BEC-13)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to analyze signals using the discrete Fourier transform (DFT).
2. Understand circular convolution, its relationship to linear convolution, and how circular convolution can be achieved via the discrete Fourier transform.
3. Able to understand the decimation in time and frequency FFT algorithms for efficient computation of the DFT.
4. Able to design digital filters on paper and implement the design by using MATLAB.
5. Able to design a digital FIR filter using Window method.
6. Able to implement digital filters in a variety of forms:-Direct form I &II, Parallel, Cascade and lattice structure.

Topics Covered

UNIT-I 9

Realization of Digital Systems: Introduction, direct form realization of IIR systems, cascade realization of an IIR systems, parallel form realization of an IIR systems, Ladder structures: continued fraction expansion of H(z), example of continued fraction, realization of a ladder structure, example of a ladder realization.

UNIT-II 9

Design of Infinite Impulse Response Digital Filters: Introduction to Filters, Impulse Invariant Transformation, Bi-Linear Transformation, All Pole Analog Filters: Butterworth and Chebyshev, Design of Digital Butterworth and Chebyshev Filters.

UNIT-III 9

Finite Impulse Response Filter Design: Windowing and the Rectangular Window, Other Commonly Used Windows, Examples of Filter Designs Using Windows ,The Kaiser Window.

UNIT-IV 9

Discrete Fourier Transforms: Definitions, Properties of the DFT, Circular Convolution, Linear

Convolution

Fast Fourier Transform Algorithms: Introduction, Decimation –In Time(DIT) Algorithm, Computational Efficiency, Decimation in Frequency(DIF) Algorithm.

Books & References

1. John G Prokias, Dimitris G Manolakis, "Digital Signal Processing", Pearson Education.
2. Oppenheim & Schafer, "Digital Signal Processing" PHI
3. Johnny R. Johnson, "Digital Signal Processing", PHI Learning Pvt Ltd., 2009.

BEC-43 WIRELESS COMMUNICATION

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Principles of Communication (BEC-28)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
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 Infrastructure to develop mobile communication system: cellular Theory.
2. Able to understand the characteristics of different multiple access techniques in mobile/wireless communication.
3. Able to understand the need of coding, channel models, diversity, equalization and channel estimation techniques. Able to apply analytical and empirical models in the design of wireless links.
4. Able to understand the Wireless communication systems and standards: GSM, IS-95.
5. Able to understand the Ad Hoc networks and new trends in Mobile/wireless communication.
6. Able to understand the radio propagation over wireless channel and different limitations.
7. Able to apply analytical and empirical models in the design of wireless links.

Topics Covered

UNIT-I 9

Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and

personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks , Wireless Local Loop(WLL), Wireless Local Area network(WLAN), Bluetooth and Personal Area Networks.

UNIT-II 9

Fundamentals of equalisation, Equalisers in communication receiver, Survey of equalisation techniques, linear equaliser, Algorithms for Adaptive Equalization, Diversity techniques, RAKE receiver. Characteristics of speech signals, quantisation techniques, vocoders, linear predictive coders, Multiple Access techniques for Wireless Communications.

UNIT-III 9

Large scale path loss:-Free Space Propagation loss equation, Path-loss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread.

UNIT-IV

GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture. 9

EXPERIMENTS

1. Simulation and calculation of throughput for a TCP connection (using ns2 simulator)
2. Simulation and calculation of throughput for a star connected network with 2 TCP and 1 UDP connection (using ns2 simulator)
3. Simulation of a Local Area Network (using ns2 simulator)
4. Simulation of Mobile Adhoc Network and comparison of the performance of Routing Protocol (DSDV, AODV & DSR) (using ns2 simulator)
5. Simulation of a Bluetooth system (using system view software)
6. Simulation of an IEEE802.11a system (using system view software)
7. Assembly of GSM setup & real time study of GSM 07.05 & 07.07 AT commands (such as network registration, call control, call setting, etc.
8. Study and implementation of Auto Dial, Call Forwarding in IP Telephony
9. Configuration of an IP phone and implementation of Class of Services (COS) and Class of Restriction (COR)
10. Analysis of signal strength and throughput at several locations in a wireless LAN
11. Study and analysis of the working of DHCP & NAT in a network
12. Programming with Cryptographic libraries: Encryption and Dcryption
13. Study of Advanced Encryption Standards (AES)
14. Study of the concept of Cellular System Design (such as frequency reuse, sectorization and frequency channel assignment) and investigation of the effect of Demographic, Traffic, Terrain on Cell Planning and to expose the students' tool used for cell-planning
15. Setting up a Virtual Local Area Network for voice IP

Books & References

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson, Second Edition.

2. T L Singal, “Wireless Communications”, McGraw Hill Publications.
3. Andrea Goldsmith, “Wireless Communications”, Cambridge University press.
4. Andreas F. Molisch, “Wireless Communications”, Wiley Student Edition.
5. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.

BEC-45 INDUSTRIAL / PRACTICAL TRAINING

Course category : Audit Course (AC)
Pre-requisite Subject : NIL
Contact hours/week : Lecture : 0, Tutorial : 0 , Practical: 2
Number of Credits : 1
Course Assessment methods : Continuous assessment through technical quality of the work, attendance, discipline, involvement and interest, project work, viva voce, project report and presentation
Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to demonstrate the use, interpretation and application of an appropriate international engineering standard in a specific situation.
2. Ability to analyse a given engineering problem, identify an appropriate problem solving methodology, implement the methodology and propose a meaningful solution.
3. Ability to apply prior acquired knowledge in problem solving.
4. Ability to identify sources of hazards, and assess/identify appropriate health & safety measures.
5. Ability to work in a team.
6. Ability to take initiatives.
7. Ability to effectively communicate solution to problems (oral, visual, written).
8. Ability to manage a project within a given time frame.
9. Ability to adopt a factual approach to decision making.
10. Ability to take engineering decision.

BEC-50 PROJECT PART-II

Course category : Department Core (DC)
Pre-requisite Subject : Project Part-I (BEC-40)
Contact hours/week : Lecture : 0, Tutorial : 0 , Practical: 10

Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, final project report, contribution made to literary world and Major examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding of electronics system requirement.
2. Defining the right architecture for right application that meets cost and performance constraints.
3. Designing and verifying the functional model of electronics system.
4. Analysis of the design on simulation software.
5. Trouble shooting the design circuits using various trouble shooting equipments.

BEC-51 RADAR TECHNOLOGY

Course category	:	Programme Electives (PE1 & PE2)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about Radar and Radar Equations.
2. Understanding the working principal of MTI and Pulse Doppler Radar.
3. Foster ability to work using Detection of Signals in Noise and Radio Direction Finding.
4. Foster ability to work using Instrument Landing System.
5. Acquired knowledge about Satellite Navigation System.

Topics Covered

UNIT-I 9

Introduction to Radar: Basic Radar, The Simply Form of the Radar Equations, Radar lock

Diagram, Radar Frequencies, Applications of Radar. The Radar Equation: Detection of Signals in Noise, Receiver Noise and the Signal-to-Noise Ratio, Probabilities of detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Radar Cross-Section of Targets, Radar Cross-Section Fluctuations, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System Losses, problems

UNIT-II 9

MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay-Line Cancelers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.

UNIT-III 9

Tracking Radar: Tracking with Radar, Mono pulse Tracking, Conical Scan and Sequential Lobing, Limitations to tracking Accuracy, Low- Angle Tracking, Tracking in Range, Other Tracking Radar Topics, Comparison of Trackers, Automatic Tracking with Surveillance Radars(ADT)

UNIT-IV 9

Detection of Signals in Noise: Introduction, Detection Criteria, Detectors, Automatic Detection, Integrators, Constant-False-Alarm Rate Receivers. Information from Radar Signals: Basic Radar Measurements, Theoretical Accuracy of Radar Measurements, Ambiguity Diagram, Pulse Compression, Target Recognition, Land Clutter, Sea Clutter, Weather Clutter

Books & References

1. Merrill I. Skolnik, "Introduction to Radar Systems" Third Edition.
2. J.C. Toomay , Paul J. Hannen " Principles of Radar" Third Edition.

BEC-52 BIOMEDICAL INSTRUMENTATION

Course category	:	Programme Electives (PE1 & PE2)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will have a clear knowledge about human physiology system.
2. They will have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering.
3. Learn several signals that can be measured from the human body. Specific examples include temperature, electrical, and pressure signals.

4. Review the cardiac, respiratory and neural physiological systems.
5. Study the designs of several instruments used to acquire signals from living systems. Examples of instruments studied include ECG, blood pressure monitors, spirometers, EEG, MRI, and ultrasound. Integrate information learned about biomedical signals, sensors and instrumentation design to create a design of your own.

Topics Covered

UNIT-I 9

Introduction: Specifications of bio-medical instrumentation system, Man-Instrumentation system Components, Problems encountered in measuring a living system. Basics of Anatomy and Physiology of the body. Bioelectric potentials: Resting and action potentials, propagation of action potential, The Physiological potentials – ECG, EEG, EMG, ERG, EOG and Evoked responses. Electrodes and Transducers: Electrode theory, Biopotential Electrodes – Surface electrodes, Needle electrodes, Microelectrodes, Biomedical Transducer.

UNIT-II 9

Cardiovascular Measurements: Electrocardiography – ECG amplifiers, Electrodes and Leads, ECG –Single channel, Three channel, Vector Cardiographs, ECG System for Stresses testing, Holter recording, Blood pressure measurement, Heart sound measurement. Pacemakers and Defibrillators. Patient Care & Monitoring: Elements of intensive care monitoring, displays, diagnosis, Calibration & Reparability of patient monitoring equipment.

UNIT-III 9

Respiratory system Measurements: Physiology of Respiratory system. Measurement of breathing mechanism – Spirometer. Respiratory Therapy equipments: Inhalators, Ventilators & Respirators, Humidifiers, and Nebulizers & Aspirators. Nervous System Measurements: Physiology of nervous system, Neuronal communication, Neuronal firing measurements.

UNIT-IV 9

Ophthalmology Instruments: Electroretinogram, Electro - oculogram, Ophthalmoscope, Tonometer for eye pressure measurement. Diagnostic techniques: Ultrasonic diagnosis, Eco-cardiography, Eco-encephalography, Ophthalmic scans, X-ray & Radio-isotope diagnosis and therapy, CAT-Scan, Emission computerized tomography, MRI.

Bio-telemetry: The components of a Bio-telemetry system, Implantable units, Telemetry for ECG measurements during exercise, for Emergency patient monitoring.

Books & References

1. R. S. Khandpur, “Biomedical Instrumentation”, TMH
2. S. K. Venkata Ram, “Bio-Medical Electronics &Instrumentation (Revised)”, Galgotia.
3. J. G. Webster (editor), “Medical Instrumentation Application & Design”, 3rd Ed WILEY, India
4. Cromwell, “Biomedical Instrumentation and Measurements” PHI
5. J. G. Webster, “Bio- Instrumentation”, Wiley
6. S. Ananthi, “A Text Book of Medical Instruments”, New Age International
7. Carr & Brown, “Introduction to Biomedical Equipment Technology”, Pearson

BEC-53 INFORMATION THEORY & CODING

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	Digital Communication (BEC-31)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will be introduced to the basic notions of information and channel capacity.
2. Students will be introduced to convolutional and block codes, decoding techniques, and automatic repeat request (ARQ) schemes.
3. Students will be understood how error control coding techniques are applied in communication systems.
4. Students will understand the basic concepts of cryptography.

Topics Covered

UNIT-I 9

Information Theory

Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit.

UNIT-II 9

Source Coding: Text, Audio And Speech

Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding.

UNIT-III 9

Error Control Coding: Block Codes

Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC.

UNIT-IV 9

Error Control Coding: Convolutional Codes

Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding.

Books & References

1. R Bose, "Information Theory, Coding and Cryptography", TMH 2007.
2. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Perason Education Asia, 2002.
3. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006
4. S Gravano, "Introduction to Error Control Codes", Oxford University Press 2007.
5. Amitabh Bhattacharya, "Digital Communication", TMH 2006.

BEC-54 ADVANCED SEMICONDUCTOR DEVICES

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	Solid State Devices & Circuits (BEC-15)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students study the basic of different kinds of modern semiconductor devices.
2. Ability to understand the basic operation and working of different diodes like PIN, Varactor diode etc. To understand the high frequency application of diodes.
3. To understand and use of the device models to explain and calculate the characteristics of the field effect transistors.
4. To be able to understand and analyze the V-I characteristics of different high power devices.
5. Understand the operation of charge-transfer devices and charge storage devices.

Topics Covered

UNIT-I 9

Review of Fundamentals of Semiconductors: Semiconductor Materials and their properties Carrier Transport in Semiconductors Excess Carriers in Semiconductor.

UNIT-II 9

Junctions and Interfaces: Description of p-n junction, Action, The Abrupt Junction, Example of an Abrupt Junction, The linearly graded Junction. The Ideal Diode Model, Real Diodes, Temperature Dependence of I-V Characteristics, High Level Injection Effects, Example of Diodes. Description of Breakdown Mechanism, Zener and Avalanche Breakdown in p-n Junction.

UNIT-III 9

Majority Carrier Diodes: The Tunnel Diode, The Backward Diode, The Schottkey Barrier Diode,

Ohmic Contacts Hetero junctions.
Microwave Diodes: The Varactor Diode, The p-i-n Diode, The IMPATT Diode, TRAPATT Diode, The BARITT Diode, Transferred Electron Devices Optoelectronic Devices: The Solar Cell, Photo detectors, Light Emitting Diodes, Semiconductor Lasers.

UNIT-IV 9

Metal Semiconductor Field Effect Transistors: Basic Types of MESFETs, Models for I-V Characteristics of Short – Channel MESFETs, High Frequency Performance, MESFETs Structures. MOS Transistors and Charge Coupled Devices: Basic Structures and the Operating Principle, I-V Characteristics, Short Channel Effects, MOSFET Structures, Charge Coupled Devices.

Books & References

1. M.S. Tyagi, "Introduction To Semiconductor Materials And Devices", John Willy-India Pvt. Ltd.
2. S. M. Sze, "Physics of Semiconductor Devices", 2e, John Willy-India Pvt. Ltd.
3. B. G. Streetman and S. Banerjee, "Solid state electronics devices", 5e, PHI.

BEC-55 OPTOELECTRONICS

Course category	:	Programme Electives (PE1 & PE2)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand fundamental properties of light and operation principles of basic optical components.
2. Demonstrate a mastery of basic mechanisms of light generation (including lasers) through detailed understanding and analysis of operation principles, characteristics, design architectures and trade-offs of semiconductor lasers.
3. Understand and compare operation principles, characteristics, design architectures and trade-offs of optical detectors and modulators of light.
4. Understand basic system design of fiber optic communication link and fundamental theory of fiber optics.

Topics Covered

UNIT-I 9

Industrial Applications Of Optoelectronics

Revision of basics of reflection, refraction, transmission and absorption of light radiation, Ray-tracing through lenses, convex, concave and plane mirrors, prisms etc. Refractive index, total internal reflection.

UNIT-II 9

Lamps And Illumination Systems, LEDs

working principle and applications, LED lighting, Display devices, indicators, numeric, alphanumeric and special function displays, Liquid Crystal Display elements, Plasma Displays, Multimedia projectors.

UNIT-III 9

Gas and solid state LASERs, pulsed lasers, industrial applications of low power lasers. Alignment, Pointing, tracking and particle Size detection Instruments. Laser Level. Wire Diameter Sensor. Laser Doppler Velocimetry-Principle of Operation. Performance Parameters. Electronic Processing of the Doppler Signal.

UNIT-IV 9

Photo detectors types and applications, Opt couplers, Opto interrupters, LASCR. used in safety interlocks, power isolators, rotary and linear encoders and remote control. Intrinsic and Extrinsic Fiber optic sensors. Digital camera and automatic inspection systems.

Introduction to Optical computing and holography.

Books & References

1. Optical Engineering Fundamentals, B.H. Walker, PHI.
2. Industrial Electronics, T.E. Kissell, PHI.
3. Electro-Optical Instrumentation Sensing and Measuring with Lasers, Silvano Donati, Pearson.
4. Fiber optics and Optoelectronics, R.P. Khare, Oxford Press

BEC-56 ELECTRONICS SWITCHING

Course category	:	Programme Electives (PE1 & PE2)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquire knowledge about switching theory and algebra.
2. Ability to learn and design sequential circuits.
3. Acquire knowledge and ability to analyze threshold gates sand their synthesis.

4. Foster ability to use PLDs and PLAs.
5. Acquired knowledge about and ability to design ASM and FSM.
6. Learn about various fault tolerance and diagnosis techniques.

Topics Covered

UNIT-I 9

Evolution of Switching systems: Introduction: Message switching, circuits switching, functions of a switching system, register-translator-senders, distribution frames, crossbar switch, a general trunking, electronic switching, Reed electronic system, digital switching systems.

UNIT-II 9

Digital switching: Switching functions, space division switching, Time division switching, two dimensional switching, Digital cross connect systems, digital switching in analog environment.

Telecom Traffic Engineering: Network traffic load and parameters, grade of service and blocking probability, modelling switching systems, incoming traffic and service time characterization, blocking models and loss estimates, Delay systems.

UNIT-III 9

Control of Switching Systems: Introduction, Call processing functions; common control, Reliability availability and security; Stored program control. Signalling: Introduction, Customer line signalling, AF junctions and trunk circuits, FDM carrier systems, PCM and inter register signalling, Common channel signalling principles, CCITT signalling system No. 6 and 7, Digital customer line signalling.

UNIT-IV 9

Packet Switching: Packets formats, statistical multiplexing, routing control, dynamic, virtual path circuit and fixed path routing, flow control, X.25 protocol, frame relay, TCP/IP, ATM cell, ATM service categories, ATM switching, ATM memory switch, pace memory switch, memory-space, memory-space-memory switch, Banyan network switch.

Books & References

1. Thiagarajan Viswanathan, "Telecommunication switching System and networks", PHI.
2. J.E. Flood, "Telecommunication switching, Traffic and Networks", Pearson education.
3. J.C. Bellamy, "Digital Telephony", John Wiley, 3e.

BEC-57 DIGITAL SYSTEM DESIGN

Course category	:	Programme Electives (PE1& PE2)
Pre-requisite Subject	:	Digital Electronics & Circuits (BEC-12)
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 Outcomes	:	The students are expected to be able to demonstrate the

following knowledge, skills and attitudes after completing this course

1. Model digital systems in VHDL at different levels of abstraction.
2. Partition a digital system into different subsystems.
3. Simulate and verify a design.
4. Transfer a design from a version possible to simulate to a version possible to synthesize
5. Use modern software tools for digital design in VHDL.
6. Describe principal parts in programmable circuits (PLD, FPGA, ASIC) and describe how small designs are implemented in programmable circuits.

Topics Covered

UNIT-I 9

Introduction to VHDL, reserve words, structures, modeling, objects, data type and operators, sequential statements and processes, sequential modeling and attributes, conditional assignment, concatenation and case, array loops and assert statements, subprograms.

UNIT-II 9

Digital System Design Automation– Abstraction Levels, System level design flow, RTL design flow, VHDL.

RTL Design with VHDL – Basic structures of VHDL, Combinational circuits, Sequential circuits, Writing Test benches, Synthesis issues, VHDL Essential Terminologies

VHDL Constructs for Structures and Hierarchy Descriptions – Basic Components, Component Instantiations, Iterative networks, Binding

Alternatives, Association methods, generic Parameters, Design Configuration.

UNIT-III 9

Concurrent Constructs for RT level Descriptions – Concurrent Signal Assignments, Guarded signal assignment Sequential Constructs for RT level Descriptions – Process Statement, Sequential WAIT statement, VHDL Subprograms, VHDL library Structure,

Packaging Utilities and Components, Sequential Statements. VHDL language Utilities - Type Declarations and Usage, VHDL Operators, Operator and Subprogram overloading, Other TYPES and TYPE– related issues, Predefined Attributes

UNIT-IV 9

VHDL Signal Model – Characterizing hardware languages, Signal Assignments, Concurrent and Sequential Assignments, Multiple Concurrent Drivers Standard Resolution

Books & References

1. Z. Navabi, “VHDL-Modular Design and Synthesis of cores and Systems”, TMH – 3e.
2. R.D.M. Hunter, T. T. Johnson, “Introduction to VHDL” Springer Publication, 2010.
3. C. H. Roth, “Digital System Design using VHDL”, PWS Publishing
4. Douglas Perry, “VHDL- Programming by examples”, MGH

BEC-58 SATELLITE COMMUNICATION

Course category	:	Programme Electives (PE1 & PE2)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Recall the fundamentals of orbital mechanics, identify the characteristics of common orbits used by communications and other satellites, and assess launch methods and technologies.
2. Identify the systems required by a communications satellite to function and the trade-offs and limitations encountered in the design of a communications satellite system.
3. Identify the radio propagation channel for Earth station to satellite and satellite to satellite communications links, and
4. Describe the basics of designing antenna systems to accommodate the needs of a particular satellite system.
5. Calculate an accurate link budget for a satellite or other wireless communications link.
6. Assess the analog and digital technologies used for satellite communications networks and the topologies and applications of those networks, and compare them to alternative systems.

Topics Covered

UNIT-I 9

Elements of Satellite Communication. Orbital mechanics, look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit. Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna

UNIT-II 9

Satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth station, design for specified C/N. Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc.

UNIT-III 9

Introduction of various satellite systems: VSAT, low earth orbit and non geostationary Direct broadcast satellite television and radio, satellite navigation and the global positioning systems, GPS position location principle, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, Timing accuracy, GPS Receiver Operation

UNIT-IV 9

Global Mobile Satellite Systems, Antenna System for mobile satellite applications, Evolution, Antenna Requirement and Technical Characteristics, Classification of Mobile Satellite Antenna(MSA), Low gain omni directional Antenna, Medium gain Directional Antenna, High gain Directional Aperture Antenna, Wire Quadrifilar Helix Antenna(WQHA) for Hand held Terminals, Antenna Systems for Mobile Satellite Broadcasting.

Books & References

1. B. Pratt, A. Bostian, "Satellite Communications", Wiley India.
2. D. Roddy, "Satellite Communications", TMH, 4th Ed.
2. S. D. Ilcev, "Global Mobile Satellite Communication", Springer
3. R. Pandya, "Mobile and Personal Communication Systems and Services", PHI.

BEC-61 MICROCONTROLLER & EMBEDDED SYSTEMS

Course category	:	Programme Electives (PE3)
Pre-requisite Subject	:	Microprocessors & Application (BEC-32)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

At the end of the course the students will be able to understand the concept and scope of microcontrollers specially 32-bit microcontroller, programming, interfacing of various external I/O devices, communication protocols used by microcontrollers and embedded networking.

Topics Covered

UNIT-I 9

Microprocessors for embedded systems

Embedded system overview and applications, features and architecture considerations-ROM, RAM, timers, data and address bus, Memory and I/O interfacing concepts, memory mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes of 32-bit. Fixed point and floating point arithmetic operations.

Introduction ARM architecture and Cortex – M series, Introduction to the Tiva family viz.

TM4C123x & TM4C129x and its targeted applications, Tiva block diagram, address space, on-chip peripherals (analog and digital) Register sets, Addressing modes and instruction set basics.

UNIT-II 9

Microcontroller Fundamentals for Basic Programming, Timers, PWM and Mixed Signals Processing

I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems,

System Clocks and control, Hibernation Module on Tiva, Active vs Standby current consumption. Introduction to Interrupts, Interrupt vector table, interrupt programming.

Case Study: Tiva based embedded system application bringing up the salient features of GPIO, Watchdog timer, etc.

Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).

Case Study: Tiva based embedded system application using ADC & PWM.

UNIT-III 9

Communication protocols and Interfacing with external devices

Synchronous/Asynchronous interfaces (like UART, SPI, I2C, USB), serial communication basics, baud rate concepts, Interfacing digital and analog external device, I2C protocol, SPI protocol & UART protocol. Implementing and programming I2C, SPI & UART interface using Tiva. CAN & USB interfaces on Tiva platform. Case Study: Tiva based embedded system application using the interface protocols for communication with external devices "Sensor Hub Booster Pack

UNIT-IV 9

Embedded networking and Internet of Things

Embedded Networking fundamentals, Ethernet, TCP/IP introduction IoT overview and architecture, Overview of wireless sensor networks and design examples. Various wireless protocols and its applications: NFC, ZigBee , Bluetooth, Bluetooth Low Energy, Wi-Fi. Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications Building IoT applications using CC3100 user API: connecting sensor devices using Tivaware sensor library.

Case Study: Tiva based Embedded Networking Application: "Smart Plug with Remote Disconnect and Wi- Fi Connectivity"

EXPERIMENTS

1. Interfacing and programming GPIO ports in C using Tiva (blinking LEDs , push buttons)
2. Interrupt programming examples through GPIOs
3. Use Hibernation mode and wake on RTC interrupt
4. PWM generation using PWM Module on Tiva
5. Interfacing potentiometer with Tiva GPIO
6. PWM based Speed Control of Motor controlled by potentiometer connected to Tiva GPIO
7. Connect the Tiva to terminal on PC and echo back the data using UART
8. Interfacing an accelerometer with Tiva using I2C
9. Experiment on USB (Sending data back and forth across a bulk transfer-mode USB connection.)
10. Using IQmath Library for implementing Low pass FIR filter
11. Review of User APIs for TI CC3100 & Initialization and Setting of IP addresses

12. A basic Wi-Fi application – Communication between two Tiva based sensor nodes using TIVA sensor library in Tiva Ware
13. Setting up the CC3100 as a HTTP server

Books & References

1. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2014, ISBN: 978-1463590154.
2. http://processors.wiki.ti.com/index.php/Hands-On_Training_for_TI_Embedded_Processors http://processors.wiki.ti.com/index.php/MCU_Day_Internet_of_Things_2013_Workshop ;
3. http://www.ti.com/ww/en/simplelink_embedded_wi-fi/home.html
4. R. Kamal, "Embedded Systems: Architecture, Programming & Design", 2007, McGraw Hill, USA 2007.

BEC-62 OPTICAL COMMUNICATION

Course category	:	Programme Electives (PE3)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Fundamentals, advantages and advances in optical communication system.
2. Types, basic properties and transmission characteristic of optical fibers.
3. Knowledge of working and analysis of optical amplifiers and important parts at the transmitter (Semiconductor lasers/LEDs, modulators etc) as well as at the receiver sides (optical detector etc.) of the optical communications system.
4. Configuration and architecture of coherent optical communication, advanced system techniques and nonlinear optical effects and their applications.

Topics Covered

UNIT-I 9

Overview of optical fiber communication- The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Optical fiber Modes and configuration, Mode theory for circular Waveguides, Step Index fibers, Graded Index fibers. Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index.

Fiber Material and its Fabrication Techniques.

UNIT-II 9

Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Attenuation Measurements Techniques,

Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, and Intermodal dispersion. Pulse broadening. Overall fiber dispersion in Multi mode and Single mode fibers, Fiber dispersion measurement techniques, Non linear effects. Optical fiber Connectors: Joints, Couplers and Isolators.

UNIT-III 9

Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product.

Laser Diodes- Basic concepts, Classifications, Semiconductor injection Laser Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, resonant frequencies, reliability of LED & ILD

UNIT-IV 9

Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling.

Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors.

Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers

EXPERIMENTS

1. To setting up fiber optic analog link.
2. Study and measurement of losses in optical fiber.
3. Study and measurement of numerical aperture of optical fiber.
4. Study and perform time division multiplexing (digital).
5. Study of framing in time division multiplexing.
6. Study of Manchester coding and decoding.
7. Study of voice coding and codec chip.
8. Study and measure characteristics of fiber optic LED's and photo detector.

Books & References

1. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3e, ,2004.
2. Joseph C. Plais, "Fiber Optic Communication", Pearson Education, 4e, 2004.
3. Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Control Systems" Schaums Outlines Series, 3e, Tata McGraw Hill, Special Indian Edition 2010.
4. I. J. Nagrath& M. Gopal, "Control System Engineering", New Age International Publishers
5. John M. Senior, "Optical Fiber Communications", PEARSON, 3e, 2010.
6. Gerd Keiser, "Optical Fiber Communications", TMH, 4e

BEC-63 DSP ARCHITECTURE & APPLICATIONS

Course category	:	Programme Electives (PE3)
Pre-requisite Subjects	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Comprehends the knowledge & concepts of digital signal processing techniques.
2. Acquire knowledge of DSP computational building blocks and knows how to achieve speed in DSP architecture or processor.
3. Develop basic DSP algorithms using DSP processors.
4. Acquire knowledge about various addressing modes of DSP and are able to program DSP processor.
5. Discuss about interfacing of serial and parallel communication devices.

Topics Covered

UNIT-I 9

Introduction To Digital Signal Processing: Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.

UNIT-II 9

Architectures For Programmable Digital Signal Processors: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing.

UNIT-III 9

Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54xx., Memory Space of TMS32OC54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor.

UNIT-IV 9

Implementation of Basic DSP And FFT Algorithms: Introduction, the Q-notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). Introduction, an FFT Algorithm for DFT Computation, Overflow and Scaling, Bit Reversed Index Generation & Implementation on the TMS32OC54xx.

Applications of DSP Using MATLAB: Mobile communication, medical, image processing, Acoustic Noise Canceller, Dynamic range compression, LPC analysis and synthesis, SSB modulation, Radar tracking implementation

EXPERIMENTS

1. Numbers representation. Fixed Point Representation (Qx, IQ Format).
2. Effect of sampling rate on waveform generation using DSP processor(Using CCS)
3. DFT computation using DSP processor
4. FIR filter design using MATLAB and find finite word length effect
5. FIR filter design using DSP processor
6. IIR filter design using MATLAB and find finite word length effect
7. IIR filter design using DSP processor
8. Analysis of speech signal
9. Application Development using CCS. Examples Signals Acquisition, DTMF tone detection techniques and the Goertzel algorithm, A GMSK Modulator Implementation

Books & References

1. Digital Signal Processing: A practical approach, Ifeachor E. C., Jervis B. W Pearson-Education, PHI,2002
2. "Digital Signal Processors", B Venkataramani and M Bhaskar TMH, 2002
3. "Architectures for Digital Signal Processing", Peter Pirsch John Weily, 2007
4. "Digital Signal Processing", S. K mitra, TMH, 2002
5. Applications to DSP Using Matlab-Proakis
7. "Digital Signal Processing", Avatar Singh and S. Srinivasan, Thomson Learning, 2004

BEC-64 ANTENNA DESIGN

Course category	:	Programme Electives (PE3)
Pre-requisite Subject	:	Electromagnetic Field Theory (BEC-14)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical 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 the radiation mechanism of antenna and also to learn about the basic parameters of antennas.
2. To have insight into the derivation of field quantities of various antennas and there by deducing the other quantities like gain, directivity, impedance etc.

3. To design, development and fabrication of various types antennas and also to explore array concepts.
4. To understand the features of antennas test range (ATR) to perform various measurements on different antennas.
5. To understand the wave propagation over ground and through different layers of atmosphere.

Topics Covered

UNIT-I

Fundamental Concepts: Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions. 9

UNIT-II

Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. 9

Aperture Antennas: Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Fourier transform method in aperture antenna theory

UNIT-III

Horn and Reflector Antennas: Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. 9

Microstrip Antennas: Basic characteristics, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

UNIT-IV

Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkun off polynomial method, Fourier transform method, and Woodward-Lawson method. 9

EXPERIMENTS

1. To verify the inverse square law of propagation: to measure the variation of the strength of radiated wave, with distance from transmitting antenna.
2. Measure parameter of dipole/folded dipole antenna:
   a) To plot the radiation pattern of the dipole antenna in azimuth and elevation planes on log and linear scales on polar and Cartesian plots.
   b) To measure the beam width(-3dB), front–to-back ratio, side lobe level & its angular position, plane of polarization &directivity and gain of the dipole antenna.
3. To demonstrate that the transmitting and receiving radiation patterns of an antenna are equal and hence confirm the reciprocity theorem of antenna.
4. To study the characteristics of Broadside array.
5. To measure various parameters of log periodic antenna using radiation pattern.
6. To measure various parameter of slotted antenna using radiation patterns.
7. To study the frequency dependant and independent antenna.
8. To study the characteristic features of end fire array.
9. To study the characteristic features of microstrip antenna.
10. To measure the phenomenon of linear and circular polarization of antennas.

11. To study an antenna design simulation software.

Books & References

1. Balanis, C.A., "Antenna Theory and Design", 3e., John Wiley & Sons.
2. Jordan, E.C. and Balmain, K.G., "Electromagnetic Waves and Radiating Systems", 2e, Prentice-Hall of India.
3. Stutzman, W.L. and Thiele, H.A., "Antenna Theory and Design", 2e, John Wiley & Sons.
4. Elliot, R.S., "Antenna Theory and Design", Revised edition, Wiley IEEE Press.

BEC-65 DIGITAL IMAGE PROCESSING

Course category	:	Programme Electives (PE4)
Pre-requisite Subjects	:	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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about discrete-time sequences, concept of energy and power, periodicity.
2. Acquired knowledge DFT and FFT.
3. Ability to design linear digital filters both FIR and IIR using different techniques and their associated structures.
4. Ability to understand the concept of linear prediction and estimation.
5. Ability to understand the concept of Multi-rate signal processing and sample rate conversion.
6. Acquired knowledge about time-frequency analysis.

Topics Covered

UNIT-I 9

Introduction

Fundamental steps in DIP, elements of DIP, Simple image model, sampling & quantization, basic relationships between pixels, colour image model. Image Transforms: One-dimensional & two-dimensional DFT, cosine, sine, Hadamard, Haar, and Slant & KL transforms. Image Enhancement: Introduction, point operations, histogram modelling, spatial operations, Transform operations.

UNIT-II 9

Image Restoration

Introduction, image observation models, Inverse & Wiener filtering, difference between

enhancement & restoration Restoration-spatial filtering, Noise reduction in frequency domain.

UNIT-III 9

Image Compression

Introduction, Pixel coding, Predictive coding, Transform coding, Inter-frame coding

UNIT-IV 9

Image Segmentation

Introduction, Spatial feature extraction, Transforms features, Edge detection, Boundary extraction, Segmentation techniques.

Books & References

1. Rafael C. Gonzalez Richard E Woods, "Digital Image Processing", Pearson, 3e, 2009.
2. Anil K Jain, "Fundamentals of Digital Image Processing", PHI.

BEC-66 ATM NETWORKS AND B-ISDN

Course category	:	Programme Electives (PE4)
Pre-requisite Subject	:	Data Communication Networks (BEC-33)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the basics of network protocols, access control, data link control, ATM, TCP/IP.
2. Understand the tradeoffs involved in network design in a variety of environments- LAN and WAN, diverse link rates, and varied error and delay conditions.
3. Understand the layered structure of protocols.
4. Understand the importance of standards.
5. Understand various concepts of broadband networks and subsequently conduct research in this field.

Topics Covered

UNIT-I 9

ATM

ATM standards, Terms and Concepts, B-ISDN Protocol Architecture, Physical Layer, ATM Layer, AAL, ATM services, ATM switches.

UNIT-II 9

Overview of ISDN

ISDN Channels, Access interface, functional devices and reference, services, Protocol structure, D-Channel Layer 3 Protocols, Numbering and addressing, ISDN Products.

UNIT-III 9

Broadband networks & Frame relay

Broadband networks: Need, Fast packet switching, Frame relay, Cell relay & ATM, FDDI, SMDS. Frame Relay: Basic Definition, Protocol Architecture, Permanent and switched VC, Frame relay standards, Multicast services.

UNIT-IV 9

SMDS Overview

SMDS Interface & Services.

ISDN, B-ISDN and Internet Protocols.

Books & References

1. Kessler & Southeick: "ISDN" – McGraw Hill, 3e, 1996.
2. William Stallings: "ISDN" – Pearson Education

BEC-67 RF ICs

Course category	:	Programme Electives (PE4)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Possess a basic knowledge of RF circuitry used in telecommunication integrated circuits.
2. Understand the concepts of high frequency transmission lines and impedance matching.
3. Understand the methodology of using analog and digital modulation of an RF carrier.
4. Understand the basic super hetrodyne architecture utilized in RFIC applications.
6. Understand basic RF characterization utilizing gain, bandwidth, noise, phase noise, S-parameters.
7. Design and simulate basic RF circuits at the schematic level, using Cadence Spectre/RF CAD tools.
8. Design basic RF circuits at the chip level including layout and simulation with extracted models

Topics Covered

UNIT-I 9

Introduction To RF And Wireless Technology: Complexity comparison, Design bottle necks, Applications, Analog and digital systems, Choice of Technology. BASIC CONCEPTS IN RF DESIGN: Nonlinearity and time variance, ISI, Random process and noise, sensitivity and dynamic range, passive impedance transformation.

UNIT-II 9

Multiple Access: Techniques and wireless standards, mobile RF communication, FDMA, TDMA, CDMA, Wireless standards. TRANSCEIVER ARCHITECTURES: General considerations, receiver architecture, Transmitter Architecture, transceiver performance tests, case studies.

UNIT-III 9

Amplifiers, Mixers and Oscillators: LNAs, down conversion mixers, Cascaded Stages, oscillators, Frequency synthesizers.

UNIT-IV 9

Power Amplifiers: General considerations, linear and nonlinear Pas, classification, High Frequency power amplifier, large signal impedance matching, linearization techniques.

Books & References

1. Behzad Razavi, RF Microelectronics Prentice Hall of India, 2001.
2. Thomas H. Lee, The Design of CMOS Radio Integrated Circuits, Cambridge University Press.

BEC-68 NEURAL NETWORKS

Course category	:	Programme Electives (PE4)
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 Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The role of neural networks in engineering, artificial intelligence, and cognitive modelling.
2. Feed-forward neural networks of increasing complexity, gradient descent learning and extensions, learning and generalization theory.
3. Hopfield model of content-addressable memory, Hopfield-Tank approach to optimisation, resistive networks for vision models, complex dynamical learning models.

4. Ability to evaluate whether neural networks are appropriate to a particular application.
5. Ability to apply neural networks to particular applications, and to know what steps to take to improve performance.

Topics Covered

UNIT-I

Introduction 9

Introduction and history, human brain, biological neuron, models of neuron, signal flow graph of neuron, feedback, network architecture, knowledge representation, Artificial intelligence and neural networks. Learning Process: Error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, learning with and without teacher, learning tasks, memory and adaptation.

UNIT-II

Artificial neurons, Neural networks and architectures Introduction, neuron signal function, mathematical preliminaries, Feed forward & feedback architecture. Geometry of Binary threshold neurons and their networks Pattern recognition, convex sets and convex hulls, space of Boolean functions, binary neurons for pattern classification, non linear separable problems, capacity of TLN, XOR solution. 9

UNIT-III

Perceptrons and LMS Learning objective of TLN, pattern space & weight space, perceptron learning algorithm, perceptron convergence theorem, pocket algorithm, α – LMS learning, MSE error surface, steepest descent search, μ – LMS and application. Back propagation and other learning algorithms Multilayered architecture, back propagation learning algorithm, practical considerations, structure growing algorithms, applications of feed forward neural networks, reinforcement learning 9

UNIT-IV

Statistical Pattern Recognition Bayes' theorem, classical decisions with Bayes' theorem, probabilistic interpretation of neuron function, interpreting neuron signals as probabilities, multilayered networks & posterior probabilities, error functions for classification problems. RBF Networks Regularization networks, generalized RBF networks, RBF network for solving XOR problem, comparison of RBF networks & multilayer perceptrons. Stochastic Machines Statistical mechanics, simulated annealing, Boltzmann machine. Introduction, Maximal eigenvector filtering, principal component analysis, generalized learning laws, competitive learning, vector quantization, Mexican hat networks. 9

Books & References

1. Kumar Satish, "Neural Networks", TMH
2. Simon Haykin, "Neural Networks", PHI
3. J. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishers, 3e.