MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV, Bhopal)

DEPARTMENT

OF

ELECTRONICS ENGINEERING

BOARD OF STUDIES

CBCS CURRICULUM

SCHEME AND SYLLABUS

FOR

B.E. ELECTRONICS ENGINEERING

2018

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV, Bhopal)

DEPARTMENT OF ELECTRONICS

Minutes of BOS Meeting

Date: 09/04/2018

The BOS Meeting was held on 9th April, 2018 in the Department. The following points were discussed and resolved:-

1. Flexible scheme has been discussed as per the guideline.
2. As compare to old scheme few subjects are revised by considering the learning capacity of students.
3. Electronics Measurement and Instrumentation has been interchanged with signal & system.
4. The syllabus for the subjects has been modified as per GATE Curriculum. Percentage change for the subjects are as follows:

S. No	Semester	Subject Name	Percentage change in syllabus
1	3	Electronics-I	30 %
2		Digital Circuit System	20 %
3		Network Theory	5 %
4		Signal & System	40 %
5	4	Electronics-II	40 %
6		Analog Communication	30 %
7		Communication Network	50 %
8		Electronics measurement & Instrumentation	30 %

5. List of electives and open electives have been finalized.
6. NPTEL and MOOC courses have been introduced to improve self-learning capability of the students.
7. Syllabus of subjects till second year have been discussed and finalized.
8. As far as old scheme is concern subjects and their codes have been discussed and finalized.
9. Lab CO's and list of experiments have been revised as per the guideline.
10. CO's for all the courses (old and new scheme) have been discussed and finalized.
11. Rubrics for project, seminar, hardware and software Lab have been discussed and finalized.
12. Inputs from all the OBE student coordinators were taken and considered for Flexible scheme

External Members: - Due to some reason External members were unable to attend the meeting.
Student OBE Coordinators: - All OBE student coordinators were also present.

Prof. Deep K. Parsediya | Prof. Madhav Singh | Dr. Karuna Markam

Dr. R. P. Narwaria | Dr. Laxmi Shrivastava | Dr. Vandana V. Thakare

Dr. Rekha Gupta | Dr. Bimal Garg | Dr. P. K. Singhal

Dr. P. K. Singhal.
Professor & Head,
Dept. of Electronics Engg., MITS

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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B.E. III Semester (ELECTRONICS) GROUP B ***For batches admitted in July, 15 & July, 16 (to be implemented in July, 2017***

Subject wise distribution of marks and corresponding credits

S.NO.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End Sem.	Mid Sem. Test	Quiz/ Assignment	End Sem.	Term work / Lab Work & Sessional		L	T	P	
1.	BELL301	Material Science	70	20	10	-	-	100	3	1	-	4
2.	BELL302	Electronics I	70	20	10	30	20	150	2	1	2	4
3.	BELL303	Digital Circuits and systems	70	20	10	30	20	150	2	1	2	4
4.	BELL304	Network theory	70	20	10	30	20	150	2	1	2	4
5.	BELL305	Electronics measurement and instrumentation	70	20	10	-	-	100	3	1	-	4
6.	BELP306	Computer Lab	-	-	-	30	20	50	-	-	4	2
7.	BELS307	Idea Generation	-	-	-	-	50-	50	-	-	4	2
8.	BELS308	Communication Skills	-	-	-	-	50	50	-	-	4	2
9.		NSS/NCC	-	-	-	-	- -	-	-	-	-	Qualifier
Total			350	100	50	120	180	800	12	5	18	26

GROUP A: (Civil, Mechanical, Computer Science, Information Technology, Biotech)
GROUP B: (Electrical, Electronics, Chemical, Automobile, Electronics & Telecommunication)

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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B.E. III Semester (ELECTRONICS) **GROUP B** ***For batches admitted in July, 15 & July, 16 (to be implemented in July, 2017***

Subject wise distribution of marks and corresponding credits

S.NO.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End Sem.	Mid Sem. Test	Quiz/ Assignment	End Sem.	Term work		L	T	P	
							Lab Work & Sessional					
1.	BELL301	Material Science	70	20	10	-	-	100	3	1	-	4
2.	BELL302	Electronics I	70	20	10	30	20	150	2	1	2	4
3.	BELL303	Digital Circuits and systems	70	20	10	30	20	150	2	1	2	4
4.	BELL304	Network theory	70	20	10	30	20	150	2	1	2	4
5.	BELL305	Electronics measurement and instrumentation	70	20	10	-	-	100	3	1	-	4
6.	BELP306	Computer Lab	-	-	-	30	20	50	-	-	4	2
7.	BELS307	Idea Generation	-	-	-	-	50-	50	-	-	4	2
8.	BELS308	Communication Skills	-	-	-	-	50	50	-	-	4	2
9.		NSS/NCC	-	-	-	-	- -	-	-	-	-	Qualifier
Total			350	100	50	120	180	800	12	5	18	26

GROUP A: (Civil, Mechanical, Computer Science, Information Technology, Biotech)
GROUP B: (Electrical, Electronics, Chemical, Automobile, Electronics & Telecommunication)

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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B.E. IV Semester (ELECTRONICS) GROUP B ***For batches admitted in July, 15 & July, 16 (to be implemented in July, 2017***

Subject wise distribution of marks and corresponding credits

S.No.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End Sem.	Mid Sem. Test	Quiz/ Assignment	End Sem.	Term work / Lab Work & Sessional		L	T	P	
1.	BELL401	Mathematics-III	70	20	10	-	-	100	3	1	-	4
2.	BELL402	Electronics II	70	20	10	30	20	150	2	1	2	4
3.	BELL403	Analog communication	70	20	10	30	20	150	2	1	2	4
4.	BELL404	Network Synthesis and Filter Design	70	20	10	30	20	150	2	1	2	4
5.	BELL405	Signal and systems	70	20	10	-	-	100	3	1	-	4
6.	BELP406	Simulation Lab		-	-	30	20	50	-	-	4	2
7.	BELS407	Seminar/ Presentation/ GD		-	-	-	50	50	-	-	4	2
8.	BELS408	Integrated Ethics and Attitude		-	-	-	50	50	-	-	4	2
9.		NSS/NCC	-	-	-	-	-	-	-	-	-	Qualifier
Total			350	100	50	120	180	800	12	5	18	26

GROUP A: (Civil, Mechanical, Computer Science, Information Technology, Biotech)
GROUP B: (Electrical, Electronics, Chemical, Automobile, Electronics & Telecommunication)

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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B.E. V Semester (Electronics) (GROUP A)
For batches admitted in July, 15 & July, 16 (to be implemented in July, 2017

Subject wise distribution of marks and corresponding credits

S.No.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End sem	Mid Sem	Quiz/	End Sem	Lab work & Sessional		L	T	P	
1.	BELL501	Principles of Management & Economics	70	20	10	-	-	100	3	1	-	4
2.	BELL502	Microprocessors & Interfacing	70	20	10	30	20	150	3	1	2	5
3.	*	Elective -1	70	20	10	-	-	100	3	1	-	4
4.	BELL504	Linear Control Theory	70	20	10	30	20	150	3	1	2	5
5.	BELL505	Digital Communication	70	20	10	30	20	150	3	1	2	5
6.	BELP506	Electronics Workshop	-	-	-	30	20	50	-	-	2	1
7.	BELS507	Self Study (Internal Assessment)	-	-	-	-	50	50	-	-	2	1
8.	BELS508	Seminar & Group Discussion (Internal Assessment)	-	-	-	-	50	50	-	-	2	1
		Total	350	100	50	120	180	800	15	5	12	26

GROUP A: (Electrical, Electronics, Computer Science, Information Technology, Electronics & Telecommunication)

GROUP B: (Civil, Mechanical, Chemical, Biotech, Automobile)

01 Theory period:01 Credit; 02 Practical Periods: 01 Credit

***Elective-I**: BELL503 Electromagnetic Fields BELL509 Optimization techniques BELL510 Renewable energy resources BELL511 Mechatronics

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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B.E. VI Semester (Electronics) (GROUP A)

For batches admitted in July, 15 & July, 16 (to be implemented in July, 2017

Subject wise distribution of marks and corresponding credits

S.No.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End sem	Mid Sem	Quiz/	End Sem	Lab work & Sessional		L	T	P	
1.	BELL601	Antenna & Wave Propagation	70	20	10	-	-	100	3	1	-	4
2.	BELL602	Digital Signal Processing	70	20	10	30	20	150	3	1	2	5
3.	BELL603	Data Communication	70	20	10	30	20	150	3	1	2	5
4.	*	Elective-II	70	20	10	-	-	100	3	1	-	4
5.	BELL605	Industrial Electronics	70	20	10	30	20	150	3	1	2	5
6.	BELP606	Minor Project – I	-	-	-	30	20	50	-	-	2	1
7.	BELS607	Self Study (Internal Assessment)	-	-	-	-	50	50	-	-	2	1
8.	BELS608	Seminar & Group Discussion (Internal Assessment)	-	-	-	-	50	50	-	-	2	1
		Total	350	100	50	120	180	800	15	5	12	26

01 Theory period:01 Credit; 02 Practical Periods: 01 Credit

*Elective-II: BELL604 Electronic System Design BELL609 Data Structure BELL610 Integrated circuits
BELL611 Microcontroller and Embedded Systems

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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B.E. VII Semester
Electronics Engineering

Subject wise distribution of marks and corresponding credits

S.No.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot			L	T	P	
			End sem	Mid Sem	Quiz/	End Sem	Lab work & Sessional					
1.	BELL701	Advanced Control System	70	20	10	30	20	150	3	1	2	5
2.	BELL702	Microwave Engg.	70	20	10	30	20	150	3	1	2	5
3.	BELL703	Cellular & Mobile Communication	70	20	10	-	-	100	3	1	-	4
4.	BELL704	VLSI Design	70	20	10	-	-	100	3	1	-	4
5.	*	Elective – III	70	20	10	-	-	100	3	1	-	4
6.	BELP706	Major Project – I	-	-	-	60	60	100	-	-	4	2
7.	BELS707	Industrial Training/ Self Study	-	-	-	-	50	50	-	-	2	1
8.	BELS708	Seminar/Group Discussion	-	-	-	-	50	50	-	-	2	1
		Total	350	100	50	120	180	800	15	5	12	26

* Elective-III: BELL 705 ATM Networks BELL709 Selected topics in communication
BELL 710 CMOS Technology BELL 711 Data Mining and Warehousing

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B.E. VIII Semester

Electronics Engineering

Subject wise distribution of marks and corresponding credits

S.No.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End sem	Mid Sem	Quiz/	End Sem	Lab work & Sessional		L	T	P	
1.	BELL801	Fiber Optics and Optical Communication	70	20	10	30	20	150	3	1	2	**6**
2.	BELL802	Satellite communication	70	20	10	30	20	150	3	1	2	**6**
3.	BELL803	TV and Radar Engg	70	20	10	30	20	150	3	1	2	**6**
4.	*	Elective – IV	70	20	10	-	-	100	3	1	-	**4**
5.	BELL805	Major Project – II				100	50	150	-	-	8	**8**
6.	BELP806	Self Study	-	-	-	-	50	50	-	-	2	**2**
7.	BELS807	Seminar/Group Discussion	-	-	-	-	50	50	-	-	2	**2**
		Total	**280**	**80**	**40**	**190**	**210**	**800**	**12**	**4**	**18**	**34**

Minimum Passing Marks: (A) Theory (End Sem) 35% (B) Theory Block Aggregate 35% (C) Duration of Theory Paper (End Sem) 3hrs
Practical (End Sem) 50% Practical Block Aggregate 50%

Elective-IV **BELL804** Neural Network and Fuzzy Systems **BELL808** Image Processing and Pattern Recognition
BELL809 Nanotechnology **BELL810** Biomedical Instrumentation

MADHAV INSTITUTE OF TECHNOLOGY AND SCIENCE, GWALIOR

DEPARTMENT OF APPLIED SCIENCE

SYLLABUS OF MATERAILS SCIENCE AND ENGINEERING FOR BE 2ND YEAR

BELL 301 (ELECTRONICS)

L	T	P
3	1	0

Unit-1 Introduction to Material Science Introduction : Importance of materials. historical perspective, Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bondings.

Unit-2 Crystal Physics Crystallography and Imperfections : Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques. Imperfections, Defects & Dislocations in solids.

Unit-3 Electric and Magnetic properties of Materials Dielectric Materials: Dielectric Materials and their applications, Magnetic properties: Concept of magnetism - Dia, para, ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages.

Unit-4: Optical properties of engineering materials & application of Integrated optical devices Survey of optical materials design for semiconductors, and device design principles of LEDs, lasers, photodetectors, modulators, fiber and waveguide inter-connects, optical filters, and photonic crystals. crystal growth, substrate engineering, thin film deposition, etching and process integration for dielectric, silicon and compound semiconductor materials.

Unit-5: Superconductors Electric properties, Semi conductors and Super conductors: Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. P-n junction and transistors. Basic devices and its application. Super conductivity and its applications. Messier effect. Type I & II superconductors. High Tc superconductors.

Books and References:

1. Elements of Material Science & Engineering by Van Vlack, Pearson

2. Materials Science and Engineering - A First Course by Raghavan, PHI

3. Material Science and Engineering by Smith, Hashemi and Prakash,

4. Material Science for Engineering Students by Fischer, Academic Press

MATERIAL SCIENCE AND ENGINEERING

(BELL 301/BETL 301)

Course Outcomes: Upon successful completion of this course, students will be able to

CO1. **Describe** historical perspective, importance of material science, various atomic model with periodic table and classify types of chemical bonding

CO2. **Outline** the various crystal types with types of cubic crystals, crystallographic techniques and imperfections

CO3. **Estimate** miller indices and atomic packing fraction.

CO4. **Explain** various dielectric and magnetic material their properties and classifications

CO5. **Summarize** optical properties of engineering material and applications of integrated optical devices.

CO6. **Elaborate** various concepts related to super conductor and semiconductors and their properties and classifications

L	T	P
2	1	2

ELECTRONICS – I
(BELL/BETL - 302)

Course objective: To understand different semiconductor devices and circuits and inculcate the capability to design and construct circuits, take measurements of circuit parameters.

Unit I

Clippers and Clampers, Power supply parameters, SMPS, Zener voltage regulator, transistor series pass regulator (with feedback) and shunt voltage regulators, Short circuit protection.

Unit II

Transistors, characteristics of bipolar junction transistors(BJT)– CB, CE, CC configurations ,Low frequency transistor amplifiers, Equivalent circuit of BJT using h parameter for CB, CE, CC configuration, calculation of transistor parameter for CB, CE, CC using h parameters,

Unit-III

Transistor Amplifier: comparison of transistor amplifier configuration (gain, input impedance, output impedance, current gain, voltage gain) cascading of BJT amplifier. Transistor biasing and bias stabilization, the operating point, stability factor ,analysis of fixed base bias , collector to base bias , Emitter resistance bias circuit, Bias compensation techniques.

Unit IV

Field effect transistors, construction and characteristics of JFET, JFET biasing circuit MOSFET construction and characteristics, small signal model. MOSFET enhancement and depletion mode, Common source amplifier. Application of FET as a voltage variable resistor (VVR).

Unit V

Multistage Amplifiers: classification of amplifiers, distortion in amplifiers, frequency response of an amplifier, step response of an amplifier, the RC coupled amplifier, low frequency response of an RC coupled stages, effect of an emitter bypass capacitor on low frequency response.

Reference Books:

1. Micro Electronics – Miliman Grabel, McGraw-Hill
2. Microelectronic Circuits – Adel S. Sedra & Kenneth C Smith, Oxford University Press
3. Electronics Devices and Circuits – Boylested Nashelsky, Prentice Hall
4. Integrated Electronics- Millman Halkias, McGraw Hill Education

Course Outcomes

After the completion of this course students will be able to:

1. Design power supplies and DC regulator circuit using Zener diode.
2. Analyse basic circuits like biasing circuits, small-signal ac circuits with emphasis on single-stage amplifier.
3. Design amplifier using field effect transistors and applied application as a VVR.
4. Conduct experiments involving electronic devices and circuits.
5. Analyze feedback concept in amplification and analyze different feedback circuits.
6. Explain the basic principle, operation, Characteristics and applications of analog devices like Zener diode, Tunnel diodes, BJT and FET.

Electronics-I
(BELL/BETL - 302)

List of Experiments

1. To study the half wave Rectifier
2. To study the Full wave Rectifier
3. To study the clipper and clamper circuits.
4. To study V-I characteristics of Zener diode.
5. To study the characteristics of Bipolar Junction Transistor.
6. To study CB, CE and CC Configuration of Bipolar Junction Transistor.
7. To study the characteristics of Junction Field Effect Transistor.
8. To study the characteristics of Enhancement mode MOSFET.
9. To study the characteristics of Depletion mode MOSFET.
10. To study the RC coupled amplifier.

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

CO1. **Implement** the basic rectifier, clipper and clamper circuits.

CO2. **Design** the transistors and amplifiers circuits.

CO3. **Troubleshoot** the already fabricated circuit individually or in a team.

CO4. **Design** simple electronics circuits using amplifier and oscillator circuit

CO5. **Develop** the ability of working in team/group and learn professional ethics.

CO6. **Handle** the basic instruments such as Multimeter, function generator and CRO properly.

L	T	P
2	1	2

Digital Circuits and Systems
(BELL/BETL - 303)

Course objective : To understand the concept of digital systems and design and analyze combinational and sequential logic circuits.

Unit I-

Digital systems and Number system: Introduction to Digital system, number system & their conversion, Compliments of numbers, Binary codes.

Boolean algebra and switching functions: minimization of Boolean functions, Canonical & standard form, concept of prime implicant etc. Karnaugh's map method, Quine& Mc Cluskey's method, Introduction to logic gates NAND/NOR realization of switching functions.

Unit II-Combinational Logic circuits: half adder, half subtractor, full adder, full subtratctor circuits. Series and parallel adder and BCD adders, look-ahead carry generator, Decoders, Encoders, multiplexers & demultiplexers.

Unit III-Sequential Circuits: Different type of flip-flops such as R-S, J-K, D, T Master slave J-K, edge triggered flip-flops. Applications of these flip-flops in shift registers, various types of counters.

Unit IV- Logic Families: RTL, DTL, all types of TTL circuits, ECL, HTL and PMOS, NMOS & CMOS logic etc. Comparison of various logic families

Unit V- Introduction to converters: Various types of analog to digital & digital to analog converters sample & hold circuits ,Finite state machine, Moore and Mealey machines., Introduction to various semiconductor memories & designing with ROM and PLA.

Reference Books:

1. Digital Electronics- W.H. Gothman- PHI
2. Digital System principles & Applications- R.J. Tocci, Pearson
3. Pulse, Digital & Switching Waveforms- Millman &Taub- Mc Graw Hill
4. Digital Design- M. Mano, Prentice Hall
5. Logic & Computer Design- M.Mano- PHE
6. Digital Circuits and design- S. Salivahanan, Vikas *Publishing* House

Course Outcomes

After the completion of this course students will be able to:

CO1. **Identify** different logic gates, their realizations and truth tables.
CO2. **Prove** properties of Boolean algebra.
CO3. **Design** various synchronous and asynchronous sequential circuits.
CO4. **Discriminate** between combinational and sequential circuits.
CO5. **Describe** the operation of different types of semiconductor memories.
CO6. **Compare** the Logic families and converters.

Digital Circuits and Systems
(BELL/BETL - 303)

List of Experiment

1. To study basic Logic Gates- NAND, AND, NOR, NOT, OR, EX-OR, EX-NOR.
2. To construct the basic Gates using universal Gates.
3. To study and verify the truth table of Half Adder and Full Adder.
4. To study and verify the truth table of Half Subtractor and Full Subtractor.
5. To study and verify Demorgan's Theorem.
6. To study D latch flip flop.
7. To study R. S. flip flop.
8. To study J. K. flip flop.
9. To study parity generator/ checker circuit.
10. To study Analog to Digital and Digital to Analog converters.

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

CO1: Verify the operation of basic logic gates and DE Morgan's theorem using standard combinational logic.
CO2: Construct the basic gates by using universal gates.
CO3: Develop half adder and full adder circuits using their truth table.
CO4: Develop the D, RS and JK flip-flops and verify their operation.
CO5: Develop the ability of working in team/group and learn professional ethics.
CO6: Handle the basic instruments such as Multimeter, function generator and CRO properly.

L	T	P
2	1	2

Network Theory
(BELL/BETL - 304)

Course objective: To analyze phasor diagrams of three phase circuits, DC and AC transients, to impart knowledge on graph theory of networks, design and analyze two port networks.

Unit-I Introduction to Circuit Elements, Characterization of Resistors, Capacitors & Inductors in Terms of their linearity & time dependence features, Characteristics of Independent & Dependent Sources, KCL & KVL for circuits with dependent & independent sources, Dot convention for coupled inductor and their characteristics, co-efficient of coupling.

Unit-II Network theorems - superposition, Thevenin, Norton, Milliman, reciprocity and maximum power transfer theorems, problem with controlled sources, Network topology, concept of network graph, Tree, Tree branch and link, Incident matrix, cut set and tie set matrices.

Unit-III Transient analysis, Transients in RL, RC and RLC circuits, initial conditions, time constants, Steady state analysis – concept of phasor and vector, impedance and admittance. Node and mesh analysis of RL, RC and RLC networks with sinusoidal and driving sources.

Unit-IV Transform Domain Analysis of Networks: The Laplace transform, use of Laplace transform for the solution of integro differential equation. Initial and final value theorem. Transforms of wave forms synthesized with step, Ramp gate and sinusoidal functions.

Unit-V The concept of complex frequency, Concept of Ports, Network functions of one port & two ports, Calculation of network functions for one port and two port, Pole & zeros of network of different kinds. Two port parameters – Z, Y, hybrid and chain Parameters. Relationship between Parameters.

Reference Book:-

1. Network Synthesis – M.E. Van Valkenberg, , Prentice Hall of India
2. Network Analysis – M.E. Van Valkenberg (PHI)
3. Network systems – D. Roy Chaudhary, New Academic Science Ltd

Course Outcomes

After the completion of this course students will be able to:

CO1. Differentiate between passive and active elements.
CO2. Discriminate between voltage dependent and current dependent sources.
CO3. Analyze the complicated network using theorems.
CO4. Compute the initial and final condition of RLC circuits.
CO5. Analyze the networks through transformation (Laplace transform).
CO6. Compute impedance, admittance and gain of the two port networks.

Network Theory

(BELL/BETL - 304)

List of Experiment

1. To study and verify the Kirchoff's Current Low (KCL).
2. To study and verify the Kirchoff's Voltage Low (KVL).
3. To study and verify the Superposition Theorem.
4. To study and verify the Thevenin Theorem.
5. To study and verify the Norton's Theorem.
6. To study and verify the Milliman's Theorem.
7. To study and verify the Reciprocity Theorem.
8. To study and verify the Maximum Power Transfer Theorem.
9. To study and verify the condition for Series RLC circuit.
10. To study and verify the condition for Parallel RLC circuit.

Course Outcome:

On completion of this Lab the student will be able to:

CO1. Evaluate the performance of different network theorems.
CO2. Develop the equivalent circuit for different network theorems.
CO3. Perform maximum power transfer to a load for series and parallel resonant circuit.
CO4. Illustrate the two port network parameters.
CO5. Demonstrate steady state response and transient response.

L	T	P
3	1	-

Electronics Measurement and Instrumentation
(BELL/BETL - 305)

Course objective : To introduce students the use of various electrical/electronic instruments, their construction, applications, principles of operation, standards and units of measurements and provide students with opportunities to develop basic skills in the design of electronic equipments.

UNIT– I

A.C. Bridges: Measurement of self inductance, measurement of incremental inductance, Measurement of capacitance, measurement of mutual inductance using different types of bridges.

UNIT – II

Transducers: Classification of transducers, Strain gauge, thermistor, thermocouple, LVDT, Synchros, Capacitive transducers, Piezoelectric transducers

UNIT–III

Signal generation: Sine wave generation, frequency synthesized signal generator, frequency divider generator, signal generator modulation, sweep frequency generator, pulse and square wave generators, Function generator, Audio frequency signal generation.

UNIT-IV

Digital Instruments: Digital volt meters.-Ramp techniques, dual slope, integrating type, resolution and sensitivity of digital meters, digital multi-meters, digital frequency meter, universal counter.

UNIT-V

CRO : Introduction to CRO, dual beam CRO, dual trace CRO, measurement of frequencies by Lissajous method, measurement of capacitance and inductance, digital storage oscilloscope.

Reference Books:

1. Electronic Instrumentation and measurement techniques- By W.D. Cooper and A.D. Helfrick, Prentice Hall
2. Electronics Instrumentation – By H.S. Kalsi, Tata McGraw-Hill
3. Electrical & Electronics Measurement and Instrumentation – By A.K. Sawhney, Dhanpat Rai & Co

Course Outcomes

After the completion of this course students will be able to:

- **CO1.** Classify different types of bridges.
- **CO2.** Calculate mutual inductance for different types of bridges.
- **CO3.** Analyze the operation of transducers.
- **CO4.** Differentiate different transducer.
- **CO5.** Explain various signal generators.
- **CO6.** Analyze the operation of CRO, digital multi-meters.

List of Practical

BELS/BETS306 CP-III (Visual Basics)

1. Write a program to perform addition, Subtraction, Multiplication and Division of two numbers.
2. Write a program to design a Login Form.
3. Write a program to print the series of odd or even numbers using input by user.
4. Write a program to determine length of a number.
5. Write a program to length of a word.
6. Write a program to design a registration Form.
7. Write a program to change the back color of form.
8. Write a program to operate Traffic Signal Light.
9. Write a program to calculate the Factorial, Square and Cube of a Number.
10. Write a program to design a Restaurant Bill.

Course Outcomes:

At the end of this lab, learner will be able to:

- **CO1.** **Explain** Computer Programming concepts.
- **CO2.** **Write** programs with Interactive Input and Output.
- **CO3.** **Explain** the concept of fundamentals of Computer, high level language, compiler and assembler and operating systems.
- **CO4.** **Classify** various identifiers and keywords, data type & sizes, variable names, declaration, statements.
- **CO5.** **Draw** a Flow of Control and program Structures.
- **CO6.** **Design** programs utilizing decision making.
- **CO7.** **Illustrate** Software Engineering principles.
- **CO8.** **Compile** the program and fix the error.

L	T	P
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Electronics –II
(BELL/BETL - 402)

Course objective: Students will be able to learn Multistage amplifiers, Negative feedback: advantages, Tuned amplifiers and analysis of Oscillators.

Unit I

Oscillators: Barkhausen criterion, Sinusoidal oscillators, L-C (Hartley-Colpitts) oscillators, RC phase shift, resonant oscillator, Wien Bridge and crystal oscillators, Clapp oscillator.

Unit II

Tuned amplifier, general behavior of tuned amplifier, Single tuned and doubled tuned amplifier, Advantages and disadvantages of tuned amplifiers, Q factor of a circuit and coil, series and parallel resonant circuit, variation of impedance with frequency, Bandwidth of series and parallel resonant circuit.

Unit III

Power Amplifiers: Introduction, Amplifier Types, Analysis and design of Class A, Class B, Class AB, class C amplifiers, Amplifier Distortion, Power Transistor Heat Sinking, Class C, harmonic distortion, push pull amplifiers,

Unit IV

Multivibrators: Monostable, Astable, Bistable (transistorized), 555 timer and its applications.

Unit V

Introduction of Operational Amplifier: Introduction, characteristics of Ideal OP-Amp, operational amplifier stages, equivalent circuit of OP-Amp, Transfer characteristics of OP-Amp, Inverting and Non inverting OP-Amp, OP-Amp parameters

Reference Books:

1. Electronics Devices and Circuits – Boylested Nashelsky, Prentice Hall
2. Integrated Electronics- Millman Halkias, McGraw Hill Education
3. Micro Electronics – Miliman Grabel, McGraw-Hill
4. Microelectronic Circuits – Adel S. Sedra & Kenneth C Smith, Oxford University Press
5. Electronics Devices and Circuits – Sanjeev Gupta, Dhanpat Rai Publications

Course Outcomes

After the completion of this course students will be able to:

CO1. Classify and distinguish different types of oscillators.
CO2. Sketch the operation and characteristics of tuned amplifier.
CO3. Analyze different types of power amplifier like Class A, Class B, Class AB and Class C.
CO4. Design of Multivibrators using BJT.
CO5. Reconstruct and analyzed Multivibrators using 555 timers.
CO6. Apply the application of Operation Amplifier as adder, subtractor, logarithm, exponential etc.

Electronics-II
(BELL/BETL - 402)

List of Experiments

1. To study of IC 555 and its application.
2. To study Hartley Oscillator.
3. To study Wien Bridge Oscillator.
4. To study Clapp Oscillator.
5. To study Colpitt Oscillator.
6. To study Crystal Oscillator.
7. To study Transistor Switching Characteristics.
8. To study IC 741 OP-AMP for Inverting and non-inverting mode.
9. To study IC 741 OP-AMP as summer, subtractor, integrator and differentiator.
10. To study IC 741 OP-AMP as current and voltage follower.

Course Outcomes:

At the end of this lab, students will be able to:

CO1: Implementation of various application using Op-Amp.
CO2: Troubleshoot the already fabricated circuit individually or in a team.
CO3: Design simple electronics circuits using amplifier and oscillator circuit
CO4: Develop the ability of working in team/group and learn professional ethics.
CO5: Handle the basic instruments such as Multimeter, function generator and CRO properly.

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Analog Communication
(BELL/BETL - 403)

Course objective: Review of Fourier theory, linear system theory, probability and random processes, Modulation and detection and Noise in modulation systems.

Unit I

Fourier series and Fourier transforms: Single side and double side spectral representation, Normalized power Parsevals theorem, convolution, Auto-correlation and cross-correlation.

Unit II

Amplitude modulation, need of modulation, single side band and double side band suppressed carrier and vestigial side band, modulation techniques their generation and detection, square law modulators, switching modulator, envelope and square law detector, balanced modulator.

Unit III

Angle Modulation, Relationship between Frequency and phase modulation, frequency and phase deviation, Carson's rule, spectrum of F.M. signal, Constant bandwidth of F.M. ,comparison of narrow band F.M. and A.M., generation of F.M. signal.

Unit IV

Probability, random variables, cumulative distribution function, Probability density function, average and variance of random variables, Gaussian and Rayleigh probability density function, Error function and complementary error functions.

Unit V

Various sources of noise, Mathematical representation of noise figure, Noise bandwidth, Noise temperature and noise figure of amplifiers in cascades. Figure of merit of modulation techniques, comparison of modulation scheme on the basis of noise.

Reference Books:

1. Communication System – Kennedy, Tata McGraw-Hill
2. Principles of communication Engg.- Haykins, Tata McGraw-Hill
3. Communication Systems - B.P.Lathi, Oxford Univ
4. Modern Digital & Analog Communication System – B.P. Lathi , Oxford:
5. Principles of communication- Taub and Schilling, McGraw-Hill Education

Course Outcomes

After the completion of this course students will be able to:

CO1. Calculate the Fourier series for periodic non-sinusoidal signals.

CO2. Analyse the periodic and aperiodic non-sinusoidal signals using Fourier Transform.

CO3. Explain the need of modulation.

CO4. Describe amplitude, frequency and phase modulation.

CO5. Classify the noise and its effect on different modulation techniques.

CO6. Describe the random variables and various distribution functions.

Analog Communication
(BELL/BETL - 403)

List of Experiments

1. Study and analysis of Balance modulator.
2. Analysis of Amplitude Modulation and calculation for modulation index.
3. Study and analysis of Amplitude Demodulation.
4. Study and analysis of Frequency Modulation and calculation for modulation index.
5. Study and analysis of Frequency Demodulation.
6. Study of time division multiplexing.
7. Study of frequency division multiplexing.
8. Study and analysis of Switching modulator.
9. Study and analysis of SSB modulation.
10. Study and analysis of DSB modulation.

Course Outcomes

At the end of this lab, students will be able to:

CO1. **Differentiate** between different modulation and demodulation techniques.
CO2. **Analyse** the Balance modulator.
CO3. **Construct** different modulation demodulation techniques.
CO4. **Calculate** the modulation index for given modulation & modulated wave.
CO5. **Differentiate** between various kind of multiplexing.

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Network Synthesis and Filter Design
(BELL/BETL - 404)

Course objective : To make the students capable of analyzing electrical network and how to synthesize an electrical network from a given impedance/admittance function.

Unit I Characteristic impedance, iterative impedance, Propagation constant, analysis of symmetrical T, π, Lattice and Bridged-T networks, image impedance, attenuators and their design.

Unit II-Network Synthesis: Positive real function, LC, RL, RC and RLC network synthesis, Foster and Cauer network.

Unit III- Realization of minimum positive real function: Minimum positive real function, Brune's method, Bott-Duffin method, Insertion Loss Synthesis-Coefficient matching technique.

Unit IV- Passive Filters: Constant K prototype Filters: Low pass, high pass, band pass and band elimination filters, m-derived filters, composite filters, frequency transformation.

Unit V- Active filters: Filter specifications, Butterworth approximation, Chebyshev approximation, elliptic function approximation, relation of the above filters. Filter design using Sallen and Key approach.

Reference Books:

1. Principles of Active Network Synthesis and Design – G. Daryanani, John Wiley & Sons
2. Network Analysis and Synthesis - F.F. Kuo, John Wiley & Sons
3. Network fields –J.D. Ryder, Prentice- Hall.
4. Network Synthesis – Van Valkenberg, Wiley: 1 edition

Course Outcomes

After the completion of this course students will be able to:

1. Compute image and impedance parameters of the different types of networks.
2. Synthesize the network using impedance and admittance functions.
3. Distinguish the PR & Minimum PR function and also synthesize the systems (using Brunes & Bott Duffin method).
4. Construct the passive filters using characteristics impedance and cutoff frequency.
5. Understand filter specifications
6. Determine the poles and zeros of networks for stabilization using Butterworth and Chebyshev approximation.

Network Synthesis and Filter Design
(BELL/BETL - 404)

List of Experiments

1. Study first order and second order Low pass filter.
2. Study first order and second high pass filter.
3. Study first order and second band pass filter.
4. Study and analysis of Lattice filter.
5. Study and analysis of attenuators.
6. To study the lead and lag active network.
7. To study the lead and lag passive network.
8. Study and analysis of Butterworth approximation.
9. Study and analysis of Chebyshev approximation.
10. Study and analysis of cascade two port network.
11. Study and realization of minimum positive real function.

Course Outcomes:

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

CO1. Classify different order of filters. (first order, second order)
CO2. Construct Different Filters. (Low pass, band pass, high pass, active, passive)
CO3. Illustrate the two port network parameters.
CO4. Design filter using Butterworth, and Chebyshev approximation.
CO5. Investigate minimum positive real function.

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Signals and Systems
(BELL/BETL -405)

Course objective: Coverage of continuous and discrete-time signals and systems, their properties and representations and methods that are necessary for the analysis of continuous and discrete-time signals and systems.

Unit-1 Introduction & Mathematical Description of Continuous – Time Signals

Definition & Classification of signals, Functions and functional notation, Signal Function; Continuous-Time Function, Complex Exponential and Sinusoidal Function with Discontinuities, Singularity Function and Related Functions; Unit Step, Signum, Unit Ramp, Unit Impulse, Periodic Impulse or Impulse Train, A Coordinated Notation for Singularity Functions, Unit Rectangle, Unit Triangle, Unit Sinc Function, Gaussian Function, Dirichlet Function, Even and Odd Functions, Periodic and non periodic Functions, Signal Energy and Power, Scaling and Shifting; Amplitude Scaling, Time Shifting, Differential and Integration,

Unit-2 Mathematical Description of Discrete – Time Signals

Signal Functions, Sampling and Discrete Time, Exponential and Sinusoidal, Singularity Functions, Kroneker Delta function, Unit –Sequence Function, Signum Function, Unit –Ramp Function, Unit – Rectangle Function, Periodic Impulse or Impulse Train, Scaling and Shifting; Amplitude Scaling, Time Shifting, Differencing and Accumulation, Even and Odd discrete Functions, Periodic and non-periodic discrete Functions, Signal Energy and Power of discrete signals,

Unit-3 Properties of Continuous and Discrete Time Systems

System Modelling, System Properties, Homogeneity, Time Invariance, Additivity, Linearity & Superposition, Stability, Incremental Linearity, Causality, Memory, Static Nonlinearity, Inevitability, Eigen functions of LTI Systems, continuous & discrete LTI system, transmission of signals through a LTI system

Unit-4 Time Domain Analysis of Continuous Time Systems

The Convolution Integral, Impulse Response, Convolution & Properties, System Interconnections, Stability and Impulse Response, Response of Systems to Standard Systems, Realization of Differential Equations,

Unit-5 Time Domain Analysis of Discrete Time Systems

The Convolution Sum, Impulse Response, Convolution &Properties, Numeric Convolution, System Interconnections, Stability and Impulse Response, Response of Systems to Standard Systems, Realization of Differential Equations,

Reference Books:

1. Proakis JP, Manolaxis; Digital Signal Processing Principles: Pearson
2. Michael J Roberts; Fundamentals of Signals & Systems, McGraw Hill
3. Oppenheim AV, Willisky AS and Nawab SH; Signal and systems; Pearson
4. Hwei. P. Hsu; Signals and systems, Schaum's outlines, TME

Course Outcomes

After the completion of this course students will be able to:

1. Represent the continuous and discrete signals in time and frequency domain.
2. Discriminate the continuous and discrete signals.
3. Recognize the standard signal functions like step, Ramp and Parabolic.
4. Analyze mathematical description of Continuous & Discrete time signals.
5. Describe the LTI system and its properties.
6. Analyze the properties of Continuous and Discrete time systems.
7. Examine the time domain analysis of Continuous & Discrete time systems.

BELS/BETS-406 [CP-IV (UNIX)]

LIST OF PRACTICALS

1. List all the subdirectories and files in your current directory.
2. Create a directory class13 and also create subdirectories (EC1)and (EC2) inside the directory class D.
3. List subdirectories of class D.
4. Create files EC1studentlist and EC2studentlist and insert 20-20 students name into each of them.
5. Display content of file EC1studentlist and EC2studentlist.
6. Display all files and subdirectories start with and end with r in your current directory.
7. Search name subhas in EC1studentlist and EC2studentlist.
8. Display the count of all the entries in files EC1studentlist and EC2studentlist.
9. Create a file EC1newlab and copy all the entries of EC2studentlist into it.
10. Move the file EC1studentlist into a new file EC11.
11. Now display all the contents of files EC11,EC2 student list and EC1newlab in sorted order.
12. Display names of all users using UNIX at this time in sorted order.
13. Now change permission of file EC11 by taking away write permission from other and group.
14. Compare the file EC2 student list and EC11.
15. Display history of all the command.
16. Write a **C** program to check whether a number is prime or not.

Course Outcomes:

At the end of this lab, learner will be able to:

CO1. Explain UNIX Programming concepts.
CO2. Write a code with Interactive Input and Output.
CO3. Draw the Flow chart for the given problem.
CO4. Write programs utilizing decision making.
CO5. Develop a code using Software Engineering principles.
CO6. Test and verifying programs.
CO7. Design research problems and conduct research in computing environment.

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PRINCIPLES OF MANAGEMENT & MANAGERIAL ECONOMICS (BELL/BETL /ELL-501/5ZH1/5Y11/5222)

Course objectives: The purpose of managerial economics is to supply a series of basic economic principles to the decision making process within the firm.

Unit I -Management Concepts: Meaning, Characteristics, Importance, process, function, levels of management, organizing process and structure, Administration, Difference and relationship between management, administration and organization, Scientific Management.

Unit II Decision Making: Meaning of a project, Characteristics, Project planning, project organization, Tools and Techniques uses of PERT and CPM.

Unit III Managerial Economics: Introduction, Meaning, Characteristics, Principles of Economics, Factors influencing manager, Micro & Macro economics, Theory of firm.

Unit IV Theory of Cost and Break-even Analysis, Theory of Production:

Production systems, Input-output Analysis, Productivity – Factors affecting, Measuring Productivity, Reasons for low productivity, Increasing Productivity of resources.

Reference Books:

1. Management Principles processor and practices-Anil Bhatt and Arya Kumar
2. Serial of Management -Harold Koontz
3. Industrial Engineering and Management - O.P. Khanna.
4. Serial Economics - D.N. Dwivedi.

Course Outcomes:

After the completion of the course, students will be able to

CO1. Explain the roles of managers in firms.

CO2. Examine the internal and external decisions to be made by managers

CO3. Analyze the demand and supply conditions and assess the position of a company

CO4. Design competition strategies, including costing, pricing, product differentiation, and market environment according to the natures of products and the structures of the markets.

CO5. Analyze real-world business problems with a systematic theoretical framework.

CO6. Develop optimal business decisions by integrating the concepts of economics, mathematics and statistics.

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MICROPROCESSOR AND INTERFACING (BELL/BETL /ELL-502/5441EL)

Course objectives: To learn architecture of microprocessor. The course covers input/output interfacing circuits and peripheral devices.

UNIT I Salient features of advanced microprocessors. RISC & CISC processors. Review and evolution of advanced microprocessors:8086,8088, 80186/286/386/486/Pentium, introduction to 8086 processor: Register organization of 8086,Architecture,signal description of 8086,minimum mode 8086 systems and timings and maximum mode 8086 systems and timings

UNIT II Intel 8086 microprocessor programming: 8086 Instruction Set, Addressing modes, Assembly Language Programming with Intel 8086 microprocessor

UNIT III Introduction to the various interfacings chips like 8155, 8255, Interfacings key boards, LEDs , ADC, DAC and memory Interfacing.

UNIT IV General purposes programmable peripheral devices (8253), 8254 programmable interval timer, 8259A programmable interrupt controller & 8257 DMA controller, USART, serial I/O & data Communication .

UNIT V Introduction to microcontrollers (8051) and embedded systems: 8051 architecture, pin description , I/O configuration , interrupts, addressing modes, an overview of 8051 instruction set, embedded system, use of microcontrollers in embedded systems

Reference Books:

1. Advance microprocessor and peripheral –A.K. Ray and K. M. Bhurchandi, Tata Mcgraw Hill
2. Microprocessor and Interfaing – D.V.Hall, McGraw Hill.
3. The Intel microprocessor - Barry B. Brey, Pearson
4. The 8086 & 8088 Microprocessor- LIU and Gibson, Tata McGraw Hill
5. The 8051 microcontroller and embedded systems-M.A. Mazidi,Janice GillispieMazidi, Pearson Prentice Hall

Course Outcomes

CO1. At the end of this course, students will be able to:

CO2. Explain the architecture and organization of microprocessor 8086, advance microprocessors and microcontroller 8051.

CO3. Develop skill in assembly language programming for 8086 and 8051.

CO4. Interface memory and I/O devices using different logic devices and interfacing chips/PPI,s

CO5. Analyze basic idea about interrupt processing, the data transfer schemes and its applications.

CO6. Distinguish between different types of general purpose programmable peripheral devices viz 8254, PIT,8259 ,PIC,8257 DMA and 8251USART .

CO7. Design some specific embedded systems using microcontrollers.

List of Experiments

MICROPROCESSOR AND INTERFACING (BELL/BETL /ELL-502/5441EL)

EXPERIMENTS

1. System introduction of 8085 & 8086
2. Hardware keyword & command description of 8085 & 8086

PROGRAMS (8085): Additional Experiments

3. To find hexadecimal addition of two numbers.
4. To find the decimal addition of two decimal numbers & result should not be greater than 199.
5. To find addition of two sixteen bit numbers.
6. To find addition of an 8 bit number series neglecting the carry generated.
7. To find separation of hexadecimal numbers into two 8 digits.
8. To find combinations of two hex nibbles to form one byte number.
9. To find hex number stored in location for odd or even parity.
10. To find multiplication by two, employing bit rotation.
11. To display flashing ''ABCDEF''.
12. To find smallest number in a data array.
13. To find smallest number from a series of numbers.
14. To arrange data array in ascending order.
15. To find 8 bit division.
16. To find multi-byte subtraction.
17. To find square root of the number.

PROGRAMS (8086):

1. Byte multiplication.
2. Word multiplication.
3. Packed BCD from ASCII.
4. BCD multiplication.
5. BCD division.
6. BCD subtraction.
7. Signed byte to word.
8. Scan string for character.
9. If – then else implementation.
10. BCD to HEX (register parameter passing).
11. Factorial by recursion.
12. 32 bit division.
13. Case conversion of string.
14. BCD string addition.
15. ASCII number to binary.
16. Square root of a number using 8087 instructions.

Course Outcomes:

After completing the lab, students will be able to:

CO1: Perform operations like addition/subtraction/multiplication/division using 8085,8086 and 8051.
CO2: Develop various BCD and string programs for 8085,8086,8051.
CO3: Demonstrate various display pattern using 8085,8086 and 8051.
CO4: Construct interface operations for various external chips using 8051.
CO5: Develop the ability of working in team/group and learn professional ethics..
CO6: Handle the programming kits properly.

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ELECTROMAGNETIC FIELDS (BELL/BETL /ELL-503 (i) /5442EL)
(Elective-I)

Course objectives: Develop an understanding of the fundamental concepts of electromagnetic fields, with an emphasis on wave propagation, relate basic electromagnetic concepts to the performance of devices, circuits, and systems.

Unit I Steady Electric Field: Coulomb's Law, units, Electric field intensity, Electric flux and flux density, Gauss law, Boundary relations, concept of divergence, Curl, scalar and vector potential. electric field in dielectric and conductor, continuity equation, methods of images.

Unit II Magnetic field due to steady currents, force between current carrying wires, Stokes theorem, vector magnetic potential, magnetization vector and its relation to magnetic field.

Unit III Maxwell's Equation: Time varying field and displacement current, faraday's law.

Unit IV Wave Equation: Pointing vector, Plane electromagnetic waves in free space, dielectric medium and conducting medium, Skin depth, slepian vector.

Unit V Waves propagation in lossy dielectrics, plane waves in lossless dielectrics, reflection of a plane wave at normal incidence , reflection of a plane wave at oblique incidence .

Reference Books:

1. Elements of Engineering Electromagnetic Third Edition- N.N. Rao- Prentice Hall, India.
2. Elements opf Electromagnetic, Second Edition- Matthew N.O. Sadiku- Saunders coll Publishing.
3. Fields & Waves in Communication Electronics- S.Ramo, J.R. Whinnery& T. Van Duzer- John Wiley & Sons.
4. Electromagnetic- J.D. Kraus-McGraw Hill
5. Electromagnetic Waves & Radiating Systems- E.C. Jordan & K.G. Balmain- Prentice Hall.

Course Outcomes

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

CO1. Solve the problems in different EM fields.
CO2. Design a programming to generate EM waves subjected to the conditions.
CO3. Applications of EM Waves in different domains and to find the time average power density.
CO4. Solve Electromagnetic Relation using Maxwell Formulae.
CO5. Solve Electro Static and Magnetic to Static circuits using Basic relations.
CO6. Analyze moving charges on Magnetic fields.
CO7. Design circuits using Conductors and Dielectrics.

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OPTIMIZATION TECHNIQUES
(BELL/BETL /ELL-503 (ii) /5442EL)
(Elective-I)

Course Objective: The general objectives of the course is to introduce the fundamental concepts of Optimization Techniques; make the learners aware of the importance of optimizations in real scenarios and provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

Unit I Introduction to Classical Methods: Terminology, Design Variables, Constraints, Objective Function, and Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

Unit II Linear Programming: Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations, Simplex method, Concept of Duality.

Unit III Single Variable Optimization Problems: Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method. Application to Root finding.

Unit IV Multivariable Optimization Algorithms: Optimality Criteria, Unidirectional Search. Direct Search Methods: Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method. Gradient Based Methods: Cauchy's Steepest Descent Method, Newton's method, Marquardt's Method.

Unit V Further Topics in Optimization Techniques: Quadratics Programming, sequentialquadratic programming, Integer Programming, Penalty Function Method, Branch and Bound Method, Geometric Programming, Dynamic programming; Genetic algorithm

Reference Books:

1. S. S. Rao: Engineering Optimization, New Age International.
2. E. J. Haug and J.S. Arora, Applied Optimal Design, Wiley, New York.
3. Kalyanmoy Deb, Optimization for Engineering Design, Prentice Hall of India.
4. A. Ravindran and K.M. Rogsdeth, Optimization G.V. Reklaites, Wiley, New York.

Course Outcomes:

At the end of this course, students will be able to

CO1. **Analyze** the basic concepts of classical methods

CO2. **Design** Optimized codes using linear programming.

CO3. **Analyze** the concept of optimality criteria for various types of optimization problems;

CO4. **Evaluate** various constrained and unconstrained problems in single variable as well as multivariable;

CO5. **Select** the methods of optimization in real life situation.

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RENEWABLE ENERGY SOURCES
(BELL/BETL /ELL-503 (iii) /5442EL)
(Elective-I)

Course objective: To understand and analyze the present and future energy demand of world; techniques to exploit the available renewable energy e-sources such as, solar, bio-fuels, wind power, tidal and geothermal effectively.

UNIT-I

Statistics on Conventional Energy Sources and Supply in Developing Countries: Definition, Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES, Classification of NCES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of these energy sources.

UNIT-II

Solar Energy: Definition, Energy available from Sun, Solar radiation data, solar energy conversion into heat, Flat plate and Concentrating collectors, Principle of natural and forced convection, Solar Engines: Stirling, Brayton engines, Photo voltaics: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power satellite, Calculation of energy through photovoltaic power generation.

UNIT-III

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics.
Bio-Mass: Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation, and economic aspects.

UNIT-IV

Nature of Geothermal Sources: Definition and classification of resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Basic features: Atmospheric exhaust and condensing, Exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels. Biomass gasification, Constructional details of gasifier, Usage of biogas for chullas, various types of chullas for rural energy needs.

UNIT-V

Wave, Tidal and OTEC energy. Difference between tidal and wave power generation. Principles of tidal and wave power generation, OTEC power plants, Operation of small open-cycle experimental facility, Design of 5 MW OTEC pro-commercial plant. Economics of OTEC, Environmental impacts of OTEC, Status of multiple product OTEC systems.

Reference Books

- Renewable Energy Sources I Twidell & Weir / Taylor and Francis / 2nd Special Indian Edition.
- Non- conventional Energy Sources / G.D. Rai / Dhanpat Ral and Sons.
- Energy Resources Utilization and Technologies /Anjaneyulu & Francis/ BS Publications/2012.
- Principles of Solar Energy / Frank Krieth & John F Kreider / Hemisphere Publications.
- Non-Conventional Energy / Ashok V Desai I Wiley Eastern.
- Non-Conventional Energy Systems / K Mittal / Wheeler.
- Renewable Energy Technologies I Ramesh & Kumar / Narosa.

Course outcomes:

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

CO1. **Build** the concepts of NCES and limitations of RES.
CO2. **Compare** various energy sources like solar, wind, geothermal, biomass and ocean energy sources.
CO3. **Examine** the effect of Solar energy in solar engines like Stirling and Brayton engines.
CO4. **Describe** horizontal and vertical axis windmill with its performance characteristics.
CO5. **Analyze** the effect of Geothermal sources for electricity generation and direct heating.
CO6. **Design** OTEC power plants and describe principles of tidal and wave power generation.

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MECHATRONICS
(BELL/BETL /ELL-503 (iv) /5442EL)
(Elective-I)

Course Objectives: To understand basic architecture of the mechatronics system; design and study the characteristics of the mechanical and electrical actuators and their selection for mechatronic systems and development of process plan and templates for design of mechatronic systems

UNIT-I

Introduction to mechatronics systems: Basic building blocks of mechatronic systems. Mechatronics key elements, Mechatronics in home, office and industry automation, Scope of Mechatronics, advantages of Mechatronics, pre-requisites for Mechatronics.

UNIT-II

Performance characteristics of sensors and transducers, position and speed measurement; proximity sensor, potentiometer, LVDT, digital optical encoder, stress and strain measurement; strain gages, force measurement with load cells, temperature measurement; thermometer, thermocouple, vibration and acceleration measurement, pressure and flow measurement.

UNIT-III

Introduction of actuators, electromagnetic principles, solenoids and relays, electric motors, DC motors, stepper motors, Hydraulic and pneumatic actuators, microactuators. Piezoelectric actuators.

UNIT-IV

Selection criteria for sensors and actuators, interfacing of sensors and actuators, Control unit; Microcontroller, PLC.

UNIT-V

Various example of mechatronics system; manipulator/ Robotic arm, quadcopter, mobile robots, Hexapod Robots, Humanoid and Biped Robots.

Reference Books

1. Mechatronics, Kenji Uchino and Jayne R. Giniewicz, publication: Marcel Dekker, Inc.
2. Applied Mechatronics- A. Smaili and F. Mrad, OXFORD university press.
3. Mechatronics System Design ,Shetty and Kolk CENGAGE Learning, India Edition
4. Introduction to Mechatronics and Measurement Systems, Alciatore and Histand Tata McGraw-Hill
5. Mechatronics, Necsulescu, Pearson education.

Course Outcome:

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

- **CO1.** **Design** the mechatronics system.
- **CO2.** **Analyse** the performance characteristics of sensors and actuators.
- **CO3.** **Write** the programs based on ladder logic for performing various tasks using PLC.
- **CO4.** **Interface** sensors and actuators for designing of any mechatronics system.
- **CO5.** **Construct** the prototype of robotic arm.
- **CO6.** **Create** the mobile robot for performing various tasks.

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LINEAR CONTROL THEORY (BELL/BETL /ELL-504/5443EL)

Course Objectives: The aim is to learn the classical and modern control system theory and how it is implemented in practical systems using electronic devices.

UNIT I Introduction to the control systems, Basic Control System Terminology, open loop , closed loop system, feedback control, Different modeling of physical systems, Linear approximation of physical systems. Transfer function of linear systems, Block diagram algebra and signal flow graphs. Effects of negative feedbacks.

UNIT II Proportional, Integral, derivative controllers, PID etc. Time domain analysis, Test input signals, first order systems, Second order systems, and higher order systems, Effects of addition of poles and zeros to open and closed loop transfer functions. Error analysis steady state error , constant and coefficients, dynamic error coefficients for type 0,1 and 2 systems.

UNIT III Concept of stability of linear systems, bounded input bounded output stability range for a parameter, co relation between the closed loop poles and stability , relative stability , Absolute stability, condition of stability characteristics equation, Routh Hurwitz Criteria and its applications.

UNIT IV Frequency Domain analysis , Performance specification in frequency domain, Co –relation between frequency domain and time domain, polar plots and Bode plots of transfer function s, Nichols Chart. Development of Nyquist stability criterion, assessment of relative stability closed loop frequency response , concept of root locus , guidelines for sketching root locus, control system design by root locus.

Unit V State variable techniques: state space representation of system , state diagram, transition matrix their properties, solution of LTI state equations, relationship between state equation and transfer function, different canonical forms, Eigen values and Eigen vectors.

Reference Books:

1. Automatic control system—B. C. Kuo, Wiley
2. Control system engineering—Nagrath & Gopal, New Age International
3. Modern control engineering –K. Ogata, Prentice Hall
4. Control system engineering- Norman Nise, John Wiley & Sons

Course Outcomes:

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

CO1. **Calculate** the transfer function of feedback control system using Block diagram and Signal flow graph method..

CO2. **Evaluate** the time domain response of first & Second order system for different standard inputs. .

CO3. **Distinguish** various controllers.

CO4. **Calculate** steady state error for type 0,1,& 2 system.

CO5. **Determine** the (absolute) stability of a closed-loop control system.

CO6. **Solve** the control system equations in state variable form.

List of Experiments:

LINEAR CONTROL THEORY (BELL/BETL /ELL-504/5443EL)

List of Experiment

1. 1. Investigate the characteristics of the open loop control system.
2. Investigate the characteristics of the closed loop control system.
3. Experimentally verify the characteristics of the thermister.
4. Experimentally verify the characteristics of the piezo-electric transducer.
5. Analyze the loading effect of the potentiometer.
6. Examine the automatic temperature control system.
7. Implementation of temperature control system using IC-555 for a fan.
8. Implementation of the electromagnetic relay switch using BJT.

Course Outcomes:

After completing this lab student will be able to:

CO 1: Explain the various type of linear control system and their applications.

CO 2: Experimentally characterize the behavior of the elementary feedback control system.

CO 3: Explain different types of temperature sensing devices.

CO 4: Experimentally explain the closed loop temperature control system.

CO 5: Demonstrate the switching dynamic characteristics of a BJT along with relay.

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DIGITAL COMMUNICATION (BELL/BETL / ELL-505/5444EL)

Course Objectives: The main objectives of this course is to understand the basics of digital modulation concepts , understand the basics of signal-space analysis and the concepts of digital transmission

Unit I

Sampling theorem for low pass and band pass signals, Ideal sampling, Natural sampling, Flat top sampling, crosstalk, aliasing, time division multiplexing, PAM, PWM and PPM their generation and detection.

Unit II

Pulse code modulation, Quantization, quantization noise, companding, Inter symbol interference, Eye pattern, Delta and adaptive modulation, Encoding techniques: On-Off signaling, Polar signaling, RZ signaling, Bipolar signaling, AMI, Manchester code, Differential encoding their advantage and disadvantages.

Unit III

Band pass data transmission: ASK, Binary phase shift keying (BPSK), QPSK, DPSK, coherent and non coherent BFSK, minimum shift keying, QAM, Concept of M-ary PSK and M-ary FSK. Spectral properties of QPSK and MSK.

UNIT IV

Matched filter and correlator detector. Gram Schmidt orthogonalization procedure and concept of signal space for the computation of probability of error, calculation of error probability for BPSK, QPSK, QAM and coherent BFSK, comparison of different modulation techniques.

Unit V

Concept of information theory, entropy, information rate, channel capacity, Shannon's theorem, Shannon Hartley theorem , BW and signal to noise ratio trade off, sources encoding, extension of zero memory source, Error correcting codes: linear block codes and cyclic codes: encoder and decoder circuits, burst error correcting codes, concept of convolution codes.

Reference Books:

1. Communication Systems –Simon Haykins, Wiley
2. Principle of Communication Systems-Taub and Schilling, Tata McGraw-Hill
3. Communication Systems-Singh and Sapre, Tata McGraw-Hill

Course Outcomes:

At the end of this course students will be able to

CO1. **Describe** the various aspects of sampling theorem viz. Aliasing, signal distortion.

CO2. **Design** the concepts of digital communication system.

CO3. **Apply** digital modulation techniques in communication systems.

CO4. **Analyze** the performance of digital communication system in terms of error rate and spectral efficiency.

CO5. **Design** the concepts of Matched filter and correlator detector.

CO6. **Solve** problems of efficient source coding and channel coding in communications systems;

DIGITAL COMMUNICATION (BELL/BETL / ELL-505/5444EL)

List of Experiment

1. Perform sampling and reconstruction.
2. Generation of various line codes for data formatting and reformatting.
3. Analyse the delta modulation and demodulation.
4. Analyse adaptive delta modulation and demodulation.
5. Verify the amplitude shift key.
6. Verify frequency shift key.
7. Verify phase shift key.
8. Conversion of analog signal into PCM format and its study
9. Analyse pulse amplitude modulation.
10. Analyse pulse width modulation.
11. Analyse pulse position modulation.

Course Outcome:

On completion of this Lab the student will be able to:

CO1.	Investigate different digital communication systems.
CO2.	Construct different modulation and demodulation systems.
CO3.	Demonstrate modern digital communication system.
CO4.	Perform various line coding technique.
CO5.	Evaluate the performance of the digital communication system using MATLAB.

Electronics Workshop – I

Lab Objective: The aim of this workshop is to provide hands on experience to the students. After successfully completing this workshop they will be able to design and fabricate working electronic hardware projects.

Course Outcomes

After completing this workshop student will be able to:

CO 1: Identify various electronics components and will able to test them.

CO 2: Properly operate various measuring instruments (such as multi-meter) and electronics equipments likes CRO, dual-power tracking power supply & function generator.

CO 3: Design the electronics circuits on bread-board.

CO 4: Do soldering and desoldering of the circuit components properly.

CO 5: Troubleshoot a not working electronic circuit and able to rectify it.

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ANTENNA AND WAVE PROPAGATION (BELL/BETL /ELL-601/6441EL)

Course objectives: To develop the students' basic understanding of antenna operation through the application of Maxwell's equations, develop the students' ability to calculate and interpret basic antenna performance parameters.

Unit I Radiation retarded potential: Radiation field from current element radiation resistance of short dipole and half wave dipole antenna Directivity and gain calculation of short dipole and half wave antenna.

Unit II Introduction to antenna: the antenna as an aperture effective lengths resonant and travelling antenna for different wave lengths, antenna arrays of point sources, two element array, end fire and broad side arrays, uniform linear arrays of N-elements, linear arrays with non-uniform amplitude distribution (Binomial distribution and Chebyshev optimum distribution).

Unit III Effect of earth on vertical pattern: image antenna, network theorems applied to antenna, self and mutual impedance of antenna feature of antenna impedance, principle of pattern multiplication, Arrays of two-driven half wave length elements (Broad side and end fire case).

Unit IV Babinet's principles and complimentary antennas: horn antennas, parabolic reflector, slot antenna, log periodic antenna.

Unit V Propagation of radio wave: Duct propagation, Influence of earths magnetic field, Sky wave, Skip distance and MUF, single hop and multiple hop transmission.

Reference Books:

1. Antenna theory- J.D. Kraus, 4th edition, Tata Mc-Graw Hill
2. Electromagnetic Fields & Radiating System - Jordan & Balmain, 2nd edition, PHI
3. Antennas(for all applications)- Kraus, Marshfka, khan, Tata Mc-Graw Hill
4. Antenna Wave Propagation-K D Prashad, New Delhi : Satya Prakashan

Course Outcome:

CO1. After the completion of this course students will be able to:

CO2. Analyze the radiation characteristics of dipole antennas of various length.

CO3. Evaluate various parameters of the antenna.

CO4. Design antenna array for the given radiation characteristics.

CO5. Analyze the effect of earth on antenna radiation properties.

CO6. Analyze the design parameters, radiation mechanism, and applications of various practical antennas.

CO7. Describe effects of earth and its atmosphere on radio wave propagation.

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DIGITAL SIGNAL PROCESSING (BELL/BETL /ELL-602/6442EL)

Course Objectives: Understand the DSP techniques relevant to Electronic automation systems.

Unit I Discrete time signals and systems: Introduction (signals, systems and signal processing, classification of signals). Discrete time signal sequences, linear time invariant system, stability and causality. Linear constant co-efficient difference equations. Fourier transform of discrete time signals. Properties of Fourier transform. Sampling of continuous time signals. Linear convolution.

Unit II Z-transform, properties of z-transform, rational z-transform, inverse z-transform, one sided z-transform, analysis of LTI systems in the z-domain, Inverse systems, minimum phase system and invertibility of LTI system.

Unit III Linear time invariant systems as frequency-selective filters: Ideal filter characteristics, highpass, lowpass and bandpass filter.

Signal flow representation of IIR system, basic network structure of FIR systems, transposed forms, basic effects, Tellegens theorem for digital filter and its application.

Unit IV Discrete Fourier Transform (DFT): Introduction of DFT and properties of DFT, representation of periodic sequences, properties of discrete Fourier series, representation of periodic sequences. circular convolution, Decimation in time FFT algorithm, decimation of frequency FFT algorithm with radix-2

Unit V Design of Digital filters: Design of linear phase FIR filter using window and frequency sampling method, IIR filter design by Impulse invariance and bilinear transformation, Butterworth filter and Chebyshev filter.

Reference Books:

1. Digital Signal Processing- Oppenheim and Schafer, Prentice Hall
2. Digital Signal Processing-Rabiner and Gold, Prentice Hall
3. Digital Signal Processing- Proakias, Pearson publication
4. Digital Signal Processing – Sanjit K. Mitra, Tata Mc-Graw Hill

Course Outcome:

After the completion of this course students will be able to:-

CO1. Differentiate between continuous and discrete time signal & systems.
CO2. Analysis of discrete time systems using z-transform.
CO3. Design of simple digital filters by placing poles and zeros and their structure implementation.
CO4. Computation of discrete Fourier transform and its efficient implementation using fast algorithm.
CO5. Design of Linear Phase FIR filters.
CO6. IIR filter design to meet specified magnitude/phase response characteristics.

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DIGITAL SIGNAL PROCESSING (BELL/BETL /ELL-602/6442EL)

List of Experiment

1. Write a program to generate & plot saw tooth waveform of duty cycle 60% for first 100 samples, peak value of the wave form is 7, & period is 10 samples, sampling rate is 20 KHz.
2. Write a program to generate & plot square waveform of duty cycle 60% for first 100 samples, peak value of the wave form is 7, & period is 10 samples, sampling rate is 20 KHz.
3. Plot an exponential sequence given as:

$$y[n] = 0.5e^{\frac{(-0.4+j\pi)N}{5}} \text{ for 100 samples.}$$

4. You are given uncorrupted signal $s[n] = 2[n.(09)^n]$, d(n) is random noise sequence which is generated as 'rand' -0.5, 'rand' is uniformly distributed random variable, Input sequence is giving:

$$x[n] = s[n]+d[n]$$

sequence x[n] goes into moving average system whose O/P is given as

$$y[n] = \frac{1}{m}\sum_{k=0}^{m-1} x[n-k] \text{ where m=3,5,7,9}$$

Plot the sequence s[n], d[n], x[n] and y[n].

5. Write a program to perform convolution between two sequences x[n] and h[n] given below:

i.e find out y[n] = x[n] * h[n]

where $x[n] = \begin{cases} 1, -N \le n \le N \\ 0, elsewhere \end{cases}$ and $h[n] = \begin{cases} 1, -N-1 \le n \le N+1 \\ 0, elsewhere \end{cases}$

6. Determine 16 point DFT of the following 8-point sequence:

$$u[n] = \begin{cases} 1, 0 \le n \le 7 \\ 0, elsewhere \end{cases}$$

7. Compute 13 point DFT of the 8-point sequence given by:

$$V[k] = \begin{cases} k/8, 0 \le k \le 7 \\ 0, elsewhere \end{cases}$$

Course Outcomes:

At the end of this lab, students will be able to:

CO1. Differentiate between continuous and discrete time signal & systems.
CO2. Analysis of discrete time systems using z-transform.
CO3. Design of simple digital filters by placing poles and zeros and their structure implementation.
CO4. Computation of discrete Fourier transform and its efficient implementation using fast algorithm.
CO5. Design of Linear Phase FIR filters.
CO6. IIR filter design to meet specified magnitude/phase response characteristics.

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DATA COMMUNICATION (BELL/BETL /ELL-603/6443 EL)

Course objectives: To provide an introduction to fundamental network architecture concepts and their applications.

Unit I Introduction, Switching Techniques: Circuit Switching, Message Switching, Packet Switching, Protocols, Layered Network Architecture and Architecture OSI & TCP/IP Reference model, ATM Model, SNA, Physical Layer Transmission Medium, RS 232 C, Modem, Topologies.

Unit II Data Link Layer: Framing BSC, HDLC. ARQ: Stop and Wait, Sliding Window. Efficiency Error and Correction. Parity Checks – CRC, Checksum, MAC Sub layer – LAN Protocols, ALOHA, Slotted, ALOHA, CSMA, CSMA/CD, Token Bus, Ring.

Unit III Network Layer: Routing – Data gram and Virtual Ckt, Dijkstra's Bellman Ford, DV and Link state routing. Congestion Control and ATM Traffic Management – AAL, X.25, Internal Layer.

Unit IV Transport Layer: Connection Oriented transport Protocol Mechanism, TCP, TSAP, Transport Flow Regulation, UDP Fragmentation & Reassemble, Session and Transport Interaction, Synchronization Points, Session Protocols Data Unit.

Unit V Synchronization, Translation, Encryption / Decryption, Data Compression and Application Layer Protocols like: FTP, Remote Login. Virtual Terminal, Network Management Protocols.

Reference Books:

1. Data and Computer Communication – W. Stallings, Pearson
2. LANs – Keiser, Tata Mc-Graw Hill
3. Data Communication & Networking – B.A. Forouzan, Tata Mc-Graw Hill
4. Internetworking with TCP/IP – VOL-I – D.E. Comer, PHI
5. ISDN and Broad band ISDN with Frame Relay & ATM – W. Stalling, Pearson

Course Outcome:

After completing this course the student must demonstrate the knowledge and ability to:

CO1. Explain the evolution of computer network and basic concepts of Data communication system

CO2. Describe the services the data link layer provided in controlling transmission errors and flow of data

CO3. Analyze the various techniques to alleviate the problem of medium allocation in broadcast network like ALOHA, CSMA etc.

CO4. Explain the principles and protocols for route calculations and be able to perform such calculations in network layer.

CO5. Explain the services and features of the transport layers of data networks.

CO6. Identify the skills of synchronization in data communication

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DATA COMMUNICATION (BELL/BETL /ELL-603/6443 EL)

List of Experment

1. Fabricate RS32 Interface cable as per following specification.
    a) Using -25 pin connector for DTE-DTE.
    b) Using -25 pin connector for DTE-DCE.
    c) Using -9 pin connector for DTE-DTE.
    d) Using -9 pin connector for DTE-DCE.
    e) Using -25 pin connector at end one and 9 pin connector at other end.
2. Write a program for displaying waveform of three characters of your surname for following codes:
    a) NRZ
    b) Manchester
    c) Differential Manchester.
3. Establish a network of 4 system using coaxial cable and UTP cable having windows 98 and XP.
4. Establish connection between two system using modems.

Course Outcomes:

After completing the lab, students will be able to:

CO1. Fabricate RS232 interface cable using different connectors.
CO2. Establish connection between two system using modems.
CO3. Establish a network of 4 system using coaxial cable and UTP cable.
CO4. Construct program using NRZ and Manchester codes.
CO5. Develop the ability of working in team/group and learn professional ethics.
CO6. Handle the experiment kit properly.

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ELECTRONIC SYSTEM DESIGN (BELL/BETL /ELL-604 (i) /6444EL)
Elective-II

Course objectives: The course objective is to provide students with knowledge of analog circuit design.

Unit I Design of Power Supply System Unregulated DC power supply system with rectifier and filter. Consideration regarding ripple. Design of emitter follower regulator (series pass transistor regulator). Design of SMPS, Step up and step down.

IC voltage regulator, Positive & negative voltage regulator, Adjustable regulator, High current short circuit protection.

Unit II Design of Single Stage and Two stage amplifier (R-C Coupled) using BJT. Design and analysis of power amplifier: class A, class B, class AB, Design of transformer coupled class A power amplifier.

Unit III Design of Oscillators using BJT's: Frequency of oscillation and condition for sustained oscillation, Sine wave oscillators, Audio frequency and radio frequency oscillator .

Unit IV Operational Amplifier: Basics of an OP-Amp, OP-Amp parameters, their basic application, Inverting amplifier, Non-Inverting amplifier, Differential amplifier, Integrator Differentiator, Voltage follower, Adder, Substractor, V to I and I to V converter. Design of Butterworth , chebyshev filters.

Unit V Design of Digital System: flip flops, registers, Counters, A to D Converter and D to A converter and Digital voltmeter.

Reference Books:

1. Introduction to system Design using Integrated Circuits- B.S. Sonde- New Age International (P) Ltd,. New Delhi.
2. Electronics Integrated Circuits and System- F.C. Fitchen, Van Nostrand Reinhold
3. Regulated Power Supply Hand Book. Texas Instrument
4. Electronics: BJT's FETS and Microcircuits – Angelo, McGraw-Hill
5. Monograph on Electronic Circuit Design- Goyal & Khetan., Khanna Publishers
6. Electronic Devices and Circuits- Boylestad Reseat and Nashelsky Louis, prentice hall
7. Integrated Electronic -Millman and Halkias, Tata Mc. Graw Hill.

Course Outcome:

After completing this course the student must demonstrate the knowledge and ability to:

CO1. Design regulated power supply.
CO2. Design single stage and multi stage amplifier using BJT.
CO3. Design oscillators using BJT.
CO4. Design of the basic Op-Amp Circuits.
CO5. Design digital circuits such as flip slop, registers, and counters.
CO6. Design analog to digital converter and digital to analog converter.

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DATA STRUCTURE
(BELL/BETL /ELL-604 (ii) /6444EL)
Elective-II

Course Objectives:
The objective of the course is to teach students efficient storage mechanisms of data for an easy access, to design and implementation of various basic and advanced data structures, to introduce various techniques for representation of the data in the real world, to develop application using data structures, to teach the concept of protection and management of data.

UNIT I
Preliminaries of algorithm, Algorithm analysis and complexity, Data structure- Definition, types of data structures
Recursion: Definition, Design Methodology and Implementation of recursive algorithms, Linear and binary recursion, recursive algorithms for factorial function, GCD computation, Fibonacci sequence, Towers of Hanoi, Tail recursion.

UNIT II
Searching Techniques: List Searches using Linear Search, Binary Search, Fibonacci Search
Sorting Techniques: Basic concepts, Sorting by: insertion (Insertion sort), selection (heap sort), exchange (bubble sort, quick sort), distribution (radix sort) and merging (merge sort) Algorithms.

UNIT III
Stacks: Basic Stack Operations, Representation of a Stack using Arrays, Stack Applications: Reversing list, Factorial Calculation, Infix to postfix Transformation, Evaluating Arithmetic Expressions.
Queues: Basic Queue Operations, Representation of a Queue using array, Implementation of Queue Operations using Stack, Circular Queues, Priority Queues.
Linked Lists: single linked list, , Operations on a Single linked list, Reversing a single linked list, circular linked list, Double linked list

UNIT IV
Trees: Properties, Representation of Binary, Trees using arrays and linked lists, operations on a Binary Tree, Binary Tree Traversals (recursive), Creation of binary tree from in, pre and post order traversals.

UNIT V
Graphs: Basic concepts, Representations of Graphs: using Linked list and adjacency matrix, Graph algorithms. Graph Traversals (BFS & DFS), applications: Dijkstra's shortest path, Transitive closure, Minimum Spanning Tree using Prim's Algorithm, Warshall's Algorithm(Algorithemic Concepts Only, No Programs required).
Reference books:
1. Data Structure with C, Seymour Lipschutz, TMH

2. Data Structures using C. Reema Tharej , Oxford
3. Data Structures, 2/e, Richard F, Gilberg , Forouzan, Cengage
4. Data Structures and Algorithms, 2008, G. A. V. Pai, TMH
5. Classic Data Structures, 2/e, Debasis , Sarnanta,PHI,2009
6. Fundamentals of Data Structure in C, 2le,' Horowitz, Sahni, Anderson Freed, University Prees

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

CO1. Design recursive algorithms for various types of functions.
CO2. Create a code for searching algorithms to find data in linear and non linear data structure.
CO3. Perform sorting of given string using various algorithms.
CO4. Represent the data in various transforms and perform operations in stacks,Queues & Lists.
CO5. Perform traversal of various data structures and their representation.
CO6. Analysis the graph theory and its algorithms and perform searching.

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INTEGRATED CIRCUITS
(BELL/BETL /ELL-604 (iii) /6444EL)
Elective-II

Course objectives: To understand the basic building blocks of linear integrated circuits and the linear and non-linear applications of operational amplifiers .To understand the theory and applications of analog multipliers and PLL, ADC and DAC.

UNIT I -BASICS OF OPERATIONAL AMPLIFIERS: Current mirror and current sources,Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier -General operational amplifier stages-and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate open and closed loop configuration.

UNIT II-APPLICATIONS OF OPERATIONAL AMPLIFIERS: Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector clipper and clamper low pass ,high pass and band pass butterworth filter.

UNIT III ANALOG MULTIPLIER AND PLL: Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis.Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and frequency synthesizing.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS: Analog and digital data conversion ,D/A converter –Specification- Weighted resistor type,R-2R Ladder types, voltage mode and current mode R-2R Ladder type switches for D/A converters, high speed sample-and-hold circuits, A/D Converters specifications Voltage Mode and Current-Mode R-2R-- Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION IC:
Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators IC 723 general purpose regulator - Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers.

REFERENCE BOOKS:

1. Analysis and Design of Analog Integrated Circuits, Gray and Meyer Wiley International, 1995.
2. Applications and Design with Analog Integrated Circuits, J. Michael Jacob Prentice Hall of India, 1996..
3. Integrated Circuits Khanna Publishers, K.R.Botkar, 1996.

4. Digital Integrated Electronics, Taub and Schilling McGraw-Hill, 1997.
5.OP-AMP and Linear IC's . Ramakant A .Gayakwad Prentice Hall / Pearson Education, 1994

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

CO1. Explain Operational amplifier and its applications.
CO2. Differentiate between various different integrated circuits, their pin configurations and about their applications.
CO3. Evaluate the performance of ICs on practical basis.
CO4. Design various waveform generators and amplifiers.
CO5. Design different A/D and D/A converters.
CO6. Design analog multipliers.

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MICROCONTROLLER AND EMBEDDED SYSTEMS
(BELL/BETL /ELL-604 (iv) /6444EL)
Elective-II

Course Objectives: To conceptualize the basics of embedded systems; organizational and architectural issues of a microcontroller; learn programming techniques used in microcontroller; understand basic concept of ARM processor and real time operating system

Unit-1The Microcontroller Architecture: Introduction to 8051 Microcontroller, Architecture, Pin configuration, Memory organization, Input /Output Ports, Counter and Timers, Serial communication, interrupts.
Introduction to Embedded Systems: Overview of Embedded System Architecture, Application areas

Unit-2 Assembly Language Programming of 8051: Instruction set, Addressing modes, Development tools, Assembler Directives, Programming based on Arithmetic & Logical operations, I/O parallel and serial ports, Timers & Counters, and ISR.

Unit-3 ARM-7 architecture: Architectural inheritance, Detailed study of Programmer model, ARM Development tools, Instruction set: Data processing, Data transfer, Control flow, Addressing modes, writing simple assembly language programs. Pipelining, Brief introduction to exceptions and interrupts handling

Unit-4 Embedded System:-Categories of embedded systems, specialties of embedded systems. Recent trends in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC. Design case studies: Digital clock, Battery Operated smart card reader, automated meter reading system, Digital camera

Unit-5 Embedded / Real Time Operating System: Architecture of kernel, Task and Task scheduler, Interrupt service routines, Semaphores, Mutex, Mailboxes, Message queues, Event registers, Pipes, Signals, Timers, Memory management, Priority inversion problem. Off-the-Shelf Operating Systems Embedded Operating Systems, Real Time Operating System (RTOS) and Handheld Operating Systems.

Reference Books:

1. The 8051 microcontroller & embedded systems, M. A. Mazidi, J. G. Mazidi, R. D. McKinlay, Pearson
2. The 8051 microcontroller & embedded systems, Kenneth J. Ayala, Dhananjay V. Gadre, Cengage Learning
3. Embedded / real – time systems: concepts, design & programming, Black Book, Dr. K.V. K. K. Prasad, Dreamtech press, Reprint edition 2013
4. Introduction to embedded systems, Shibu K. V., McGraw Hill
5. ARM System on chip Architecture, Steve Furber, Pearson edition second

Course Outcomes:

After going through this subject the student would be able to-

CO1. Summarize the architecture and working of a microprocessor and microcontroller.

CO2. Apply basic concepts to program a processor using assembly language and implement various addressing modes.

CO3. Configure different peripherals in a microprocessor

CO4. Illustrate different data transfer modes using DMA and interrupts.

CO5. Describe different co processors and their applications

CO6. Summarize 8051 microcontroller, ARM7 and concept of embedded systems & RTOS.

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INDUSTRIAL ELECTRONICS (BELL/BETL /ELL-605/6445EL)

Course Objectives: The objective is to increase the understanding of power electronic fundamentals, applications and recent developments in the power electronics field.

Unit I Power semiconductor Devices- Classification of power semiconductor devices ,characteristics , construction , application and theory of operation of power diodes , power transistors , thyristors working of diac , triac , IGBT , GTO.turn on/turn off methods and their circuits

Unit II Rectifiers, controlled rectifiers, half wave and full wave configuration and their parameters, use of freewheel diode in controlled rectifier configuration, dual converters.

Unit III INVERTERS AND CHOPPERS, Classification of inverters ,voltage and current communicated inverters ,PWM inverters ,principle of choppers ,chopper and their classification.

Unit IV A.C. voltage controllers and cyclo converters classification and operation of AC voltage controllers and cyclo converters ,their circuit analysis for different type of loads .various types of heating and welding.

Unit V Acoustics- Microphones-carbon , moving coil ,ribbon, crystals ,condenser, their working principles and characteristics ,noise figure and sensitivity and shielding. Loudspeakers- moving coil, electrodynamics horn type. Multiway speaker system, crossover network and their frequency characteristics. various types of sound recording-magnetic recording, disk and crystal recording reverberations ,building and studio acoustics ,high fidelity.

Reference Books:

1. Power Electronics-P.S.Bhimbra, Khanna Publishers
2. Power Electronics – Rashid Publisher: Pearson
3. Power Electronics – P.C.Sen Tata McGraw-Hill
4. Audio and Video system-R. G. Gupta Tata McGraw-Hill Education

Course Outcome:

CO1. After completing this course the student must demonstrate the knowledge and ability to:
CO2. Analyze the characteristics of different power semiconductor devices.
CO3. Apply power circuit analysis techniques to solve power networks with linear and non-liner loads.
CO4. Design phase controlled rectifier circuits.
CO5. Design inverter and chopper circuits.
CO6. Analyze different converters with their applications.
CO7. Evaluate different characteristic parameters of rectifiers, inverter and converters.
CO8. Explain the concept of microphones and speakers.

Department of Electronics Engineering

INDUSTRIAL ELECTRONICS (BELL/BETL /ELL-605/6445EL)

List of Experiment

1. Estimate the V-I characteristics of SCR.
2. Analyze characteristics of SCR using DC bias alone triggering.
3. Interpret the characteristics of SCR triggering DC bias with super imposed AC trigger.
4. Measure characteristics of SCR R triggering.
5. Evaluate characteristics of SCR RC triggering.
6. Estimate characteristics of SCR UJT triggering.
7. Analyze characteristics of SCR R triggering as half wave rectifier.
8. Measure characteristics of SCR R triggering as Full wave rectifier.
9. Evaluate characteristics of SCR R triggering as Bridge rectifier.

Course outcome

After completing this lab students will able to:

CO1. Experimentally explain the characteristic of an SCR.
CO2. Demonstrate the different triggering techniques of SCR and able to differentiate between AC and DC triggering.
CO3. Experimentally verify the R, RC and UJT triggering of SCR.
CO4. Experimentally verify the ripples in a rectified output.
CO5. Do experimental demonstration of the half-wave, full-wave and bridge rectifier using SCR.

L	T	P
3	1	2

ADVANCED CONTROL SYSTEM (BETL/ELL701/7441EL)

Course objectives: To understand the basics of mathematical modeling of control systems , to study the stability analysis of linear and nonlinear systems.

Unit I Advantages and disadvantages of digital control system, Ideal sampler, sampled and hold circuit, zero order hold circuit, Z transform, Inverse Z transform by various method, mapping between s plane and Z plane, solution of the linear difference equation.

Unit II Pulse transfer function, general procedure for obtaining pulse transfer function, pulse transfer function of cascaded elements, pulse transfer function of closed loop systems. Transfer function of discrete data system, stability analysis of closed loop system in the z plane, Jury stability test.

Unit III Non Linear Systems: introduction , common physical non linearity's, phase plane method , basic concepts ,singular points, stability of non linear system , construction of phase trajectories, system analysis by phase plane method, Describing functions methods, basic concepts derivation of describing function, liapunov's stability criterion.

Unit IV Review of root locus, lead compensation, lag compensation, lag- lead compensation and their comparison, review of state space methods, observability and controllability of system , pole placement by state feedback.

UnitV Tuning rules of PID controller, modifications of PID controllers, Introduction to software package used in control systems- MATLAB SIMULINK.

Reference Books:

1. Automatic control system—B. C.Kuo, wiley
2. Control system engineering—Nagrath & gopal, Publishers: New Age International
3. Modern control engineering –K. Ogata, Pearson; 5 edition
4. Control system engineering—Norman Nise, Publisher: Wiley
5. Discrete time Control system— K. Ogata, Pearson; 2 edition

Course Outcomes

After the completion of this course students will be able to:

CO1. **Describe** quantitatively the basics of digital control system.
CO2. **Examine** the stability analysis of closed loop system in Z plane.
CO3. **Demontrate** an understanding of non linear control system
CO4. **Examine** the stability of control system using Root Locus technique.
CO5. **Represent** any system by state space model
CO6. **Design** PID controller to meet system performance.

ADVANCED CONTROL SYSTEM (BETL/ELL701/7441EL)

1. 1. Familiarization with the Matlab package for the simulation of the control system design.
2. Determine the characteristics of the proportional controller using Matlab.
3. Determine the characteristics of the PI controller using Matlab.
4. Determine the characteristics of the PID controller using Matlab.
5. Experimentally verify the performance characteristics of the DC motor speed control system.
6. Design a DC motor speed control system using IC-555.
7. Speed control of servo motor by PWM technique.
8. Design a passive RC lead compensating network for maximum phase lead.

Addition Experiments

1. Determine the root locus of transfer functions.
2. Magnitude and phase bode plot of a transfer functions.

Course Outcomes

After completing this lab student will be able to:

CO1: Explain various control systems for the operations of DC motors and their applications.
CO2: Experimentally demonstrate the four quadrant operation of a DC motor.
CO3: Experimentally characterize a stepper motor and its applications.
CO4: Demonstrate the pulse width modulation technique for the speed control of motor.
CO5: Demonstrate the operation of magnetic amplifier in different configurations.

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MICROWAVE ENGINEERING (BETL/ELL702/7442 EL)

Course objectives: The goal of this course is to introduce students to the concepts and principles of the advanced microwave engineering, theory and design of passive and active microwave components, and microwave circuits.

Unit I Review of Maxwell's equation, Rectangular waveguides, characteristics of TE and TM wave in rectangular wave guides, Dominant mode in rectangular waveguide, Cylindrical waveguides, waveguide excitation.

Unit II Microwave resonator, Microwave Network representations. Scattering matrix, S-Matrix for two, three & four port networks such as E-plane tee, H-plane tee, Magic tee, directional coupler, tuning screw, quarter wave transformer, matched load, isolator, circulator.

UnitIIITransit time effect, Tubes for very high frequency limitation of conventional tubes, Reflex klystron, two cavity klystron, Magnetron, Travelling Wave Tube.

UnitIVPin diode, Tunnel diode, GUNN effect devices, varactor diode, IMPATT diode, circuit application of above devices, MASERS AND LASERS.

UnitVMeasurement of VSWR, impedance, frequency, dielectric constant power, attenuation and phase shift. Planar transmission lines Introduction to micro strip lines, slotlines, coplanar lines.

Reference Books:

1. Introduction to Microwaves -Wheeler G.J., Prentice-Hall
2. Microwave circuits & passive devices- Sisodia and Raghuvanshi, New International.
3. Microwave engineering/David M. Pozar.—4th ed. , John Wiley & Sons, Inc.
4. Microwave Devices and Circuits, SAMUEL Y. LIAO, PRENTICE HALL
5. Microwave and Radar Engineering. Kulkarni, McGraw Hill Education;

Course Outcomes

After the completion of this course students will be able to:

CO1. **Analyze** modes and dominant mode in rectangular waveguide and cylindrical waveguide.
CO2. **Calculate** S-Matrix parameters for different port networks, and Microwave resonator.
CO3. **Explain** Microwave Network representations, H-plane tee, Magic tee, directional coupler.
CO4. **Design** isolator, basic microwave amplifiers, particularly klystrons, magnetron, ~~and RF filters, basic RF oscillator and mixer models.~~
CO5. ~~**Enumerate and**~~ **demonstrate** application of different diodes in microwave circuits.
~~**CO6.** **Design** different types of transmission lines.~~
~~**CO7.** **Compute** the measurement parameters such as VSWR, impedance, frequency, dielectric constant~~ power, attenuation and phase shift etc related to microwave circuits and transmission lines.

MICROWAVE ENGINEERING (BETL/ELL702/7442 EL)

1. Interpret the roles of various microwave components used in the microwave bench setup.
2. Measure microwave frequency.
3. Analyze the E-plane tee junction properties and measure its isolation & amp; coupling coefficient.
3. Examine the performance of directional coupler.
4. Analyze the H-plane tee junction properties and measure its isolation & amp; coupling coefficient.
5. Inspect the performance of three port circulator
6. Analyze the magic/hybrid tee junction properties and measure its isolation & amp; coupling coefficient.
9. Measure the radiation pattern of the antenna.

Course Outcomes:

After completing the lab, students will be able to:

CO1. Investigate the properties of E-plane and H-plane tee.

CO2. Examine the three port circulator.

CO3. Demonstrate the performance of directional coupler.

CO4. Develop the ability to measure microwave frequency.

CO5. Develop the ability of working in team/group and learn professional ethics.

CO6. Handle the experiment setup and kits properly.

L	T	P
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CELLULAR AND MOBILE COMMUNICATIONS (BETL/ELL703/7443EL)

Course objectives: The main objective of the course is to provide a comprehensive and state of the art knowledge in the area of mobile communication. The course emphasis is on the structure and function of the complete mobile communication system.

UnitI Introduction to wireless communication systems, different generations of wireless networks. Cellular system design fundamentals, frequency reuse, handoff strategies, Interference and system capacity, Trunking and grade of service.

UnitII Mobile radio propagation: free space propagation model, Ground reflection propagation model, Long term fading, Small scale multipath propagation, Time dispersion parameters, Coherence bandwidth, Doppler spread and coherence time, types of small scale fading, Clarke's model for flat fading, level crossing and fading statistics.

UnitIII Capacity in cellular systems, cell splitting and sectoring, cell-site antennas and mobile antenna, cochannel interference reduction, Frequency management and channel assignment.

UnitIVFrequency division and time division multiple access. Global System for Mobile: System Architecture. GSM Radio subsystem,. GSM.. GSM Traffic Channel and Control Channel, Frame Structure.

UnitV Spread spectrum multiple access (Frequency Hopped Multiple Access and. Code Division Multiple Access). Different spreading codes.CDMA Digital Cellular system: different standards with detailed description of forward and reverse channels. Capacity of cellular systems.

Reference Books:

1. Mobile cellular telecommunication- W. C. Lee, McGraw-Hill
2. Wireless communication -T. S. Rappaport, Prentice Hall
3. Wireless communication – Simon Haykins, Pearson

Course Outcomes

After the completion of this course students will be able to:

CO1. **Build** the concepts of wireless communication and cellular systems.
CO2. **Analyze** mobile radio propagation models and parameters related to it.
CO3. **Describe** about cell splitting, sectoring, cell-site antenna and frequency management for cellular system.
CO4. **Differentiate** TDMA and FDMA.
CO5. **Analyze** GSM system architecture and its frame structure.
CO6. **Describe** spread spectrum multiple access and CDMA.

CELLULAR AND MOBILE COMMUNICATIONS (BETL/ELL703/7443EL)

List of Experiment

1. Develop the program to compute the blocking probability.
2. Generation of BFSK,MSK and GMSK signals.
3. Write a computer program to generate a Rayleigh fading envelop.
4. Generate the Walsh-Hadamard codes of length 2
5. Write a computer program to generate a maximal length sequencecode of length 31 using the polynomial: $1+X+X^2+X^4+X^5$.
6. Generate the set of Gold codes using the following m-sequences:
   (i) $1+X+X^2+X^4+X^5$ (ii) $1+X^2+X^5$

Course Outcomes:

At the end of this lab, students will be able to:

CO1. **Illustrate** the Blocking probability.
CO2. **Demonstrate** the generation of BFSK, MSK, and GMSK signal
CO3. **Develop** the programing skill for Rayleigh fading envelope.
CO4. **Investigate** the generation different code used for cellular and mobile communication.
CO5. **Evaluate** the performance of the cellular and mobile communication system using MATLAB.

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VLSI DESIGN (ELL704/7444EL)

Course Objectives: To develop the students' understanding the design of rudimentary logic functions and implementation at the transistor-level in complementary metal-oxide semiconductor (CMOS) technology.

UnitI Introduction, Trends & Projections in VLSI Circuits, Flow diagram of VLSI Circuit Design and VLSI Design issues. MOSFET fundamentals, Enhancement Mode MOSFETs, Depletion Mode MOSFETs, Weak & strong Inversion Conditions, Threshold Voltage Concept in MOSFETs, IV Characteristics of a MOSFET, Limitations in IV Model.

Unit II Basic VLSI Design Styles-NMOS, CMOS Process flow ; Noise Margin; Inverter Threshold Voltage; NMOS Inverter design and characteristics; CMOS Inverter Design and Properties; Inverter as an Amplifier and Differential Amplifier, Delay , Power Dissipation and scaling in CMOS circuits.

UnitIII Parallel& Series Equivalent circuits; Static CMOS Circuit Design: case study; VLSI Interconnects.

UnitIV Stick Diagrams; Physical Design Rules; Layout Designing; Euler's Rule for VLSI Physical Design. High Speed Dynamic CMOS logic families; Precharge-Evaluate logic; Dynamic CMOS logic circuits, cascading ,

.

Unit V Memory / Regular Structure Design; ROM Design, SRAM Design SPICE models, introduction to Xilinx, overview of verilog ,VHDL,VHDL Operators, Basic concepts

Reference Books:

1. CMOS Digital Integrated Circuits-Analysis & Design - S.M. Kang & Y. Leblibici-TMH, Ed. 2003.
2. Solid State Electronic Devices-B.G. Streetman & S. Banerjee- PHI.
3. Introduction to VLSI- K. Eshraghian&Pucknell - PHI.
4. Digital Integrated Circuits-A Design Perspective -J.M. Rabaey -PHI.
5. Design of Analog CMOS Integrated Circuits- B. Razavi-TMH.
6. Principles of CMOS VLSI Design: A System Perspective - N.H.E. Weste & K. Eshraghian - McGraw Hill Pub.

Course Outcomes:

After the completion of this course students will be able to:

- **CO1.** **Design** different VLSI Circuits.
- **CO2.** **Describe** MOSFET fundamentals its manufacturing and fabrication process.
- **CO3.** **Design** inverter, parallel and series equivalent circuits and VLSI interconnects.
- **CO4.** **Illustrate** circuit diagram, stick diagrams and layouts design rules for MOS.
- **CO5.** **Describe** MOS transistor characteristics and its various Performance parameters .
- **CO6.** **Design** CMOS subsystems and Semiconductors memories- SRAM DRAM SRAM SPICE models.
- **CO7.** **Design** programs for VHDL, and Verilog.

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SELECTED TOPICS IN COMMUNICATION (BETL/ELL705 (i) /7445)
(Elective-III)

Course objectives: Objective of this course is to provide students with the knowledge and understanding of advanced digital telecommunications systems with special emphases on digital modulation techniques.

UNIT I Signal design for band-limited channels: Nyquist criterion for zero ISI, design of communication system using pulses with a raised cosine spectrum, partial response signaling, basic concept of equalizers for compensation of ISI.

UNIT II Error rate performance of BPSK, QPSK and BFSK over flat Rayleigh fading channel, diversity techniques, tapped delay line channel model and RAKE demodulator.

UNIT III Diversity using multiple antennas. Trellis coded modulation.

UNIT IV Multiuser detection: Detection of multiuser CDMA signals, single user detector and multiuser MMSE detector for synchronous CDMA transmission.

UNIT V OFDM: Principle, modulation by DFT, cyclic OFDM extension, reduction of inter carrier interference and peak-to-mean power ratio.

Reference Books:

1. Digital communication – John G Proakis, McGraw-Hill
2. Communication Systems –Simon Haykins, Wiley
3. Principle of Communication Systems-Taub and Schilling, Tata McGraw-Hill
4. Communication Systems-Singh and Sapre, Tata McGraw-Hill

Course Outcomes

After the completion of this course students will be able to-

CO1. **Design** communication system and build the concepts of equalizers for compensation of ISI.
CO2. **Evaluate** the error rate performance of BPSK, QPSK and BFSK.
CO3. **Analyze** OFDM modulation technique and reduce inter carrier interference.
CO4. **Build** the CDMA concepts and modulation techniques.
CO5. **Detect** multiuser CDMA signals for synchronous CDMA transmission.
CO6. **Analyze** diversity using multiple antennas and build the concept of Trellis coded modulation.

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ATM NETWORK (BETL/ELL705 (ii) /7445)
(Elective-III)

Course objectives: To Understand the principle of ATM as transfer mode for the future broadband ISDN. Develop the students knowledge of the ATM protocol, network architecture and ATM applications in different networks.

Unit I Introduction to ISDN, B-ISDN, B-ISDN service, ATM basics, ATM Services, Architecture of B-ISDN, virtual channel, Virtual path, ATM performance Parameters, Signaling techniques.

Unit II ATM – performance Reference Model (PRM) layered architecture, relationship between ATM PRM and OSI reference model. Layer functions, User Network Interface (UNI), Physical layer of UNI, functions of transmission convergence sub layer, physical medium characteristic ATM layer cell headers of B-ISDN, UNI & MNI, ATM adaptation layer, operation and maintenance of B-ISDN UNI.

Unit III B-ISDN signaling, meta signaling, ATM adaptation layer for signaling, signaling protocols, switches & cross connects.

Unit IVATM transmission network, Cell transfer function, transmission systems, network synchronization, B-ISDN local network Topology & Technology, Trunk, network structure, ATM network implementation and its equipments.

Unit V Evolutionary scenarios forBISDN fiber to the customer, integration of TV distribution, LAN's, Man's to BISDN, Voice delay & Eco problem, Tainting in BISDN, Telecommunication management networks, Gigabits LAN's, Optical switching, ATM standardization.

Reference Books:

1. ATM Network - Rainer Handel, Huber & Schooder- Addison Wesley
2. ATM Theory & Application- David E.M. Dysan -McGraw Hill
3. Computer Network –Tannanbaum
4. An Introduction to ISDN- William Stalling- McMillan Publishing Co. USA.

Course Outcomes

After the completion of this course students will be able to:

- **CO1.** **Express** the concept of ISDN, BISDN and also identify the services of ATM network.
- **CO2.** **Identify** virtual path, virtual channel, transmission path and also **compare** the different switching techniques.
- **CO3.** **Classify** the layers of ATM network and compare it with OSI model.
- **CO4.** **Illustrate** the signaling protocol for BISDN and ATM network.
- **CO5.** **Calculate** parameters for ATM network implementation.

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CMOS TECHNOLOGY (BETL/ELL710 /7445)
(Elective-III)

Course objective: This course aims at understanding the manufacturing methods and their underlying scientific principles in the context of technologies used in VLSI chip fabrication.

Unit -I
Introduction
CMOS Logic: Inverter, NAND Gate, Combinational Logic, NOR Gate, Compound Gates, Pass Transistors andTransmission Gates, Tristates, Multiplexers, Latches and Flip-Flops, CMOS Fabrication and Layout: Inverter Crosssection ,Fabrication Process, Layout Design rules, Gate Layout, Stick Diagrams. VLSI Design Flow.

Unit -II
MOS Transistor Theory: Ideal I-V Characteristics, C-V Characteristics: MOS Capacitance Models, MOS GateCapacitance Model, MOS Diffusion Capacitance Model. Non ideal I-V Effects: Velocity Saturation and MobilityDegradation, Channel Length Modulation, Body Effect, Subthreshold Conduction, Junction Leakage, Tunneling,Temp. and Geometry Dependence.DC Transfer characteristics: Complementary CMOS Inverter DC Characteristics,Beta Ratio Effects, Noise Margin, Pass Transistor DC Characteristics .

Unit -III
CMOS Processing Technology
CMOS Technologies: Background, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide(SiO2), Isolation, Gate Oxide, Gate and Source/Drain Formation, Contacts and Metallization, Passivation, Metrology.Layout Design Rules: Design Rules Background.

Circuit Unit –IV
Characterization and Performance Estimation
Delay Estimation: RC Delay Models, Linear Delay Model, Logical Effort, Parasitic Delay. Logical Effort and TransistorSizing: Delay in a Logic Gate, PowerDissipation: Static Dissipation, Dynamic Dissipation, Low-Power Design. Interconnect: Resistance, Capacitance,Delay, Crosstalk. Design Margin: Supply Voltage, Temperature, Process Variation.

Unit V.
Array Subsystem: Introduction, SRAM, DRAM, Read-Only Memory, Serial Access Memories, Content-Addressable Memory.Programmable Logic Arrays.

References:

1. Neil H.E. Weste, David Harris, Ayan Banerjee: CMOS VLSI Design, Third Edition, Pearson Education.
2. Neil H.E. Weste, Kamran Eshraghian: Principle of CMOS VLSI Design, Pearson Education.
3. B. Razavi: Design of Analog CMOS Integrated Circuits, TMH Publication.
4. J. M. Rabaey, Digital Integrated Circuits, PHI Learning.
5. J. P. Uyemura: Chip Design for Submicron VLSI, Cengage Learning.

Course Outcomes

After the completion of this course students will be able to-

CO1. **Describe** ~~the~~ various CMOS logic circuits, fabrication process and layout design.

CO2. **Design** different ~~MOS~~ Describe MOSFET ~~fundamentals~~ Characteristics, model etc and non-idealities.

CO3. **Classify** the CMOS Process technology and layout design rules for CMOS circuits.

CO4. **Describe** ~~MOS transistor characteristics and its various performance, Parameters that effect~~ the operation the of CMOS circuits. Examine the delay, power dissipation and noise effect in CMOS logic gates.

CO5. **Examine** the Semiconductors Memories and **design** ~~problems~~ related to ~~programmable logic~~ array.

CO6 : Design programmable logic array circuits

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DATA WAREHOUSE AND MINING (BETL/ELL-711/7445)
(Elective-III)

Course objective: To introduce the basic concepts of Data Warehouse and Data Mining techniques, examine the types of the data to be mined and apply preprocessing methods on raw data and Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.

Unit-I

Introduction: Motivation, important, Data type for mining: relational databases, Data warehouses. Transactional databases, advanced Databases system and its Applications, Data mining Functionalities Concept/Class description, Association Analysis classification & prediction, cluster analysis, Outer liner Analysis classification of data Mining Systems, Major issues in data mining.

Unit -II

Data warehouse and OLTP Technology for Data Mining: Differences between operational Database systems & Data warehouse, A multidimensional Data Model, Data warehouse Architecture, Data warehouse Implementation Data cube technology.

Unit -III

Data pre-processing: Data cleaning, Data Integration and Transformation Data reduction Discretization and concept Hierarchy Generation. Data Mining Primitives Languages and system Architectures, Concept Description, Characterization and comparison Analytical characterization.

Unit -IV

Mining Association rules in large databases : Association rule mining : Market Basket Analysis , Basic concepts, Mining single Dimensional Boolean Association rules from Transactional databases : The Apriori algorithm, Generating Association rules from frequent items, Improving the efficiency of Apriori, other algorithms & their comparison, Mining multilevel Association Rules, Multidimensional Association rules constrained based Association rule Mining.

Unit -V

Classification & Prediction and cluster Analysis: Issues regarding classification & prediction Different classification methods, Prediction, cluster Analysis, Major clustering methods Application & Trends in data mining: Data mining Applications, Currently available tools, case study , current status.

Reference Books:-

1. Data Mining concepts and techniques - Jiawei Han and Micheline Kamber, Morgan Kaufmann **Publishers,**
2. Data mining and Techniques – Arun Kumar and Pujari, Pearson Education
3. Data mining Introductory and Advanced Topics – Margaret H. Dunhan, Pearson Education

Course Outcomes:

After the completion of this course students will be able to

CO1. **Distinguish** between various Data Mining techniques.

CO2. **Differentiate** between various tools of Data Mining and their techniques to solve the real time problems.

CO3. **Investigate** the techniques of clustering, classification, association finding, feature selection and visualization to real world data.

CO4. **Examine** interesting patterns from different kinds of databases.

CO5. **Examine** the cluster Analysis, analyze supervised and unsupervised models

CO6. **Design** various algorithms based on data mining tools.

L	T	P
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FIBER OPTICS & OPTICAL COMMUNICATION

(BETL/ELL801 /8441 EL)

Course objectives: This course gives an introduction of the principles and technologies of optical fiber communications and optical networks. It covers optical fiber waveguide theory, the structure and performance of active and passive optical devices, optical fiber communication systems, the structures and key technologies of optical fiber information networks.

Unit I Introduction to optical communication, principles of light transmission, Optical fiber modes and configurations, Mode theory for circular wave-guides, Single-mode fibers, Multimode fibers, Numerical aperture, Mode field diameter, V-number, fiber materials, Fiber fabrication techniques.

Unit II Optical sources, LED'S, LASER diodes, Model reflection noise, Power launching and coupling, Population inversion, fiber splicing, optical connectors, Photo-detectors, PIN, Avalanche detector, Response time, Avalanche multiplication noise.

Unit III Signal degradation in optical fibers, Attenuation losses, Signal distortion I optical wave guides, Material dispersion, Wave guide dispersion, Chromatic dispersion, Inter-modal distortion, Pulse broadening in Graded index fibers, Mode coupling, Advance fiber designs: dispersion shifted, Dispersion flattened, Dispersion compensating fibers, Design optimization of single mode fibers.

Unit IV Coherent optical fiber communication, Modulation techniques for Homodyne and Heterodyne systems, Optical filter link design, Rise time budget and link power budget, Long haul systems bit error rate, line coding, NRZ, RZ, Block Codes, eye pattern.

Unit V Advance system and techniques, wavelength division multiplexing, optical amplifiers, semiconductor amplifier, EDFA, Comparison between semiconductor and optical amplifier, Gain band width, Photonic switching, Optical Networks, Optical fiber bus, Ring topology, Star architectures, FDDI, SONET.

Reference Books:

1. Optical Communication Systems – By J. H. Franz, V. K. Jain, Narosa Publishing House
2. Optical Fiber Communication – By G. Keiser , Tata McGraw-Hill Education
3. Optical Fiber Communication- By John M. Senior, Prentice Hall

Course Outcomes

After the completion of this course students will be able to:

CO1. ~~**Learn** the basic elements of optical fiber transmission link, fiber modes configurations and fabrication techniques.~~ Discuss Fiber optics modes configuration

CO2. **Classify** various optical sources, fiber splicing techniques, optical connectors with their principles.

CO3. **Analyze** different optical receivers and their noise performances.

CO4. **Calculate** the channel impairments like losses and dispersion.

CO5. **Discuss** Coherent optical transmission system, ~~the~~ installation and performance verification of digital optical fiber link.

CO6. **Discriminate** between different amplifiers, and learn variety of networking aspects, FDDI, SONET, WDM.

FIBER OPTICS & OPTICAL COMMUNICATION

(BETL/ELL801 /8441 EL)

List of Experiment

1. Demonstration of different elements of fibre optic communication.
2. To set up an analog optical fiber link.
3. To set up a digital optical fiber link.
4. Demonstrate the AM system using analog input signal.
5. Demonstrate the AM system using digital input signal.
6. Determine the propagation loss in optical fibre.

Course Outcome:

On completion of this Lab the student will be able to:

CO1. Demonstrate different elements of fibre optical communication.
CO2. Examine fibre optic link, digital as well as analog.
CO3. Determine the propagation loss in optical fibre
CO4. Operate AM system using analog input in fiber optics
CO5. Operate AM system using digital input in fiber optics

L	T	P
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SATELLITE COMMUNICATION
(BETL/ELL802/8442EL)

Course objectives: The course provides the basic concepts and principles of satellite communication and learns how the satellite provides communication services.

UNIT I Introduction:- Origin of satellite communication current state of satellite communication. Orbital aspect of satellite communication: - Orbital mechanism, equation of orbit, locating Satellite in orbit. Orbital elements, orbital perturbation. Space craft subsystem:- Altitude and orbit control system, Telemetry tracking and command power system, communication Subsystem.

UNIT II Satellite link design :- system noise temperature and G/T ratio , down link design, domestic satellite system, uplink design, design of satellite link for specified.

Unit III Multiple access techniques:- FDMA, FDM/FM/FDMA, Effects of intermodulation, Companded FDM/FM/FDMA,TDMA,TDMA FRAME Structure and design, TDMA Synchronization and timing code division multiple access on board processing, SCPS system, digital speech interpolation system DAMA.

UNIT IV Propagation on satellite:- Earth's path- propagation effects, atmospheric absorption Scintillation effects land and sea multipath ,rain and ice effects, rain drop distribution Calculation of attenuation rain effects on Antenna noise temperature. Eliminating propagation effects:- Attenuation, site diversity, De polarization.

UNIT V Encoding and forward error correction; Error detection and correction, channel capacity, Error detecting code, linear block codes, error correction with linear block codes, performance of block error correction codes, convolution codes, cyclic code, BCH and codes ,error detection on satellite links. Earth station technology - earth station design, antennas tracking, LAN, HPA, RF, Multiplexing factors affecting orbit utilization, tracking, equipment for earth station.

Reference books

1. Satellite communication by D.C.Agrawal, Khanna Publisher
2. Satellite communication by T.Pratt. , Wiley Publisher
3. Advance electronic communication systems –WAYNE –Tomasi , Prentice Hall
4. Satellite communication-Robert M Gagliardi , CBS Publisher
5. Satellite communication-Dennis –Roddy, McGraw-Hill

Course Outcomes

After the completion of this course students will be able to :

CO1. Explain basic concepts and terminologies of satellite communication
CO2. Calculate the link power budget.
CO3. Analyse the different multiple Access schemes for Satellite communication
CO4. Classify different Propagation effects in satellite.

CO5. Solve problems related to channel coding techniques.
CO6. Distinguish different satellite system.

SATELLITE COMMUNICATION
(BETL/ELL802/8442EL)

List of Experiment

1. Demonstrate the set-up of direct satellite link between transmitter and receiver.
2. Demonstrate active satellite link and link fail operations.
3. Analyse the audio video transmission through satellite link between transmitter and receiver.
4. Analyse the baseband analog signal (voice) in satellite link.
5. Evaluate the transmit and receive function generator waveforms through satellite link.
6. Demonstrate the transmission of tone through satellite link.
7. Determine uplink and downlink frequencies of a satellite link

Course Outcome:

On completion of this Lab the student will be able to:

CO1. Differentiate the direct and active satellite link.
CO2. Illustrate the satellite transmission and reception of data/ signal.
CO3. Evaluate the performance of satellite transmission and reception of data/ signal.
CO4. Investigate uplink and downlink frequencies.
CO5. Demonstrate satellite transmission and reception.

L	T	P
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TV AND RADAR ENGINEERING

(BETL/ELL803/8443EL)

Course objectives: The objective of this course is to introduce to the students the basics of TV picture transmission and reception and different radar systems with their applications.

Unit I Scanning number of scanning lines, Flicker, Interlaced scanning, vertical resolution, horizontal resolution, Video signal bandwidth diagram, blanking pulses, synchronizing pulses, bandwidth requirement, vestigial side band transmission.

Unit II Monochrome Color Picture tube, Television camera tube, image orthicon vidicon, plumbicon, television transmitter, television application.

Unit III Television receiver D.C. restoration, inter carrier sound system, compatibility of colour television, colour theory, colour television camera, colour television picture tube, antenna, HDTV.

Unit IV Principles of RADAR, Radar frequencies, pulse RADAR, RADAR range equation, RADAR application, RADAR cross section of targets RADAR indicator, Noise figure of receiver, Mixer duplexer, Line pulsar.

Unit V MTI RADAR, Delay line canceller, digital signal processing, limitation of MTI RADAR, CW RADAR, FM CW RADAR.

Reference Books:

1. TV Engineering- Dhake, Tata McGraw-Hill Education
2. Monochrome and colour Television -R.R. Gulati, Wiely Eastern
3. RADAR System –Skolnik, McGraw-Hill

Course Outcome

After the completion of this course students will be able to:

CO1. **Explain** the various components of the composite video signal, TV camera tube, and picture tube.
CO2. **Characterize** various types of monochrome and color television systems.
CO3. **Analyze** basic ~~factors required~~ for successful transmission and reception of TV signals.
CO4. **Explain** the advanced topics in digital television and High definition television.
CO5. **Evaluate** the various performance factors related to the RADAR.
CO6. ~~Explain target detection and tracking using radar systems.~~

requirement

Describe the digital Signal processing techniques used in Radar Systems.

TV AND RADAR ENGINEERING

(BETL/ELL803/8443EL)

List of Experiments

1. To illustrate RF tuner, IF amplifier and sound IF amplifier.
2. To observe picture tube and power amplifier
3. To examine video output.
4. To examine vertical and horizontal output.
5. To detect sound output and EHT output.
6. To identify faults in different sections of TV.

Course Outcomes:

After completing this lab students will able to:

CO1. **Recognize** different audio and video compression standards used for T.V.
CO2. **Model** the faithful transmission and reception of monochrome and colour television signals.
CO3. **Identify** faults in different sections of TV.
CO4. **Develop** the ability of working in team/group and learn professional ethics..
CO5. **Handle** the experiment kit properly.

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Image Processing and Pattern Recognition

(ELL804 (i) /8444 EL)

(Elective IV)

Course objectives: The course is designed to introduce students to theoretical concepts and issues associated with Image Processing and pattern recognition.

Unit I Digital Image Processing Problems and Application Two dimensional system, Matrix theory result, Block Matrix and Conical Products. Two Dimensional four and Z Transform

Unit II Image Perception, Introduction to Monochrome Vision Model, Color Representation, Color Vision Model, Image Sampling and Quantization. Image Quantization, Optimum Mean Square Quantizer, Compentor Design. Analytical Models for Practical Quantizer, Visual Quantization.

Unit III Image Transform, Two Dimensional Orthogonal and unitary Transform, Properties of Unitary Transform, Properties of Two Dimensional DFT, Cosine Transform, Hadamard Transform, R Transform, Slant Transform, KL Transform.

Unit IV Image Enhancement, Method of Image Enhancement: Point Operation Histogram Modeling, Spatial Transform Operation, Color Image Enhancement.

Unit V Image Feathers Extraction – Hash Reduction, Boundary Extraction, Introduction to Image Data Comparison, Image Restoration.

Reference Books:

1. Fundamental of Digital Image Processing - A. K. Jain PHI New Delhi
2. Digital Image Processing – Gonzalez, Pearson
3. Image Processing Analysis and Machine Vision – Milan Sonka, CL Engineering
4. Image Processing Theory –Dr. M.A. Sid- Ahmed , McGraw-Hill

Course Outcomes

After the completion of this course students will be able to:

CO1. **Calculate** the various transforms and represent image in matrix form
CO2. **Quantize** the image and represent it in monochrome & colour models.
CO3. **Enhance** the features of image to make it better for processing.
CO4. **Extract** the features and deduce. The Stage of data using boundary detection.
CO5. **Perform** the compression of data to save memory and band width.
CO6. **Transform** the image so that various operations can be performed.

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NEURAL NETWORKS AND FUZZY SYSTEMS
(BETL/ELL804 (ii) /8444 EL)
(Elective IV)

Course objectives: The aim of this course is to provide students with an understanding of the fundamental theory of neural networks and fuzzy systems and to model and solve complicated practical problems such as recognition and classification .

Unit I Introduction, Human Brain and Biological Neurons, Properties of Artificial Neural system, ANN, Training of Neural Networks, Perceptron and linears reparability.

Unit II Multilayer feedback networks, Back Propagation, Training, Recurrent networks, Hopfield nets and energy function, statistical training methods and Boltsman machine, Counter propagation network architecture, operation, training of kohonen layer, training of grossberg layer, Cauchy training.

Unit III Competitive learning, Architecture of ART, Working of ART, Implementation and training of ART.

Unit IV Fuzziness Probability: Fuzzy sets and systems, fuzzy entropy theorem, substheed theorem, entropy-hobsethood theorem, Fuzzy associative memory, Fuzzy and neural Function entimators, fuzzy Hebb FAMs, Adaptive FAMS.

Unit V Fuzzy and Neural control systems, Comparison of Fuzzy and Neural systems, Fuzzy image transform coding, Fuzzy controller, Kalman Filter Controller.

Reference Books:

1. Neural Computing theory and Practice- P.D. Wosotman, Coriolis Group
2. Neural networks and Fuzzy systems - Bert Keske, Prentice-Hall
3. Neural Network- Simon Haykins, Prentice Hall
4. Fuzzy logic with engineering application- Timothy, John Wiley & Sons

Course Outcomes

After the completion of this course students will be able to:

CO1. **Explain** the basic concepts of neural networks
~~CO2. **Analyze the concept of human neural structure & ANN.**~~
CO3. **Analyze** the various feed forward/ feedback neural networks.
CO4. **Examine** different learning methodologies.
CO5. **Explain** the concept of fuzziness involved in various systems and fuzzy set theory. .
CO6. **Analyze** the application of fuzzy logic control to real time systems.
CO7. **Design** fuzzy controllers.

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NANOTECHNOLOGY

(BETL/ELL804 (iii) / 8444 EL)

(Elective IV)

Course objectives: The objectives of this course are to provide the students with knowledge and the basic understanding of nanotechnology.

UNIT-I NANOTECHNOLOGY: Background, what is nanotechnology, types of nanotechnology and nano-machines, top down and bottom up techniques, Molecular nanotechnology, atomic manipulation-nanodots, self-assembly, Dip pen nanolithography,

UNIT-II NANOMATERIALS : What are nanomaterials? Preparation of nanomaterials-Plasma arcing, Chemical Vapor Deposition, Sol-gels techniques, Electro deposition, Ball Milling, Natural nanomaterials, Applications of nanomaterials-Insulation materials, Machine tools, Phosphors, Batteries, High power magnets Medical implants.

UNIT-III CARBONTUBES: New forms of carbon, Carbon tubes-types of nanotubes, formation of nanotubes, Assemblies, purification of Carbon nanotubes, Properties of nanotubes, applications of nano tubes.

UNIT-IV OPTICS, PHOTONICS AND SOLAR ENERGY: Light and nanotechnology, Interaction of light and nanotechnology, Nano holes and photons, Solar cells, nano particles and nanostructures; Optically useful nanostructured polymers, Photonic Crystals.

UNIT-V NANOELECTRONICS: Introduction, Tools of Micro- and Nanofebrication-optical and electron beam lithography, Molecular beam lithography, Quantum electronic devices, Molecular electronics, Simple ideas about quantum computers.

APPLICATIONS: MEMs, robots, Nanomachines, Nanodevices, New Computing System, Optic-electronic devices, Environmental applications, Nanomedicine, Biological nano-technological future.

Reference Books:

1. Nanotechnology-A Gentle Introduction to the Next Big Idea Mark Ratner and Daniel Ratner, Prentice Hall.
2. Nanotechnology-Basic Science and Emerging Technologies Mick Wilson, Kamali Kannangra
3. Geoff Smith. Michelle Simons and Burkhard Raguse, Overseas Press.
4. Nanotechnology: Rebecca L Johnson, Lerner Publications.
5. Introduction to Nanotechnogy: Charles P. Poole Jr., Chapman and Hall/CR

Course Outcomes

After the completion of this course students will be able to:

CO1. **Describe** the basic concepts of nanotechnology
CO2. **Classify** the preparation of Nanomaterials
CO3. **Identify** carbon tubes, its preparation and properties
CO4. **Analyze** the optics, photonics and solar energy of nanotechnology
CO5. **Describe** the application of Nanotechnology and nanomaterials
CO6. **Develop** Environmental applications and design toots of Micro and Nanofebrication-optical and electron beam lithography

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BIO-MEDICAL INSTRUMENTATION
(BETL/ELL804 (iv) /8444 EL)
(Elective IV)

Course objectives: this course gives knowledge of the principle of operation and design of biomedical instruments and gives the introductory idea about human physiology system which is very important with respect to design consideration.

Unit I 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, Bio potential Electrodes – Surface electrodes, Needle electrodes, Microelectrodes, Biomedical Transducer.

Unit II 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 Respiratory system Measurements: Physiology of Respiratory system. Measurement of breathing mechanism – Spirometer. Respiratory Therapy equipment: Inhalators, Ventilators & Respirators, Humidifiers, and Nebulizers & Aspirators.

Nervous System Measurements: Physiology of nervous system, Neuronal communication, Neuronal firing measurements.

Unit IV 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.

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

Prosthetic Devices and Therapies: Hearing Aides, Myoelectric Arm, Diathermy, Laser applications in medicine.

Reference Books:

1. Cromwell, "Biomedical Instrumentation and Measurements" PHI
2. R. S. Khandpur, "Biomedical Instrumentation", TMH
3. J. G. Webster (editor), "Medical Instrumentation Application & Design", 3rd Ed WILEY, India
4. S. Ananthi, "A Text Book of Medical Instruments", New Age International
5. Pandey& Kumar, "Biomedical Electronics and Instrumentation", Kataria

Course Outcomes

After the completion of this course students will be able to:

CO1. **Demonstrate** the principle operation, design and the background knowledge of biomedical instruments and specific applications of biomedical engineering.

CO2. **Enumerates** various electrodes and transducers for different biomedical applications.

CO3. **Illustrate** the measurements involved in some medical equipment.

CO4. **Examine** the human physiology system.

CO5. **Explain** the comprehensive biomedical instrumentation knowledge to solve the Engineering Problems related to medical field.

CO6. **Describe** quantitatively as well as qualitatively the medical diagnosis & therapy and Bio-telemetry principles involved in medical.