Dr. Bhimrao Ambedkar University, Agra - 282002

(Formerly Agra University, Agra)

www.dbrau.ac.in

Institute of Engineering & Technology
Khandari Campus, Agra

BACHELOR OF ENGINEERING
(B.E.)

Course Structure & Evaluation Scheme

Approved for 2nd, 3rd, 4th Year only

(Electronics and Communication Engineering)

w.e.f. 2019-20

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
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Department of Electronics & Communication Engg.

Vision of the Department:

To become a centre of excellence in the field of Electronics & Communication Engineering by providing quality education and research to produce human resource to cater the needs of Industry and Society.

Mission of the Department:

M1: To provide the state-of-the-art infrastructure and employ competent & committed human resourcefor carrying out teaching and research.

M2: Developing strong foundations in core areas of Electronics & Communication Engineering by subsuming theory with extensive practical training and exposure to industry.

M3: Developing skilled professionals for Industry and R&D organizations.

M4: Developing value based socially committed professionalism for the holistic development

Program Educational Objectives:

The broad objective of the program is to facilitate the development of competent and successful professionals in tune with modern day technological and societal requirements. The department of Electronics and Communication at IET Khandari, has developed and maintain a well-defined set of educational objectives. The objectives undergo continuous review and modification to assure the quality of our program and graduates. The most recent version ofour educational objective list is given below.

PEO 1: Graduates will have curiosity, desire to experiment, innovation and nature to work in team.

PEO 2: Graduates will be able to strengthen the fundamentals of Mathematics and Science, promote proficiency in Electronics and Communication engineering, soft skills and readiness for Industry & competitive exams and will have entrepreneurial talent.

PEO 3: Graduate will reflect social responsibility and life-long learning by inculcating integrity, accountability, cultural and environmental sensitivity

Program Specific Outcomes

PSO1: The ability to apply concepts in Electronics and Communication Engineering to design and implement complex systems in the areas related to Analog and Digital, Communication, Signal Processing, Microwave, VLSI, Embedded Systems etc

PSO2: The ability to comprehend the technological advancements in the usage of modern design tools for a variety of applications.

Program outcomes suggested by the NBA for engineeringprograms

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs givenin the Table below, ensure that the POs are aligned to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA). These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum.

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and designsystem components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Undergraduate Degree Courses in Engineering & Technology

BACHELOR OF ENGINEERING (ELECTRONICS & COMMUNICATION ENGINEERING)

General, Course structure & Theme
&
Semester-wise credit distribution

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 2 Hours Practical (Lab)/week	0.5 credits 1 credit

B. Structure of Undergraduate Engineering program:

S. No.	Category	Suggested Breakup of Credits (Total 160)
1.	Basic Science Courses (BSC)	20
2.	Engineering Science Courses (ESC)	30
3.	Humanities, Social Science and Management Courses (HSMC)	10
4.	Professional Core Courses (PCC)	60
5.	Professional Elective Courses (PEC)	18
6.	Open Elective Courses (OEC)	14
7.	Seminar	2
8.	Project	10
9.	Internships in industry	8
10.	Mandatory Courses (MC)	NC
	Total Credits	172

E. Course code and definition:

Course code	**Definitions**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses

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

Table: Structure of B.E. Program

S. No.	Courses		Credits							Actual Credits
		Total Credits	I&II	III	IV	V	VI	VII	VIII	
1.	Basic Science Courses (BSC)	20	17	4						21
2.	Engineering Science Courses (ESC)	30	19	8	4					31
3.	Humanities, Social Science and Management Courses (HSMC)	10	4		3	3				10
4.	Professional Core Courses (PCC)	60		9	14	11	15	8	7	64
5.	Professional Elective Courses (PEC)	18				3	4	3	4	14
6.	Open Elective Courses (OEC)	14				3	3	3	4	13
7.	Seminar	2						2		02
8.	Project	10						3	7	10
9.	Internships in industry	8		2		2		3		07
10	Mandatory Courses (MC)	NC		Y	Y		Y			
	Total Credits	**172**	**40**	**23**	**21**	**22**	**22**	**22**	**22**	**172**

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Institute of Engineering & Technology

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B.E I Year (Semester-I) CSE, ECE & EE (Group - A)

Course Structure & Evaluation Scheme

(Effective from academic year 2019-20)

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC - 103	Mathematics-I	3	1	0	30	10	40	60	-	100	4
2	BSC - 101	Physics	3	1	0	30	10	40	60	-	100	4
3	BCS - 101	Problem Solving and Computer Programming using "C"	3	1	0	30	10	40	60	-	100	4
4	BME - 101	Engineering Graphics and Design	2	0	0	30	10	40	60	-	100	2
5	BEE - 101	Basic Electronics Engineering	2	0	0	30	10	40	60	-	100	2
6	BSC - 151	Physics Lab	0	0	2	20	20	40	-	60	100	1
7	BCS - 151	Problem Solving and Computer Programming using "C" Lab	0	0	2	20	20	40	-	60	100	1
8	BME - 151	Engineering Graphics and Design Lab	0	0	2	20	20	40	-	60	100	1
9	BEE - 151	Basic Electronics Engineering Lab	0	0	2	20	20	40	-	60	100	1
		Total	13	3	8	230	130	360	300	240	900	20

Group A : CSE, ECE & EE.

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B.E I Year (Semester-II) CSE, ECE & EE (Group - A)

Course Structure & Evaluation Scheme

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC - 203	Mathematics-II	3	1	0	30	10	40	60	-	100	4
2	BSC - 202	Chemistry	3	1	0	30	10	40	60	-	100	4
3	BHSM - 201	Professional English	2	0	0	30	10	40	60	-	100	2
4	BME - 202	Workshop Concepts	2	0	0	30	10	40	60	-	100	2
5	BEE - 201	Fundamentals of Electrical Engineering	3	1	0	30	10	40	60	-	100	4
6	BSC - 252	Chemistry Lab	0	0	2	20	20	40	-	60	100	1
7	BHSM - 251	Professional English Lab	0	0	2	20	20	40	-	60	100	1
8	BME - 252	Workshop Concepts Lab	0	0	2	20	20	40	-	60	100	1
9	BEC - 251	Fundamentals of Electrical Engineering Lab	0	0	2	20	20	40	-	60	100	1
		Total	13	3	8	230	130	360	300	240	900	20

Group A : CSE, ECE & EE.

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B.E II Year (Semester-III) Electronics & Communication Engineering

Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC	BSC 301	Mathematics III	4	-	-	30	10	40	60	-	100	4
2	PCC	BEC 301	Digital Electronics	4	-	-	30	10	40	60	-	100	4
3	PCC	BEC 302	Electronic Devices & Circuits	3	-	-	30	10	40	60	-	100	3
4	ESC	BEE 301	Network Analysis & Synthesis	3	1	-	30	10	40	60	-	100	4
5	ESC	BCS 302	Data Structure	3	-	-	30	10	40	60	-	100	3
6	MC	MC 302	Human Values & Professional Ethics	2	-	-	30	10	40	60	-	100	-
7	ESC	BCS 352	Data Structure Lab	-	-	2	20	20	40	-	60	100	1
8	PCC	BEC 351	Digital Electronics lab	-	-	2	20	20	40	-	60	100	1
9	PCC	BEC 352	Electronic Devices & Circuits Lab	-	-	2	20	20	40	-	60	100	1
10		BEC 354	Mini Project or Internship Assessment	-	-	-	-	-	100	-	-	100	2
			Total	19	1	6	240	120	460	360	180	1000	23

*The Mini Project or internship (4 weeks) conducted during summer break after II semester and will be assessed during III semester.

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B.E II Year (Semester-IV) Electronics & Communication Engineering

Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	HSMC	BHSM 401	Industrial Management	3	-	-	30	10	40	60	-	100	3
2	PCC	BEC 401	Electromagnetic Theory	3	1	-	30	10	40	60	-	100	4
3	PCC	BEC 402	Microprocessor and its Applications	3	1	-	30	10	40	60	-	100	4
4	PCC	BEC 403	Signals& Systems	3	1	-	30	10	40	60	-	100	4
5	ESC	BCS 404	JAVA	3	-	-	30	10	40	60	-	100	3
6	MC	MC 401	Environment and Ecology	2	-	-	30	10	40	60	-	100	-
7	PCC	BEC 451	PCB Design Lab	-	-	2	20	20	40	-	60	100	1
8	PCC	BEC 452	Microprocessor and its Applications Lab	-	-	2	20	20	40	-	60	100	1
9	ESC	BCS 454	JAVA Lab	-	-	2	20	20	40	-	60	100	1
			Total	17	3	6	240	120	360	360	180	900	21

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B.E III Year (Semester-V) Electronics & Communication Engineering

Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	BHMC	BHSM 501	Economics for Industry	3			30	10	40	60	-	100	3
2	PCC	BEC 501	Antenna & Wave Propagation	3		-	30	10	40	60	-	100	3
3	PCC	BEC 502	Automatic Control Systems	3		-	30	10	40	60	-	100	3
4	PCC	BEC 503	Electronic Measurement & Instrumentation	3		-	30	10	40	60	-	100	3
5	PEC	DE-EC 501-505	Departmental Elective-1	3		-	30	10	40	60	-	100	3
6	OEC	OE-EC 501-514	Open Elective-1	3		-	30	10	40	60	-	100	3
7	PCC	BEC 552	Automatic Control Systems Lab	-	-	2	20	20	40	-	60	100	1
8	PCC	BEC 553	Electronic Measurement & Instrumentation Lab	-	-	2	20	20	40	-	60	100	1
9		BEC 555	Internship						100			100	2
			Total	18		4	220	100	420	360	120	900	22

*The internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.

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B.E III Year (Semester-VI) Electronics & Communication Engineering

Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEC 601	Analog Communications	3	1	-	30	10	40	60	-	100	4
2	PCC	BEC 602	Digital Signal Processing	3	1	-	30	10	40	60	-	100	4
3	PCC	BEC 603	Linear Integrated Circuits	3	1	-	30	10	40	60	-	100	4
4	PEC	DE-EC 601-605	Departmental Elective-2	4		-	30	10	40	60	-	100	4
5	OEC	OE-EC 601-614	Open Eletive-2	3		-	30	10	40	60	-	100	3
6	MC	OHS 601	Occupational Health & Safety	2		-	30	10	40	60	-	100	
7	PCC	BEC 651	Analog Communications Lab	-	-	2	20	20	40		60	100	1
8	PCC	BEC 652	Digital Signal Processing Lab	-	-	2	20	20	40	-	60	100	1
9	PCC	BEC 653	Linear Integrated Circuits Lab	-	-	2	20	20	40		60	100	1
			Total	17	4	6	240	120	360	360	180	900	22

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B.E IV Year (Semester-VII) Electronics & Communication Engineering

Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEC701	Digital Communications	3		-	30	10	40	60	-	100	3
2	PCC	BEC702	Wireless & Mobile Communication	3		-	30	10	40	60	-	100	3
3	PEC	DE-EC 701-705	Departmental Elective-3	3		-	30	10	40	60	-	100	3
4	OEC	OE-EC 701-714	Open Elective-3	3	-	-	30	10	40	60	-	100	3
5	PCC	BEC751	Digital Communications Lab	-	-	2	20	20	40		60	100	1
6	PCC	BEC752	Wireless & Mobile Communication Lab	-	-	2	20	20	40		60	100	1
7		BEC 753	Seminar			4			100	-		100	2
8		BEC 754	Internship Assessment						100			100	3
9		BECP 755	Minor Project	-					40		60	100	3
			Total	12		8	160	80	480	240	180	900	22

*The internship (4 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.

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B.E IV Year (Semester-VIII) Electronics & Communication Engineering

Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEC 801	Optical Communications	3	-	-	30	10	40	60	-	100	3
2	PCC	BEC 802	Satellite Communication	3	-	-	30	10	40	60	-	100	3
3	DEC	DE-EC 801-805	Departmental Elective-4	4	-	-	30	10	40	60	-	100	4
4	OEC	OE-EC 801-814	Open Elective-4	4	-	-	30	10	40	60	-	100	4
5	PCC	BEC 851	Optical Communications Lab	-	-	2	20	20	40		60	100	1
6		BECP 852	Major Project	-	-			200	200	-	200	400	7
7				14		2	140	260	400	240	260	900	22

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Departmental Elective Courses		
DE-1	DE-EC 501 DE-EC 502 DE-EC 503 DE-EC 504 DE-EC 505 DE-EC 506	1. Electrical Engineering Materials 2. Electronics Circuit Switching 3. Process Control 4. Embedded Systems 5. Electronic Product design 6. MOOCs Course
DE-2	DE-EC 601 DE-EC 602 DE-EC 603 DE-EC 604 DE-EC 605 DE-EC 606	1. Power Electronics 2. High Speed Semiconductor devices 3. Optical Network 4. Consumer Electronics 5. Computer Networks 6. MOOCs Course
DE-3	DE-EC 701 DE-EC 702 DE-EC 703 DE-EC 704 DE-EC 705 DE-EC 706	1. VLSI 2. Nano-Electronics 3. Information Theory & Coding 4. Artificial Intelligence 5. Electromagnetic Interference 6. MOOCs Course
DE-4	DE-EC 801 DE-EC 802 DE-EC 803 DE-EC 804 DE-EC 805 DE-EC 806	1. Microwave and Radar Engineering 2. Digital Image Processing 3. Opto-Electronic Devices 4. IC Technology 5. Fuzzy Logic and Neural network 6. MOOCs Course

List of Open Electives		
Open Elective – I		
1.	OEC 501	Environmental Pollution and Management
2.	OEC 502	Urban and Town Planning
3.	OEC 503	**Laser System and its Application**
4.	OEC 504	**Bio- Medical Engineering**
5.	OEC 505	Industrial Engineering & Automation
6.	OEC 506	Total Quality Management
7.	OEC 507	Production Planning and Control
8.	OEC 508	Value Engineering
9.	OEC 509	Operation Research
10.	OEC 510	Graph Theory
11.	OEC 511	Computer Based Numerical and Statistical Techniques
12.	OEC 512	VLSI Circuits
Open Elective – II		
1.	OEC 601	Water Resources Conservation
2.	OEC 602	Environmental Management
3.	OEC 603	**Robotics**
4.	OEC 604	Mechatronics
5.	OEC 605	Composite Materials
6.	OEC 606	Entrepreneurship
7.	OEC 607	Mechanical System Design
8.	OEC 608	Product Development & Design
9.	OEC 609	Modeling And Simulation
10.	OEC 610	**Internet of Things**
11.	OEC 611	Electrical and Hybrid Vehicles
12.	OEC 612	**Nanoelectronics**

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Open Elective – III		
1.	OEC 701	Finite Element Analysis
2.	OEC 702	Environment Impact Assessment
3.	OEC 703	**Digital System Design using VHDL**
4.	OEC 704	**Micro Electro Mechanical System**
5.	OEC 705	Non-Conventional Energy Resources
6.	OEC 706	**Nanotechnology**
7.	OEC 707	Non-Destructive Evaluation
8.	OEC 708	Introduction to Mechanical Micro Machining
9.	OEC 709	Data Science
10.	OEC 710	Big Data Analytics
11.	OEC 711	**Machine learning and Python Programming**
12.	OEC 712	**Embedded Systems**
Open Elective – IV		
1.	OEC 801	Remote Sensing And Geographic Information System
2.	OEC 802	Infrastructure Engineering
3.	OEC 803	Advance Sensors and Transducer
4.	OEC 804	**Multimedia Communication**
5.	OEC 805	Power Plant Engineering
6.	OEC 806	Optimization Methods in Engineering
7.	OEC 807	Fracture Mechanics
8.	OEC 808	Machine Tool Design
9.	OEC 809	Block chain
10.	OEC 810	Computer Vision
11.	OEC 811	Metro Systems and Engineering
12.	OEC 812	**Speech and Audio Processing**

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BCS-301 Mathematics III

L-T-P-C
4-0-0-4

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

1. Solve the Fourier Transform of function.
2. Compute poles & zeros.
3. Evaluate the real & complex integrals with the help of Cauchy's Residue Theorem.
4. Utilize curve fitting techniques for data representations and computation in engineering analysis.
5. Use Binomial, Poisson & Normal Distribution to solve statistical problems.

Unit-1 (9 Hrs)

Fourier Transform: Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Inversion formula for Fourier transform, operational properties. Discrete and Fast Fourier transform. Applications of Fourier transform to solve boundary value problems.

Unit-2 (8 Hrs)

Functions of a Complex Variable and Conformal mapping: Limit, Continuity, Differentiability and Analyticity of functions of a complex variable, Cauchy-Riemann equations, Harmonic functions, Complex functions as mappings, Linear Transformation, Inverse transformation, Bilinear Transformations, Conformal Mapping & applications.

Unit-3 (9 Hrs)

Integration of Complex Functions: Contour integrals and evaluations, Cauchy's Theorem, Cauchy's Integral Formulae, Liouville's theorem, Convergence of power series, Taylor series, Laurent series, Zeros and Singularities of a complex function, Residues and Residue theorem, Evaluation of definite and improper integrals.

Unit-4 (7 Hrs)

Curve-fitting: method of least- squares, Normal equations, Normal equation in case of straight line, Fitting a straight line, Polynomial, non-linear and exponential curves, Change of origin.

Probability: Basics of probability, random variables, Expectation, Baye's theorem and probability distributions, Binomial, Poisson and Normal distributions.

Unit-5 (9 Hrs)

Statistical Methods: Sampling Theory, Parameters of Statistics, Tests of hypothesis and significance, z-test, t-test, $\chi 2$-test **,**Goodness of fit test**,** Time series analysis, Index numbers, Quality control chart and acceptance sampling, Introduction to design of experiments, Forecasting models.

Text & Reference Books:

1. R.K. Jain and S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.
2. Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons, 1962.
3. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
5. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

BEC 301 Digital Electronics

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand binary codes, binary arithmetic, minimization techniques and their relevance to digital logic design.
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder and sequential logic circuits.
3. Understand finite state machines and develop a digital logic to find out sustainable solution of a real life problem.
4. Understand and implement various digital integrated circuits using different logic families and simple systems composed of PLDs.

Unit-1 (7 Hrs)
Digital Fundamentals: Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map minimization and Quine-Mc Cluskey method of minimization.

Unit-2 (7 Hrs)
Combinational Logic Design: Design Examples: Arithmetic Circuits, BCD to 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, Digital Comparator, Parity generators, Multiplexers and their use in combinational logic designs, multiplexer, De-multiplexers and their use in combinational logic designs, Decoders, Demultiplexer.

Unit-3 (8 Hrs)
Sequential Logic Design: 1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops. Conversion of flip flops. Application of flip flops: Registers, Shift registers, Counters, Sequence Generators, ripple counters, up/down counters, synchronous counters. Basic design steps-State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, Finite state machine implementation.

Unit-4 (6 Hrs)
Digital Logic Families: Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, Figure of merit, Fan in, Fan out, Current and voltage parameters, Noise immunity, Operating temperatures and Power supply requirements, TTL logic. Operation of TTL NAND gate, Active pull up, Wired AND, Open collector output. Tri-State logic. CMOS logic –CMOS inverter, NAND, NOR gates, Wired logic, Open drain output. Interfacing CMOS and TTL. Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I2L, DCTL.

Unit-5 (8 Hrs)
Programmable Logic Devices and Semiconductor Memories: Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM.

Text/ Reference Books:

1. R.P. Jain, Modern Digital Electronics, 3rd edition, 12th reprint, Tata McGraw Hill Publication, 2007.
2. M. Morris Mano, Digital Logic and Computer Design, 4th edition, Prentice Hall of India, 2013.
3. Anand Kumar, Fundamentals of digital circuits, 1st edition, Prentice Hall of India, 2001.
4. Tokheim, H. Roger L., Digital Electronics Principles & Application, 8th edition Tata McGraw-Hill, 2013.
5. NPTEL video lectures on Digital Circuits.

BEC 351 Digital Electronics Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Implement the basic digital theory concepts practically and will be able to verify various results derived in theory.
2. Design, analyze and troubleshoot broad range of combinational and sequential circuits for various practical problems using basic gates and flip flops I.C's.
3. Develop technical writing skills to communication effectively and present one's own work.
4. Acquire teamwork skills for finding sustainable solution of a complex problem and working effectively in groups.

List of experiments:

1. To study about logic gate and verify their Truth table.
2. To design and implement half adder and full adder.
3. To design and implement half subtractor and full subtractor
4. To design and implement 8:1 MUX.
5. To design and implement 1:8 DEMUX.
6. To design and implement Encoder.
7. To design and implement Decoder.
8. To design and implement R-S flip flop and J K flip flop
9. To design and implement D& T flip flop
10. To design and implement Master -Slave flip flop
11. To design and implement SISO AND SIPO.
12. To design and implement PISO and PIPO.
13. To design and implement DECADE counter

Text/Reference Books:

1. R.P. Jain, Modern digital Electronics, Tata McGraw Hill, 4th edition, 2009
2. A. Anand Kumar, Switching Theory & Logic Design, PHI.
3. W.H. Gothmann, Digital Electronics- An introduction to theory and practice, PHI, 2nd edition, 2006.

BEC 302 Electronic Devices & Circuits

L-T-P-C
3-0-0-3

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

1. Understand the working of switching devices and apply the same in designing complex circuits with fewer devices.
2. Design amplifier and other complex circuits with the help of special semiconductor devices which will further increase real time applications and reduce runaway situations.
3. Apply the mathematical modeling for the electronic devices and circuits in turn helps in improvement in design in terms of size, power requirement and ease of use.
4. Use variety of electronic devices for designing society friendly electronic gadgets used for security and other useful purposes.

Unit-1 (7 Hrs)

Semiconductor Physics- Mobility and conductivity, Charge densities in a semiconductor, Fermi Dirac distribution, Carrier concentrations and Fermi levels in semiconductor, Generation and recombination of charges, Diffusion and continuity equation, Mass action Law, Hall effect.

Unit-2 (8 Hrs)

Junction Diodes- Formation of homogenous and heterojunction diodes V-I characteristics, Small signal models of diode, Diode as a circuit element, Diode parameters and load line concept, Applications of diodes in rectifier, Clipping, Clamping circuits and voltage multipliers, Breakdown diodes, and Zener diode as voltage regulator

Special Semiconductor Devices: Optoelectronic Devices, Photoconductors, Photo Diode, Photo Transistor, Photo Voltaic Sensor, Photo Emission, Solar Cells, LED, LCD, Laser Diode, Schottky Diode

Unit-3(7 Hrs)

Small Signal Circuit: Two Port Network, Hybrid (H-Parameter)Model, Typical Values of H-Parameter Model, Conversion of CE, CB, CC Configuration to Equivalent Hybrid Model, CB Circuit Analysis, CE circuit with & without R_E analysis, CC circuit analysis, Analysis of CE, CB & CC Configuration with approximate Hybrid Model.

Unit-4 (8 Hrs)

FET: Introduction, The Junction FET, Basic Construction, Operation, P- Channel FET, N-Channel FET, High Frequency Model of FET, Low Frequency FET Amplifiers, Transfer Characteristics of FET, MOSFET, Enhancement Mode, Depletion Mode of FET, Circuit Symbol of MOSFET,V-MOSFET.

Unit-5 (9 Hrs)

Feedback Amplifiers and Oscillators: Principles of feedback in amplifiers advantages of negative feedback. Classification of feedback, voltage series, and voltage shunt, current series. Current – shunt effect of feedback on input and output impedance. Gain, stability, noise, distortion and band width Barkhausen criterion for sinusoidal oscillators. Phase shift oscillator. Wein-bridge oscillator, Hartley oscillator, Colpitts oscillator, crystal oscillator, frequency stability.

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Text/Reference Books:

1. Millman Halkias, Integrated Electronics, T.M.H
2. R.L. Boylestad, Louis Nashelsky, Electronic Devices & Circuits Theory, Pearson education

3. David Bell, Electronic Devices & Circuits, Oxford Publications
4. M. Rashid, Microelectronic Circuits : Analysis & Design, Cengage learning
5. Millman, Electronics Devices and Circuits, TMH
6. Electronic Devices,7edition, Floyd, Pearson 2008
7. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing
8. Shail Jain & D.R. Choudhary, Linear Integrated Circuit, PHI.

BEC 352 Electronic Devices & Circuits Lab

L-T-P-C
0-0-2-1

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

1. Understand the characteristics of diodes, transistors, JFETs..
2. Understand the operation and characteristics of different configurations of BJT.
3. Design complex electronic circuits with fewer devices.
4. Able to understand the concept and applications of feedback mechanism in electronic circuits.

List of experiments:

1. Study of Lab Equipments and Components: CRO, Multimeter, and Function Generator, Power supply- Active, Passive Components and Bread Board.
2. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.
3. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, and ripple factor.
4. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
5. Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
6. Characteristic of BJT: BJT in CE configuration- Graphical measurement of h-parameters from input and output characteristics. Measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.
7. Field Effect Transistors: Single stage Common source FET amplifier–plot of gain in dB Vs frequency, Measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
8. Oscillators: Sinusoidal Oscillators a. Wein’s bridge oscillator b. phase shift oscillator.
9. Simulation of Amplifier circuits studied in the lab using any available simulation software.

Text/Reference Books:

1. Millman Halkias, Integrated Electronics, T.M.H
2. R.L. Boylestad, Louis Nashelsky, Electronic Devices & Crcuits Theory, Pearson education
3. David Bell, Electronic Devices & Circuits, Oxford Publications
4. M. Rashid, Microelectronic Circuits : Analysis & Design, Cengage learning
5. Millman, Electronics Devices and Circuits, TMH
6. Electronic Devices,7 edition, Floyd, Pearson 2008
7. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing
8. Shail Jain & D.R. Choudhary, Linear Integrated Circuit, PHI.

BEE 301 Network Analysis & Synthesis

L-T-P-C
3-1-0-4

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Apply Laplace Transform for steady state and transient analysis.
4. Determine different network functions.

Unit-1 (9 Hrs)

Graph Theory- Graph of a network, Definitions, Tree, Co tree, Link, basic loop and basic cut set, Incidence matrix, Cut set matrix, Tie set matrix, Node and Mesh Analysis with dependent current and voltage sources. Mutual coupled circuits, Dot Convention in coupled circuits.

Unit-2 (7 Hrs)

Network Theorems (Applications to AC Networks)- Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem. Millman's theorem, Compensation theorem. Concept of duality and dual networks.

Unit-3 (9 Hrs)

Network Transient and steady state analysis-Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response, Evaluation of time response both through classical and Laplace methods.

Unit -4 (10 Hrs)

Network Functions- Concept of complex frequency, Transform impedances network functions of one port and two port networks, Concept of poles and zeros, Properties of driving point and transfer functions.

Two Port Networks- Characterization of LTI two port networks; Z, Y, ABCD, A'B'C'D', g and h parameters, Reciprocity and symmetry, Inter-relationships between the parameters, Interconnections of two port networks, Ladder and Lattice networks: T & Π representation.

Unit-5(8 Hrs)

Network Synthesis- Positive real function; definition and properties, Properties of LC, RC and RL driving point functions, Synthesis of LC, RC and RL driving point immitance functions using Foster and Cauer first and second forms.

Text/Reference Books:

1. M. E. Van Valkenburg, Network Analysis, Prentice Hall of India
2. Alexander, Sadiku, Fundamentals of Electric Circuits, McGraw Hill
3. D. Roy Choudhary, Networks and Systems, Wiley Eastern Ltd.
4. C. L. Wadhwa, Network Analysis and Synthesis, New Age International Publishers
5. A. Chakrabarti, Circuit Theory, Dhanpat Rai & Co.
6. Hayt, Kimmerly, Durbin, Engineering Circuit Analysis, McGraw Hill
7. Donald E. Scott, An Introduction to Circuit analysis: A System Approach, McGraw Hill
8. M. E. Van Valkenburg, An Introduction to Modern Network Synthesis, Wiley Eastern Ltd.
9. T. S. K. V. Iyer, Circuit Theory, Tata McGraw Hill.
10. Joseph A. Edminister, Theory& Problems of Electric Circuits, McGraw Hill.

11. U.A Bakshi, V.A Bakshi, Network Theory , Technical Publications
12. C.K Alexander and Sadiku, Fundamentals of Electric Circuit, Indian Edition.
13. A.V. Oppenheim, A.S. Willsky, with S. Nawaab, Signals & Systems, Prentice Hall India

BCS 301 Data structure

L-T-P-C
3-0-0-3

Course Outcomes: At the end of this course students will demonstrate the ability to

1. To review the concepts of fundamental data structures to be used in programming. To understand various searching algorithms.
2. To understand the various operations on different types of data structures such as stacks, queues and linked lists. To apply and analyze various data structures on different applications.
3. To understand, analyze and compare various sorting algorithms. To understand the concept of hashing and its techniques.
4. To understand the various types of tree structures and their implementation. To evaluate various tree structures. To be able to apply tree structures on various problems.
5. To understand and implement various types of graphs**.** To study and implement various shortest path algorithms on graphs.

Unit-1 (8 Hrs)
Introduction: Basic concepts and notations, Mathematical background, Revision of arrays and pointers, Recursion and implementation of Recursion, Time and Space Complexity, Asymptotic notations: Big Oh, Big Theta and Big Omega, Time-Space trade-off.
Searching: linear search and binary search techniques.

Unit 2 (7 Hrs)
Stacks and Queues: Sequential representation of stacks and queues, Primitive Stack operations: Push & Pop, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, conversion of infix to postfix.
Lists: List representation techniques, Dynamics Storage allocation, Representation of stacks and queues using linked list, Operations on a Linked List: Insertion, Deletion, Traversal, Introduction to Doubly linked list, introduction to circularly linked list.

Unit 3 (8 Hrs)
Sorting Algorithms and hashing: Insertion sort, Bubble sort, Quick sort, Merge sort, Heap sort, Shell sort, Time and Space complexity of sorting algorithms, hashing.

Unit 4 (7 Hrs)
Trees: Definition and basic concepts, Linked tree **r**epresentations, Binary tree traversal algorithms,(Preorder, Inorder, Postorder), Binary search tree, Insertion and Deletion in Binary search tree, Multiway search trees, B trees, B+ tree and their applications.

Unit 5(6 Hrs)
Graphs: Introduction to Graphs, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Graph Traversal: Depth First Search and Breadth First Search, Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm.

Text Books and References:

1. Y. Langsam, M.J. Augenstein and A.M. Tenenbaum, Data Structure Using C and C++. Second Edition, Prentice Hall of India, 1997.
2. Seymour Lipschutz, Data Structures, Schaum's Outlines, Tata McGraw Hill , New Delhi, 2006
3. Lafore – Data structure & Algorithms in java, BPB Publication.
4. Sartaj Sahni – Data structure, Algorithms & application in C++ , McGraw Hill.

BCS 352 Data Structures Lab

L-T-P-C
0-0-2-1

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

1. Analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. Implement search problem (Linear Search and Binary Search) .
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity and will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Course Detail: Write Program in C / C++ for following:

List of experiments:

1. To implement stack using array.
2. To implement queue using array.
3. To implement circular queue using array.
4. To implement various operations on linked list:(a)insert (b)delete (c) display
5. To implement stack using linked list.
6. To implement queue using linked list.
7. To implement linear search.
8. To implement binary search.
9. To implement bubble sort.
10. To implement insertion sort.
11. To implement merge sort.
12. To implement quick sort.
13. Program to find the factorial of a number using recursion.
14. To implement Heap sort.
15. Implementation of graph menu driven program.

MC 302/MC 402 Human Values & Professional Ethics

L-T-P-C
2-0-0-0

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

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.
4. Distinguish between ethical and unethical practices, and start working over the strategy to actualize a harmonious environment wherever they work.

Unit-1 (7 Hrs)

Course Introduction: Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations.

Unit-2 (7 Hrs)

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

Unit-3 (7 Hrs)

Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti (Mutual Happiness); Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and disrespect; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society.

Unit-4 (7 Hrs)

Understanding Harmony in the Nature and Existence: Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectivity and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Unit-5 (7 Hrs)

Implications of the Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco friendly production systems, technologies and management models. Improving quality of work life at work place.

Text/References Books:

1. R R Gaur, R Sangal, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2009.
2. A Nagraj, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak,1998.
3. R. Subramanian, Professional Ethics, 2017.
4. P L Dhar, RR Gaur, Science and Humanism, Commonwealth Publishers, 1990.
5. A N Tripathy, Human Values, New Age International Publishers, 2003..
6. Subhas Palekar, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati, 2000.
7. E G Seebauer & Robert L. Berry, Fundamentals of Ethics for Scientists &Engineers , Oxford University Press, 2000.
8. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
9. B P Banerjee, Foundations of Ethics and Management, Excel Books, 2005.
10. B L Bajpai, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

BHSM 401 Industrial Management

L-T-P-C
3-0-0-3

Unit-1 (8 Hrs)
Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.

Unit-2 (7 Hrs)
Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management, Introduction to Human resources management: Nature of HRM, functions and importance of HRM.

Unit-3 (7 Hrs)
Work Study: Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study — stop watch methods — steps — allowances — standard time calculations — work sampling, Production Planning and Control Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED

Unit-4 (7 Hrs)
Quality Control: statistical quality control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans, Introduction to TQM.

Unit-5 (5 Hrs)
Project Management: Project network analysis, CPM, PERT and Project crashing and resource leveling.

Text/Reference Books:

1. Engineering Management (Industrial Engineering & Management)/ S.C. Sharma & T.RBanga, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-072)
2. Industrial Engineering and Management/ P. Khanna, Dhanpatrai publications Ltd.
3. Production & Operation Management /PaneerSelvam /PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Management I RaviShankar/ Galgotia.

BEC-401 Electromagnetic Theory

L-T-P-C
3-1-0-4

Course Outcomes: At the end of this course, student will have the ability to:

1. Understand the concepts of electromagnetic and magneto-statics
2. Understand and apply the time varying fields and Maxwell's equation to enhance various devices performance, hence upgrading its impact on society,
3. Analyse Uniform plane wave, Poynting vector and Flow of power to deign more efficient devices for improving communication capabilities in turn reduce impact of radiations.
4. Understand the basic concepts of transmission line and guided waves and apply them in designing better transmission line in terms of low power losses.

Unit-1 (10 Hrs)

Electrostatics and Magnetostatics: Review of vector calculus, Coulomb's law, Electric displacement and Displacement density, Lines of Force and Lines of Flux. Gauss's law, The potential function, Field of infinitesimal electric dipole, Field due to continuous distribution of charges, equipotential surfaces, Divergence Theorem, Poisson's Equation and Laplace's equation, Solution by means of Electrical images, Capacitance, Capacitance of parallel plate and coaxial cables, Energy in Electrostatic fields, Boundary conditions.

Unit-2 (8 Hrs)

Steady Magnetic Field: Magnetic field strength H, Magnetic flux density B, MMF, Ampere's circuital law, Ampere's law in differential vector form, Permeability, Energy stored in a Magnetic field, Ampere's law for a current element (Biot-Savart Law), Magnetic vector potential, Boundary conditions, Analogies between Electric and Magnetic fields.

Unit-3 (8 Hrs)

Time varying fields and Maxwell's equation: The Equation of continuity for Time-Varying Fields, Maxwell's Equations, Representation in Differential form, Integral form, Boundary conditions, Faraday's law of electromagnetic induction, Transformer and motional emf, Time harmonic field, Electromagnetic potential, Relation between circuit theory and field theory.

Unit-4 (8 Hrs)

Uniform plane wave: Wave equation: solution for Dielectric and Conducting media, free space propagation, Surface impedance, Depth of penetration (skin depth), phase velocity, and group Velocity, Polarization of uniform plane waves, Reflection by a Perfect conductor and perfect dielectric (normal and oblique incidence), Brewster Angle.

Poynting Vector and Flow of Power: Poynting theorem, Instantaneous average and Complex Poynting Vector.

Unit-5 (8 Hrs)

Transmission line and guided waves: Distributed parameters Model of Transmission Line, open wire and coaxial cable, Transmission line theory: line equation, lossless line, Voltage standing wave ratio (VSWR), Transmission line as circuit element, Quarter wave transformer, Impedance matching, single stub, Wave between parallel planes, TE waves, TM waves, characteristics of TE and TM waves, TEM waves and its properties.

Text/Reference Books:

1. Sadiku , Matthew N.O., Elements of Electromagnetics, Oxford University Press, 3rd Ed.
2. K. D. Prasad, Electromagnetic, Antenna, and wave Propagation,
3. Jorden &Balmein, Electromagnetic- Wave and radiating system, Tata McGraw-Hill.
4. Harington, R. F., Time Harmonic EM Fields, Tata McGraw Hill.
5. Collin, R. E, Antennas and Radio Wave Propagation, Tata McGraw Hill.
6. Pramanik, Ashutosh, Electromagnetism, Theory & Applications, Prentice Hall (India)
7. Schaum's Outlines, Electromagnetics, Tata McGraw Hill.
8. Kraus, Fleisch, Electromagnetics with Applications, 5th Ed., Tata McGraw-Hill,
9. Hayt, Engineering Electromagnetic, (sixth edition)
10. J.F.D. Kraus, Electromagnetic-Antenna

BEC 402 Microprocessors and its Applications

L-T-P-C
3-1-0-4

Course Outcomes: At the end of this course, the students will:

1. (i) Recall and apply a basic concept of digital fundamentals to microprocessor based personal computer system and Recall the memory types and understand the interfacing of memory with microprocessor. (ii) Understand the internal architecture and organization of 8085 & 8086.
2. (i) Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller. (ii) Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.
3. Discuss how the different peripherals are interfaced with microprocessor like 8255, 8253/54,8237,8279,etc.
4. (i)To analyze the concepts of memory interfacing for faster execution of instructions and improves the speed of operations & hence performance of microprocessors. (ii) To understand the basic knowledge of advanced processor and Analyze the internal architecture of 80286, 80486 and Pentium processor.
5. (i) Analyze the internal architecture and real time control of 8051. (ii) Analyze the internal architecture of ARM Processors.

Unit-1 (8 Hrs)
Introduction to Microprocessor: Evolution of Microprocessors, Register structure, ALU, Bus Organization, Timing and Control.
8-bit microprocessor: 8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction set- Data Transfer Operation, Arithmetic Operation, Logic Operation and Branch Operation; Introduction to Assembly language program., Assembler Directives, Parameter passing and recursive procedures.

Unit-2 (8 Hrs)
Programming Technique With Additional Instruction: Looping, Counting, Indexing, Additional data Transfer and 16 bit Arithmetic instruction, Counters and time delays, Stack and Subroutine.
16 bit Microprocessor: Architecture of 8086- Register Organization, Execution unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. Features of Numeric processor 8087,Floating point representation, range resolution, normalization, representation of zero, unused codes, parity bit and error detection.

Unit-3 (7 Hrs)
Basic of Interfacing: Programmed I/O, Interrupt driven I/O, DMA(8257), Parallel I/O (8255-PPI), Serial I/O(8251/8250, RS-232 standard)8259Programmable Interrupt Controller, 8237-DMA Controller, 8253/8254 Programmable Timer/Counter,(8279) Keyboard and display interface, ADC and DAC interfacing

Unit-4 (8 Hrs)
Memory and I/O Interfacing: Types of memory, RAM and ROM , Concepts of virtual memory, Cache memory. Advanced coprocessor Architecture-286,486, Pentium
Application: LED, LCD and Keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, Sensor Interfacing.

Unit-5 (6 Hrs)
An Introduction to Microcontroller 8051: The 8051 Architecture, Instruction set, Basic Assembly language programming concept.
Introduction to Risc Processor: ARM microcontrollers Interface design.

Text/ Reference Books:

1. Douglas V.Hall, 8086 Microprocessors Architecture
2. R.S. Gaonker, Microprocessor Architecture: Programming and Applications with the 8085/8080A/ Penram Interational Publishing, 1996.
3. Kenneth J.Ayala, The 8051 Microcontroller, Penram International Publishing.
4. M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson Education, 2007.
5. Liu Gibson, Microprocessor
6. Ray, A.K. & Burchandi, K.M., Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing, Tata McGraw Hill.
7. Brey, Barry B., INTEL microprocessors, 4th Ed, Prentice Hall (India).

BEC 452 Microprocessor and its Applications Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Do basic assembly language programming of 8085.
2. Do advance assembly language programming of 8086.
3. Do basic assembly language programming of 8085 for interfacing of peripherals.
4. Do advance assembly language programming of 8086 for interfacing of peripherals.

List of Experiments: Introduction to 8085 Microprocessor

1. Signed and Unsigned binary addition.
2. Signed Multiplication.
3. Signed and Unsigned binary division
4. BCD addition and subtraction.
5. Ascending and Descending.
6. BCD and binary conversion
7. Binary to BCD conversion
8. Programs for 16 bit arithmetic operations for 8086
9. Program for sorting an array for 8086
10. Program for searching for a number or character in a string for 8086
11. Interfacing with seven segment display
12. Interfacing with 8255 in I/O mode and BSR mode
13. Interfacing with 8253
14. Interfacing with ADC/DAC
15. Look up table method for finding the ASCII of an alpha numeric code.
16. Programming using arithmetic, logical and bit manipulation instructions of 8051
17. Program and verify Timer/Counter in 8051.
18. Program and verify interrupt handling in 8051.
19. UAR operation in 8051.
20. Interfacing LCD to 8051.
21. Interfacing matrix or keyboard to 8051

BEC 403 Signals and Systems

L-T-P-C
3-1-0-4

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Understand and classify different types of signals and systems as per their properties.
2. Represent continuous and discrete time signals and systems in time and frequency domain using different transforms.
3. Understanding frequency concepts for analog and digital signals.
4. Get familiarized with the characteristics and applications of Linear Time Invariant Systems for practical applications.
5. Analyze LTI systems using Laplace/Z-Transform. Use of LTI systems for various applications.

Unit-1 (10 Hrs)

Introduction and Classification of signals: Definition of signal and systems, communication and control systems as examples,Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power.

Elementary signals : reasons for using standard test signals, exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc.

Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non- causal, static and dynamic, stable and unstable, invertible.

Unit-2 (8 Hrs)

Time domain representation of LTI System: System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Computation of convolution sum. Properties of convolution. System interconnection, system properties in terms of impulse response, step response in terms of impulse response.

Unit-3 (7 Hrs)

Fourier Series: Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, orthogonality, Amplitude and phase response, FS representation of CT signals using trigonometric and exponential Fourier series. Applications of Fourier series, properties of Fourier series and their physical significance, Gibbs phenomenon, Discrete Time Fourier Series, properties, convergence of DTFS.

Unit-4 (8 Hrs)

Fourier Transform: Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, FT of standard periodic CT signals, Properties and their significance, Interplay between time and frequency domain using sinc and rectangular signals, introduction to Discrete Time Fourier Transform and sampling Theorem.

Unit-5 (8 Hrs)

Laplace Transform: Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, stability considerations in S domain, Application of Laplace transforms to the LTI system analysis and difference equation with zero initial condition.

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Introduction to Z transform: Region of convergence, properties of the Z transform, Inverse transform using counter, integration, complex convolution theorem, Parseval's relation. Unilateral Z transform and its application to difference equation with zero initial condition.
Introduction to Correlation: Autocorrelation, Cross correlation, and their properties.

Text/Reference Books:

1. Simon Haykins and Barry Van Veen, Signals and Systems, 2nd Edition, Wiley India.
2. Charles Phillips, Signals, Systems and Transforms, 3rd Edition, Pearson Education.
3. A.V. Oppenphim, A.S.Willsky and S.H.Nawab; Signals and Systems, Prentice Hall.
4. B.P. Lathi, Signal and Sytem, Oxford university press , New Delhi.
5. M.J. Roberts, Signal and Systems, Tata McGraw Hill, 2007.
6. Shaila Apte, "Signals and Systems-principles and applications", Cambridge University press, 2016.
7. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007.
8. Peyton Peebles, Probability, Random Variable, Random Processes, 4th Edition, Tata McGraw Hill.
9. Nagoor Kanni, Signals and Systems, 2nd edition, McGraw Hill.
10. NPTEL video lectures on Signals and Systems

BCS 404 JAVA

L-T-P-C
3-0-0-3

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

1. Able to understand the use of OOPs concepts.
2. Able to understand the use of abstraction, object, class.
3. Able to understand the concept of Inheritance and Polymorphism as well as packages and Interfaces
4. Able to design GUI based applications and develop applets for web applications.
5. Able to develop and understand exception handling, multithreaded applications with synchronization, use of collection and framework

Unit-1 (7 Hrs)
Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.

Unit-2 (6 Hrs)
Objects and Classes: Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File, this reference.

Unit-3 (8 Hrs)
Inheritance and Polymorphism: Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.

Unit-4 (8 Hrs)
Event and GUI programming: Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing.

Unit-5 (6 Hrs)
Multithreading in Java and I/O programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java, Introduction to JavaBeans and Network Programming.

Text/Reference Books:

1. Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson.
2. Programming in Java, Sachin Malhotra & Saurabh Chaudhary, Oxford University Press.
3. Murach's Beginning Java 2, Doug Lowe, Joel Murach and Andrea Steelman, SPD.
4. Core Java Volume-I Fundamentals, Eight Edition, Horstmann& Cornell, Pearson Education.
5. The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, TMH.
6. Java Programming, D. S. Malik, Cengage Learning.

BCS 454 JAVA Lab

L-T-P-C
0-0-2-1

Course outcomes: The student is expected to have hands on experience with the following:

1. Basics of Java programming, multi-threaded programs and Exception handling
2. The skills to apply OOP in Java programming in problem solving
3. Use of GUI components (Console and GUI based)

List of experiments:

1. Program to define a structure of a basic JAVA program.
2. Program to define the data types, variable, operators, arrays and control structures.
3. Program to define class and constructors. Demonstrate constructors.
4. Program to define class, methods and objects. Demonstrate method overloading.
5. Program to define inheritance and show method overriding.
6. Program to demonstrate Packages.
7. Program to demonstrate Exception Handling.
8. Program to demonstrate Multithreading.
9. Program to demonstrate I/O operations.
10. Program to demonstrate Network Programming.
11. Program to demonstrate Applet structure and event handling.
12. Program to demonstrate Layout managers.

MC 301/ MC 401 Environment and Ecology

L-T-P-C
2-0-0-0

Unit-1 (7 Hrs)

Nature of Environment Introduction to Environmental Science - Definition and scope and need for public awareness Ecosystems Concept, structure and functions, restoration of damaged ecosystems Biodiversity – Definition, description at national and global level, threats and conservation Natural Resources - Renewable and non-renewable and their equitable use for sustainability, Material cycles – carbon, nitrogen and sulphur cycle. Conventional and Non-conventional Energy Sources – fossil fuel-based, hydroelectric, wind, -nuclear and solar energy, biomass, biodiesel, hydrogen as an alternative fuel

Unit-2 (7 Hrs)

Impact of Human Activity on Environment Human Population and Environment – Population growth, population explosion and migration; Impact of farming, housing, mining, transportation and industrial growth Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics.

Unit-3 (7 Hrs)

Environmental Changes and Human Health Environmental Pollution–Definition, causes and effects, control measures for water, air, soil, marine, land, noise, thermal pollution, Climate change– Greenhouse effect and global warming, acid rain, ozone layer formation and depletion Impact on human health – water and air borne diseases, diseases induced by residual impurities in drinking water (fluoride and arsenic); Toxic wastes and carcinogens; Nuclear hazards.

Unit-4 (7 Hrs)

Environmental Protection through Assessment and Education Indicators and Impact Assessment – Bio-indicators, Natural disasters and disaster management, Impact assessment through inventorying and monitoring Environmental Protection– Role of individuals, organizations and government in pollution control Laws, Conventions and Treaties–National legislation, issues in the enforcement of environmental legislation, initiatives by non- governmental organizations, global efforts in environmental protection Environmental education–women and value education Recommended

Text/Reference Books

1. Environmental Studies, J Krishnawamy , R J Ranjit Daniels, Wiley India.
2. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional, 1993.
3. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
4. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.
5. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press
6. Textbook of Environmental Science and Technology, M.Anjireddy, BS Publications
7. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar, 9781259006050, McGrawHill India, 2012.
8. Environmental Studies, D.L. Manjunath, 9788131709122 Pearson Education India, 2007
9. Textbook of Environment Ecology, Singh, Acme Learning
10. Perspective in Environmental Studies, Kaushik, New Age International
11. Environmental Studies, B. Joseph, 2nd Ed., 978-0070648134, Tata McGraw Hill

BEC451 PCB DESIGN LAB

L-T-P-C
0-0-2-1

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

1. Understand the basic concepts and principles to measure the different electrical signals.
2. Understand the operation and characteristics of different electrical instruments used around them
3. Understand and design the printed circuit boards.
4. Able to do the wiring with the meter in the main line efficiently

List of Experiments:

1. Study of CRO, DMM & Function Generator.
2. Study of various types of Active & Passive Components based on their ratings.
3. Winding shop: Step down transformer winding of less than 5VA.
4. Soldering shop: Fabrication of DC regulated power supply
5. Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.
6. Introduction to PCB Design software
7. PCB Lab: a.) Artwork & printing of a simple PCB. b.) Etching & drilling of PCB.
8. Wiring & fitting shop: Fitting of power supply along with a meter in cabinet.

BHSM 501 Economics for Industry

L-T-P-C
3-0-0-3

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

1. Define the main concepts and describe the models and methods in economic analysis
2. Explain economic events in individual markets and the aggregate economy using basic theory and tools
3. Apply supply and demand analysis to relevant economic issues
4. Explain how individual decisions and actions as a member of society affect the economy locally, nationally and internationally
5. Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets

Unit 1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Meaning of Demand, Determinants of Demand, Shifts in demand, Law of Demand, Price Elasticity of Demand &Types, Income Elasticity, Cross price Elasticity, Determinants of Elasticity, uses and importance of elasticity.

Unit 2

Concept of Supply: Law of Supply, Factors affecting Supply, Elasticity of supply.

Demand Forecasting: Introduction, Meaning and Forecasting, Methods or Techniques of Demand Forecasting, Criteria for Good Demand Forecasting, Demand Forecasting for a New Product.

Unit-3

Cost Analysis: Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run; Short run and long run, Break-Even Analysis; Production functions: laws of variable proportions, law of returns; Economies of scale: Internal and external.

Unit-4

Market Structure: Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.

Unit-5

Nature and characteristics of Indian economy, concepts of LPG, elementary concepts of National Income, Inflation and Business Cycles, Concept of N.I. and Measurement., Meaning of Inflation, Types and causes , Phases of business cycle. Investment decisions for boosting economy (National income and per capital income)

Text/References Books:

1. Premvir Kapoor, Sociology and Economics for Engineers, Khanna Publishing House (Edition 2018)
2. Salvatore D, “Principles of Microeconomics”, Oxford University Press.
3. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.
4. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.
5. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford University Press.

BEC 501 Antenna & Wave Propagation

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. define various antenna parameters.
2. understand the various special antennas with their applications.
3. understand the reflector antennas & types of reflector antennas.
4. understand the various antenna parameter measurements & antenna arrays.
5. discuss radio wave propagation.

Unit-1 (8 Hrs)

Antenna Fundamentals: Introduction to Antenna, Antenna Types, Antenna Parameters, Power Density, Radiation Intensity, Radiation Pattern, Antenna Directivity, Antenna Gain, Antenna Effective Area (Apertures), Relation between Power Gain & Directive Gain, Plane Angle & Solid Angle, Antenna Band Width, Antenna Beam Width, HPBW(Half Power Beam Width), BWFN(Beam Width First Null), Beam Efficiency, Radiation Resistance & Loss Resistance, Antenna Efficiency, Radio Communication Link (FRISS Transmission Formula), Single-to-Noise Ratio(SNR), Front-to-Back Ratio(FBR), Antenna Noise Figure(F)

Unit-2 (8 Hrs)

Special Antennas: Classification of Antennas, Radio Spectrum Bands, Directional & Non directional Antennas, Omni directional Antenna as a Reference Antenna, Mono pole Antenna, Dipole Antenna, Half Wave or Hertz Antenna, Quarter Wave or Marconi Antenna, Folded Dipole Antenna, Yagi-Uda Antenna, Loop Antenna, Horn Antenna, Helical Antenna with their Construction, Operation, Advantages, Disadvantages and Applications

Unit-3 (8 Hrs)

Reflector & Dish Antennas: Introduction, Need of Reflector Antennas, Types of Reflector Antennas, Flat Sheet Reflectors, Corner Reflectors, Dish (Parabolic) Reflector Antennas, Comparison Between Parabolic and Corner Reflector Antennas, Feed Methods for Reflector Antennas, Applications of Reflector Antennas

Unit-4 (8 Hrs)

Antenna Measurements: Introduction, Test Antenna, Reference Antenna, Antenna Parameters Measurement Setup, Antenna Range Measurement, Antenna Radiation Pattern Measurement, Antenna Gain Measurement

Antenna Arrays: Introduction, Need of Antenna Arrays, Types of Antenna Arrays, Applications of Antenna Arrays

Unit-5 (8 Hrs)

Radio Wave Propagation: Introduction to Radio Wave Propagation, Structure of Atmosphere, Different Regions & Layers of Atmosphere, Different Modes of Propagation, Ground wave propagation, Space wave propagation, LOS propagation, Applications, Sky wave propagation, Structural of the Ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by Ionosphere, Critical Frequency, MUF, LUF, Virtual Height, Skip Distance, Relation Between MUF and Skip Distance, Multi-Hop Propagation, Characteristics of different Layers of Ionosphere

Text/ Reference Books:

1. J. D. Krauss, "Antennas", TMH Publication.
2. K. D. Prasad, "Antenna and Wave Propagation", Pragati Prakashan.
3. A. R. Harish, M. Sachidananda, "Antennas and Wave Propagation", Oxford University Press.
4. R.E. Collin, "Antennas and Radio wave Propagation", McGraw Hill.

BEC 502 Automatic Control Systems

L-T-P-C
3-0-0-3

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

1. develop the mathematical model of the physical systems.
2. analyze the response of the closed and open loop systems.
3. analyze the stability of the closed and open loop systems.
4. Understanding the concept of gain margin and phase margin.
5. develop and analyze state space models

Unit-1 (8 Hrs)

Control System And Their Representation: Terminology and basic structure of control system, Open loop and Closed loop systems, analogous systems. Physical Systems and their models, Electromechanical systems, electrical analogy of physical systems. Transfer function, Block diagram representation of physical systems, Block diagram algebra, Signal Flow graph and Mason's formula.

Unit-2 (7 Hrs)

Time Response: Types of test inputs, Response of first and second order system, Time domain specifications, Static and Dynamic Error coefficients

Stability: Concepts of stability, location of roots in s-plane for stability, asymptotic stability and relative stability, Routh-Hurwitz stability criterion.

Unit-3 (8 Hrs)

Root Locus: Root locus plot, Properties of Root loci and applications, Stability range from the loci. Determination of roots of the closed loop system, Effect of pole zero addition

Nyquist Plots: Polar plots, Nyquist plots and Nyquist stability criterion

Unit-4 (7 Hrs)

Bode Plots: Concepts of Gain margin and phase margin, Bode plots Frequency-domain specifications.

Unit-5 (8 Hrs)

Controllers: Introduction to PID and Lag-lead type Controllers

State Variable Analysis: Concepts of state, state variable and state model. State variable models for LTI systems. Canonical representations, Transfer function to state-space and vice-versa. Solution to state equations. Concepts of controllability & observability.

Compensation Design: compensation design using frequency domain techniques.

Text/ Reference Books:

1. KUO B.CI Automatic control system/Pill.
2. Ogata Kj Modern Control Engineering / PHI.
3. Nagrath I.J. &Gopal, M/Control Systems Engineering/New Age International.
4. S.N. Sivanandam/Control Systems Engineering /Vikas Publishing House Pvt. Ltd.
5. Singh &Janardhanan - Modern control engineering /Cengage learning

6. Control Systems,Srivastava,TMH 2009
7. Systems and Control - Stanislawhizak, Oxford
8. Control System Engineering,S. K. Bhattacharya,Pearson
9. Control Systems: Theory And Applications,Ghosh,Pearson

BEC 552 Automatic Control Systems Lab

L-T-P-C
0-0-2-1

Note: The minimum of 10 experiments are to be performed from the following, out of which at least three should be software based.

1. To study P, PI and PID temperature controller for an oven and compare their performance.
2. To study and calibrate temperature using resistance temperature detector (RTD)
3. To design Lag, Lead and Lag-Lead compensators using Bode plot.
4. To study DC position control system
5. To study synchro-transmitter and receiver and obtain output vs input characteristics
6. To determine speed-torque characteristics of an ac servomotor.
7. To study performance of servo voltage stabilizer at various loads using load bank.
8. To study the behaviour of separately excited dc motor in open loop and closed loop conditions at various loads.
9. Software based experiments (Use MATLAB, LABVIEW software etc.)
10. To simulate PID controller for transportation lag.
11. To determine time domain response of a second order system for step input and obtain performance parameters.
12. To convert transfer function of a system into state space form and vice-versa.
13. To plot root locus diagram of an open loop transfer function and determine range of gain ‘k’ fir stability.
14. To plot a Bode diagram of an open loop transfer function.
15. To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

Reference Books:

1. K.Ogata,“Modern Control Engineering” Prentice Hall of India.
2. Norman S.Nise, “Control System Engineering”, John Wiley & Sons.
3. M.Gopal, “Control Systems: Principles & Design” Tata Mc Graw Hill

BEC 503 Electronic Measurement & Instrumentation

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. understand the fundamentals & characteristics of measurement & instrumentation.
2. analyze the different types with their applications of sensors and transducer.
3. apply the skills how to use electronic instruments & bridges with their applications.
4. apply the skills how to use display & special devices with their applications.
5. understand the operation, classification & application of telemetry & data acquisition system.

Unit-1 (8 Hrs)

Introduction to Measurement: Measurement system, Methods of measurement, Classification of instrument systems, Characteristics of instruments, Unit, Dimensions, Standards, Scientific notations.

Errors in Measurement: Introduction to Error, Errors in Measurement, Gross error, Systematic error, Absolute error, Relative error, Accuracy, Precision, Resolution, Sensitivity.

Unit-2 (8 Hrs)

Sensors & Transducers: Sensors, Transducers, Definition, Types of transducers, Selection of transducers, Advantages of transducers, Applications of transducers, Characteristics, Factors affecting the choice of transducers, Strain gauges, Resistance Temperature Detector, Load Cell transducers, Linear variable differential transducers, Thermocouple sensors, Piezoelectric transducers, Photoelectric transducers.

Unit-3 (8 Hrs)

Electronic Instruments: Digital multi meter, Digital frequency meter, Voltmeter, Ammeter, Energy meter, Q-meter.

Bridges: Introduction, Types, Balance condition, Applications, Resistance measurement, Measurement of low, medium and high resistances, Wheatstone bridge, AC bridges for inductance measurement, AC bridges for capacitance measurement, Advantages and Applications of bridges in measurement system.

Unit-4 (8 Hrs)

Display Devices: Cathode Ray Oscilloscope (CRO): Block diagram, Cathode Ray Tube (CRT) & its components, Applications of CRO in measurement, Measurement of voltage, frequency and phase by CRO, Types of CRO, Digital Storage Oscilloscope (DSO), Applications of Digital Storage Oscilloscope(DSO), Electronic measurement using Cathode ray oscilloscope(CRO) and Digital storage oscilloscope(DSO).

Special Devices: Spectrum Analyzer, Logic Analyzer, Data Loggers, Digital Read Out Systems, Digital Input devices, Digital Output devices.

Unit-5 (8 Hrs)

Telemetry and Data Acquisition Systems: Introduction to telemetry, Telemetry types, Landline telemetry, Radio telemetry, Telemetry applications, Introduction to Data acquisition systems, Data acquisition systems types, Analog Data acquisition systems and Digital Data acquisition systems, Data acquisition systems applications.

Text/ Reference Books:

1. A.K.Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. Rajendra Prasad, "Electronic Measurement and Instrumentation Khanna Publisher
3. M.M.S. Anand, "Electronic Instruments and Instrumentation Technology" PHI Learning.
4. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press.

5. Oliver and Cage, "Electronic Measurements and Instrumentation", Tata McGraw Hill Publication.
6. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier Buterworth Heinmann.

BEC 553 Electronic Measurement & Instrumentation Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. apply the skills how to select the correct sensors & transducers to find unknown values.
2. analyze the different types with their characteristics of sensors and transducer.
3. apply the skills how to use electronic instruments with their applications.
4. apply the skills how to use display devices with their applications.

List of Experiments:

1. To study & observe the characteristics of RTD Sensor.
2. To study & observe the characteristics of Load Cell Sensor.
3. To study & observe the characteristics of LVDT.
4. To study & observe the characteristics of Ultrasonic Sensor.
5. To study & observe the characteristics of Smoke Sensor.
6. To study & observe the characteristics of IR Sensor.
7. To study & observe the characteristics of Thermocouple Sensor.
8. To study & observe the characteristics of NTC Temperature Sensor.
9. To study & observe the characteristics of Humidity Sensor.
10. To study & observe the characteristics of Photo Diode.
11. To study & observe the application of FPGA Trainer Kit.

Text/ Reference Books:

1. A.K.Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. Rajendra Prasad, "Electronic Measurement and Instrumentation Khanna Publisher
3. M.M.S. Anand, "Electronic Instruments and Instrumentation Technology" PHI Learning.
4. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press.
5. Oliver and Cage, "Electronic Measurements and Instrumentation", Tata McGraw Hill Publication.
6. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier Buterworth Heinmann.

BEC 601 Analog Communications

L-T-P-C
3-1-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Acquired knowledge about basic elements of a communication system.
2. design AM systems.
3. design Angle modulated systems.
4. design Pulse modulated systems.

Unit-1 (9 Hrs)

Communication System: Elements of Analog communication System and its Fundamental Limitations, Need of Modulation, Applications of Analog Communication.

Random Processes: Random Process, Stationary Processes, Ergodic Processes, Transmission through LTI, Power spectral density, Gaussian process.

Noise: External and internal sources of noise, Thermal noise, Calculation of thermal noise, Shot noise, Noise figure, Noise temperature, Equivalent noise bandwidth.

Unit-2 (8 Hrs)

Amplitude (Linear Modulation): Generation and detection of Amplitude Modulation, DSB-SC, SSB, VSB, Carrier Acquisition, AM transmitter, AM Receiver, Receiver Characteristics.

Unit-3 (8 Hrs)

Angle (Exponential Modulation): Types of Angle Modulation, Concepts of Instantaneous frequency and Phase, Wideband and Narrowband FM, Generation and detection of FM, Generation and detection of PM. Comparison of AM and FM.

Unit-4 (8 Hrs)

Noise performance of CW Modulation Systems: Noise in DSB-SC, SSB-SC and AM system, Noise in FM and PM, FM threshold and its extension, Pre-emphasis and De-emphasis in FM**,** Concept of TDM and FDM.

Unit-5 (7 Hrs)

Sampling theory & Pulse modulation: Sampling process, sampling theorem, signal reconstruction, flat top sampling of band pass signals, Analog Pulse Modulation: Types of analog pulse modulation, Method of generation and detection of PAM, PWM, PPM, Spectra of pulse modulation.

Text/References Books:

1. Simon Haykin, Communication Systems. John Wiley
2. B.P. Lathi, Modern Analog & Digital Communication. Oxford Univ Press
3. P. chakrabarti, Analog Communication System. Dhanpat Rai
4. Taub & Schilling, Principles of Communication Systems. Tata McGraw-Hill
5. Kennedy, George & Davis, Bernard, Electronic communication systems. Tata McGraw Hill
6. Singh, R.P. & Sapre, S.D., Communication Systems: Analog & Digital. Tata McGraw Hill
7. A.B. Carlson, Communication Systems. Tata McGraw-Hill
8. Carlson, A. Bruce, Crilly, Paul B. & Rutledge, Janet C, Communication Systems an Introduction to Signals & Noise in Electrical Communication. Tata McGraw-Hill

BEC 651 Analog Communications Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. Generate various AM signals
2. Generate FM signals
3. Evaluate the performances of AM and FM systems
4. Perform signal sampling by determining the sampling rates for baseband signals and reconstruct the signals

List of Experiments:

1. Generation of AM Signal and measurement of Modulation Index.
2. Envelop Detector for AM Signals
3. Generation & Detection of DSB-SC Signal.
4. SSB Generation.
5. To study the Varactor modulator.
6. To study the Reactance modulator.
7. Generation of FM Signal.
8. FM Detector using PLL.
9. To study the analog signal, sampling and reconstruction.

BEC 602 Digital Signal Processing

L-T-P-C
3-1-0-4

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

1. Determine response of LTI systems using time domain and DFT techniques.
2. Compute DFT of real and complex discrete time signals.
3. Computation of DFT using FFT algorithms and linear filtering approach.
4. Solve problems on digital filter design and realize using digital computations.

Unit-1 (7 Hrs)
Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution

Unit-2 (7 Hrs)
Additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method. Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms).

Unit-3 (8 Hrs)
Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and decimation-in-frequency algorithms. Goertzel algorithm, and chirp-z transform.

Unit-4 (6 Hrs)
IIR filter design: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters, analog to analog frequency transformations.
Design of IIR Filters from analog filter using Butterworth filter: Impulse invariance, Bilinear transformation.

Unit-5 (8 Hrs)
Structure for FIR Systems: Direct form, Linear Phase, Frequency sampling structure, Lattice structure. FIR filter design: Introduction to FIR filters, design of FIR filters using Rectangular, Hamming, Hanning and Bartlett windows.

Text/ Reference Books:

1. Discrete Time Signal Processing, Oppenheim & Schaffer, PHI, 2003.
2. Digital Signal Processing, S. K. Mitra, Tata Mc-Graw Hill, 3rd Edition, 2010.
3. NPTEL video lectures.

BEC 652 Digital Signal Processing Lab

L-T-P-C
0-0-2-1

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

1. Describe sampling thorem in MATLAB
2. Understand and verify different system properties
3. Find DFT and its Inverse DFT
4. Design FIR filter in MATLAB using window method
5. Design IIR filter in MATLAB.

List of experiments:

1. Study of Sampling theorem, effect of under sampling.
2. Study of Quantization of continuous - amplitude, discrete- time analog signals.
3. Study of different types of Companding Techniques.
4. Study of properties of Linear Time- Invariant system.
5. Study of Convolution: Series and Parallel system.
6. Study of Discrete Fourier Transform (DFT) and its inverse.
7. Study of Transform domain properties and its use
8. Study of FIR filter design using window method: Lowpass and highpass filter.
9. Study of FIR filter design using window method: Bandpass and Bandstop filter.
10. Study of Infinite Impulse Response (IIR) filter.

Text/Reference Books:

1. Digital Signal Processing, Lee Tan: Elsevier publications, 2007

BEC 603 Linear Integrated Circuits

L-T-P-C
3-1-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. analyze and design analog circuits such as: differential amplifier, Op-amp and current mirror.
2. analyze and develop skill to design circuits such Op-amp circuit as comparator Schmitt trigger precision rectifier peak detector circuit, integrator circuit, difference circuit square wave and triangular wave generator etc.
3. understand the concept of filters & oscillators develop to design various filter and oscillator circuit.
4. know about various type of techniques to develop A/D and D/A convertors.
5. understand the basics of timer IC 555 and phase locked loop, its working concept.

Unit – 1 (7 Hrs)

Op-Amp Basics: Introduction, Differential amplifier configurations, DC & AC analysis of all Differential amplifier configurations, swamping resister, constant current bias, current mirror circuits, level translator, Block diagram of op-amp, op-amp-internal circuit, op-amp characteristics, voltage series and voltage shunt feedback amplifier.

Unit – 2 (7 Hrs)

Inverting/Non-inverting amplifier, voltage follower, summing, averaging, scaling amplifier, difference amplifier, ideal Integrators, practical integrator with frequency response, ideal Differentiators, practical differentiator with frequency response, instrumentation Amplifiers, filters, Oscillators. Logarithmic amplifiers, Precision rectifier, peak detector, sample and hold circuits. OP – AMP as comparator, Schmitt trigger, clipper and clamper, square and triangular wave generator, Multi-vibrator: monostable, astable and bistable.

Unit – 3 (6 Hrs)

Filter & Oscillators: Types of filter(LP, HP, BP and Notch), first order and second order low-pass and high-pass butterworth filter, filter design, frequency scaling Oscillator principal, types and frequency stability, design of phase shift, wein bridge, quadrature,voltage controlled oscillator.

Unit – 4 (8 Hrs)

Voltage Regulators &Data Converters: Transistorized series-pass Regulator, Overload short circuit and Thermal shut-down protection fixed voltage regulators (78/79, XX), 723 IC Regulators (Current limiting, Current fold back); SMPS.

DAC: types of DAC, weighted resistor, R2R ladder ADC: types of ADC, Flash type, counter type, successive approximation resistor.

Unit – 5 (7 Hrs)

Signal generators and wave shaping circuits: IC timer (555) , internal structure, pin diagram, monostable and astable operation PLL: 565 phase locked loop, block diagram of PLL, and its function, VCO, phase detector, applications of PLL,FM demodulation using PLL

Text/ Reference Books:

1. Sedra Smith Microelectronics/Oxford Universities Press.
2. Gayakwad/OP Amps and Linear Integrated circuits/PHI.
3. D. Roy Choudhary, sheil B Jain, Linear integrated circuits, New Age Publishers, 2010.

1. C.S. Soclof/Application of analog Integrator circuits/PHI.
2. D. P. Singh /semiconductor devices and circuits /Dhanpat Rai & Co.
3. Jacob applications & Design with analog Ics/PHI 1996.

BEC 653 Linear Integrated Circuits Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. design and implement an inverting and non- inverting amplifier circuit.
2. design and implement a summing amplifier difference amplifier, a differentiator and an integrator circuit.
3. design and implement RC and LC oscillator.
4. know about and design square wave generator to operate at frequency f_o=500H.
5. know about timer-555 operation as monostable and astable multivibrator.

List of Experiments:

1. To design and implement an inverting amplifier circuit.
2. To design and implement a non- inverting amplifier circuit.
3. To design and implement a summing amplifier circuit.
4. To design and implement a difference amplifier circuit.
5. To design and implement a differentiator circuit.
6. To design and implement an integrator circuit.
7. To design and implement RC oscillator.
8. To design and implement LC oscillator.
9. To study and design square wave generator to operate at frequency f_o=500H.
10. To study timer-555 as monostable and astable multivibrator.

OHS 601 Occupational Health & Safety

L-T-P-C
2-0-0-0

Course Outcome: After learning the course the students should be able to:

1. Identify the diseases associated with occupation.
2. Manage safety in industries by suggesting safety measures.
3. Identify the accidental causes & apply the preventions.
4. Identify Fire Explosion & apply PPE.
5. Identify & apply Hazards & Risk identification, Assessment and control techniques.

Unit-1

Occupational Health: Classification of occupational health hazards, dangerous properties of chemical and their health effects, routes of entry of toxic material into human body, permissible exposure limits, Threshold limit value, lethal dose and lethal concentration, Ergonomics, constituents of ergonomics, application of ergonomics for safety & health, occupational diseases due to metals & dusts, fumes & chemical compounds.

Unit-2

Safety: Concept, Philosophy & Psychology of safety: Concept of safety, Nature of concept of safety, Philosophy of safety, safety terminology, philosophy of total safety concept, safety psychology, accident causative factors, general psychological factors

Unit-3

Accident Causes and prevention: Causation, Accident problem, Reasons for prevention, factors impending safety, Accident prevention

Safety Management: Concept of management, element of management, functions, management principles, safety management & its responsibilities, safety Organization

Electrical Safety: Electricity and Hazardous, Indian standards, effects of electrical parameters on human body, safety measures for electric works

Unit-4

Fire and Explosion: Fire phenomena, classification of fire and extinguishers, statutory and other standards, fire prevention & protection system, explosion phenomena, explosion control devices, fire awareness signs

Personal Protective Equipment: Need of PPE, Indian standards, factors of selection of PPE, non respiratory equipments, respiratory equipments.

Unit-5

Hazards & Risk identification, Assessment and control techniques: Hazards, Risks & detection techniques, Preliminary hazard analysis(PHA) & hazard analysis(HAZAN), failure mode effect analysis(FMEA), Hazard and operability(HAZOP) study, Hazard ranking (DOW & MOND index), Fault tree analysis, Event tree analysis(ETA), major accident hazard control, on-site and off-site emergency plans. Safety in different industries as case study.

BEC 701 Digital Communications

L-T-P-C
3-0-0-3

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

1. Model a digital communication system and Identify source coding and channel coding schemes for Digital communication link
2. Understand the wave form coding techniques and evaluate the performance of PCM, DPCM and DM in a digital communication system
3. Comparison of various digital modulation techniques.
4. Design encoder and decoder schemes for error control.

Unit-1 (9 Hrs)

Elements of Digital communication and information theory: Model of a digital communication system ; logarithmic measure of information, entropy and information rate, conditional entropy and redundancy, source coding fixed and variable length code words, Source coding theorem, prefix doing and craft inequality, Shannon–fano and Huffman coding, maximum entropy of a continuous source (with Gaussian distribution) entropy of a band limited white Gaussian noise, Mutual information and channel capacity of a discrete memory less channel of a BSC, Hartley Shannon law.

Unit-2 (8 Hrs)

Waveform coding techniques: Discretization in time and amplitude, Linear quantizer, quantization noise power calculation, signal to quantization noise ratio, non–uniform quantizer, A law & μ law companding; encoding and pulse code modulation, bandwidth of PCM, Differential pulse code modulation, Delta modulation, Idling noise and slope overload, Adaptive delta modulation, adaptive DPCM. Comparisonof PCM and DM.

Digital multiplexing: Fundamentals of time division multiplexing, electronic commutator, bit, byte interleaving E1 Carrier system, Synchronization and signaling of E1, TDM, PCM hierarchy.

Unit-3 (8 Hrs)

Digital Baseband transmission: Line coding and its properties. NRZ & RZ types, signaling format for Unipolar, polar, bipolar, AMI & Manchester coding and their power spectra (No derivation), HDB and B&W signaling, ISI, Nyquist criterion for zero ISI & raised cosine spectrum. Matched filter receiver, derivation of its impulse response and peak pulse signal to noise, correlation detector decision threshold and error probability for binary Unipolar (on – off), signaling.

Unit-4 (8 Hrs)

Digital modulation techniques: Types of digital modulation, wave forms for amplitude, frequency and phase shift keying. Method of generation and detection of coherent & non–coherent binary ASK, FSK & PSK, differential phase shift keying, Quadrature modulation techniques (QPSK and MSK) probability of error and comparison of various digital modulation techniques**.**

Unit-5 (9 Hrs)

Error control coding: Error free communication over a noisy channel, Hamming sphere, hamming distance and hamming bound, relation between minimum distance and error detecting and correcting capability, linear block codes, encoding & syndrome decoding; cyclic codes, encoders and decoders for systematic cycle codes; convolutional codes, code tree & Trellis diagram, Viterbi and sequential decoding, burst error correction.

Text/References:

1. Simon Haykin, Communication Systems. John Wiley
2. B.P. Lathi, Modern Analog & Digital Communication. Oxford Univ Press
3. B.Sklar, Digital Communications, 2nd Edition, Pearson Education, New Delhi, 2009.
4. P. chakrabarti, Analog Communication System. Dhanpat Rai
5. Taub & Schilling, Principles of Communication Systems. Tata McGraw-Hill
6. Kennedy, George & Davis, Bernard, Electronic communication systems. Tata McGraw Hill
7. Singh, R.P. & Sapre, S.D., Communication Systems: Analog & Digital. Tata McGraw Hill
8. A.B. Carlson, Communication Systems. Tata McGraw-Hill
9. Carlson, A. Bruce, Crilly, Paul B. & Rutledge, Janet C, Communication Systems an Introduction to Signals & Noise in Electrical Communication. Tata McGraw-Hill

BEC 751 Digital Communications Lab

L-T-P-C
0-0-2-1

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

1. Perform signal sampling for baseband signals and reconstruct the signals.
2. Generate digital modulation signals for ASK, PSK and FSK and perform their detection.
3. Understand and generate QPSK signal.
4. Single bit error detection and correction.

List of Experiments:

1. Sample and hold circuit.
2. ASK, FSK, PSK modulation and detection
3. PCM Modulation and detection
4. PAM, PWM, PPM generation and detection.
5. QPSK Generation
6. Pulse data coding and decoding techniques for NRZ formats
7. Delta modulation and detection.
8. Single bit error detection and correction.

BEC 702 Wireless & Mobile Communication

L-T-P-C
3-0-0-3

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

1. Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
2. Compare different technologies used for wireless communication systems.
3. Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks.
4. Demonstrate an ability explain multiple access techniques for Wireless Communication
5. Demonstrate an ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks.

Unit-1 (7 Hrs)

Evolution of mobile radio communication fundamentals: General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency.

Unit-2 (7 Hrs)

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, .

Unit-3 (8 Hrs)

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SCFDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems.

Unit-4 (6 Hrs)

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.

Unit-5 (8 Hrs)

Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.

Text/ Reference Books:

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition.
2. Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications.
3. T L Singal ,"Wireless Communications ", McGraw Hill Publications
4. NEPTL Lecture.

BEC 752 Wireless & Mobile Communication Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Describe the evolution of mobile communication system.
2. Describe the various concept of cellular system.
3. Illustrate the various models of propagation in mobile communication.
4. Express the equalization & channel coding for various system.
5. Compare the different wireless networks &standards.
6. Set up experiments for wireless mobile communication.

List of experiments:

1. To understand the Basic circuit of Mobile phone (Transmitter, Receiver and Base band control Section).
2. To study working of SIM card in GSM handset SIM card detection.
3. To Study and observe Transmitted/Received RF signal.
4. Study and observe Transmitted (I & Q) /Received (I & Q) signals constellations.
5. Study and analyze the Buzzer in 4G LTE Smart Phone Tech Book.
6. To study and Analyze the Vibrator in 4G LTE smart phone Tech book
7. Study of switch faults in User Interface Section of 4G LTE Smart PhoneTechBook
8. Study and analyze the Power Management Unit in 4G LTE Smart Phone TechBook
9. To study AT commands using GSM trainer module
10. To study General Packet Radio Receiver

Text/Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.
2. Haykin& M. Moher, “Modern wireless communication”, Pearson

BEC 801 Optical Communications

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. familiarize with basic concepts and theory of optical fiber communication system.
2. learn transmission characteristics of optical fiber in optical fiber communication system.
3. understand the various optical sources used in optical fiber communication system.
4. understand the various optical receivers used in optical fiber communication system.
5. understand optical link design in optical fiber communication system.

Unit-1 (8 Hrs)

Overview of optical fiber communication: Block diagram of optical fiber communication system, advantage of optical fiber communication, transmission link, basic structure of optical fiber, light propagation in optical fiber using ray theory transmission, total internal reflection, acceptance angle, numerical aperture, optical fiber modes, step index, graded index fiber, fiber materials, fiber fabrication.

Unit-2 (8 Hrs)

Transmission characteristics of optical fiber: Introduction, attenuation , absorption losses, scattering losses, bending losses, distortion in optical fiber communication system, optical power launching, coupling, power calculation, fiber to fiber joints, fiber splicing technique, fiber connectors.

Unit-3 (8 Hrs)

Optical sources: LASER: Basic concepts of laser, Semiconductor injection laser (ILD), Characteristics of Injection laser, Advantage of LASER, Applications of LASER.
LED: LED structures, LED power and efficiency, LED characteristics, LED advantages, LED applications.

Unit-4 (8 Hrs)

Optical detectors: Requirement for photo detections p-n photodiode, advantages of p-n photodiode, characteristics of photo detections, avalanche photodiodes, phototransistors, Performance considerations, Noise in optical receiver, Optical Power meter.

Unit-5 (8 Hrs)

Optical link design: Point to point link, system considerations, link power budget, rise time budget, modulation formats for optical communication system, introduction to WDM concepts, multiplexing strategies in optical fiber.

Text/ Reference Books:

1. G. Keiser: Optical Fiber Communication – MGH
2. Jenkins & White : Fundamentals Of Optics – MGH
3. J. M. Senior : Optical Fiber Communication – PHI
4. Gagliardi & Karp: Optical Communication – Wiley

BEC 851 Optical Communications Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. understand and measure the basic properties of the propagation of light in optical fiber communication system
2. understand the differences between types of light sources utilized in optical fiber communication system
3. understand the differences between types of light receivers utilized in optical fiber communication system
4. understand the different types of modulation techniques used in optical fiber communication system

List of Experiments:

1. To study & observe how Analog Signal can be transmitted through Optical Fiber Cable & reproduced at the receiver end.
2. To study & observe how Digital Signal can be transmitted through Optical Fiber Cable & reproduced at the receiver end.
3. To study & observe Voice Link through Optical Fiber Cable.
4. To measure the power of Optical Fiber Cable using Optical Power Meter.
5. To observe the bending loss in Optical Fiber Cable.
6. To study & observe the Losses (Propagation Loss) in Optical Fiber Cable.
7. To study & perform Amplitude Modulation & Demodulation through Optical Fiber Cable.
8. To study & perform Frequency Modulation & Demodulation through Optical Fiber Cable.
9. To study & perform Pulse Amplitude Modulation & Demodulation through Optical Fiber Cable.
10. To study & perform Pulse Width Modulation and Demodulation through Optical Fiber Cable.
11. To study Pulse Position Modulation and Demodulation through Optical Fiber Cable.
12. To study & observe the Numerical Aperture of Optical Fiber & measure the Numerical Aperture of Optical Fiber Cable.

Text/ Reference Books:

1. G. Keiser: Optical Fiber Communication – MGH
2. Jenkins & White : Fundamentals Of Optics – MGH
3. J. M. Senior : Optical Fiber Communication – PHI
4. Gagliardi & Karp: Optical Communication – Wiley

BEC 802 Satellite Communication

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. define orbital mechanics and satellite launch methodology.
2. describe satellite sub systems
3. design link power budget for satellite
4. explain different satellite access
5. describe DTH and Compression standard.

Unit-1 (7 Hrs)

Introduction: frequency allocations for satellite systems. orbits and launching methods: Kepler's three laws of planetary motion, terms used for earth orbiting satellites, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, local mean solar point and sun-synchronous orbits, standard time.

Unit-2 (7 Hrs)

The Geostationary orbit: Introduction, antenna look angles, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage, launching orbits. polarization: antenna polarization, polarization of satellite signals, cross polarization discrimination. depolarization: ionospheric, rain, ice.

Unit-3 (8 Hrs)

The Space segment: Power supply, attitude control, station keeping, thermal control, tt&c subsystem, transponders, antenna subsystem, Morelos and Satmex 5, Anik-satellites, advanced Tiros-n Spacecraft. the earth segment, receive-only home TV systems, master antenna tv system, community antenna TV system, transmit-receive earth station.

Unit-4 (6 Hrs)

The space link: Introduction, equivalent isotropic radiated power, transmission losses, the link power budget equation, system noise, carrier-to-noise ratio (C/N), the uplink, the downlink, effects of rain, combined uplink and downlink C/N ratio, inter modulation noise, intersatellite links. interference between satellite circuits.

Unit-5 (8 Hrs)

Satellite Services VSAT systems: Network architecture, access control protocols, basic techniques, VSAT earth station, calculation of link margins for a VSAT star network. direct broadcast satellite television and radio: digital DBS TV, BDS TV system design and link budget, error control in digital DBS-TV, installation of DBS-TV antennas, satellite radio broadcasting.

Text/ Reference Books:

1. Roddy: Satellite Communications, TMH.
2. Timothy Prattt: Satellite Communications, Wiley India.
3. Pritchard, Suyderhoud and Nelson: Satellite Communication Systems Engineering, Pearson Education. 4. Agarwal: Satellite Communications, Khanna Publishers.
4. Gangliardi: Satellite Communications, CBS Publishers.
5. Chartrand: Satellite Communication, Cengage Learning.
6. Raja Rao: Fundamentals of Satellite communications, PHI Learning
7. NEPTL Lectures.

DE-ECE 501 Electrical Engineering Materials

L-T-P-C
3-0-0-3

Course Objectives: At the end of the course, students will demonstrate the ability to

1. understand bonding in solids, crystal structure structural Imperfections and apply its role in materials behaviour that play a critical role in determining many physical properties.
2. understand electrical and thermal conductivity in metals. Illustrate thermoelectric effect. Evaluate heat developed in current carrying conductors. Also Understand superconductivity and super conducting materials.
3. know basics of magnetic materials and understand soft, hard and permanent magnetic materials.
4. Compare between dielectric and insulator and illustrate effect of dielectric on the behaviour of a capacitor.
5. know about basics of electrical components and understand effect of different electrical materials used in construction of different Electrical Components and classify according to their application.

Syllabus

Unit – 1

Crystal Structure of Materials: A. Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth.

B. Energy bands in solids, classification of materials using energy band, direct and indirect band gap materials.

Unit – 2

Conductivity of Metals: Electrical conductivity, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductors, classification of superconductors, meissner effect, properties and application of superconductors, limitation of superconductors.

.

Unit – 3

Mechanism of Conduction in semiconductor materials: Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, P-N junction diode, junction transistor, FET & IGFET, properties of semiconducting materials.

Unit – 4

Magnetic Materials: Classification: Diamagnetism, Para magnetism, Ferromagnetism, Anti-ferromagnetism and Ferrimagnetism, magnetostriction, Properties of magnetic materials, soft and hard magnetic materials, permanent magnetic materials, permittivity, dielectric losses and loss tangent, ferro-electricity and piezoelectricity

Unit – 5

Advanced materials: Smart materials, classification and application of smart materials, Introduction to Nano-science and Nano-technology, biomaterials, useful biomaterial in human organs, application of biomaterials.

Text/Reference Books:

1. A.J. Dekker,"Electrical Engineering Materials" Prentice Hall of India
2. R.K. Rajput," Electrical Engg.Materials," Laxmi Publications.
3. C.S. Indulkar & S.Triruvagdan "An Introduction to Electrical Engg. Materials, S.Chand& Co.
4. Solymar, "Electrical Properties of Materials" Oxford University Press.
5. Ian P. Hones," Material Science for Electrical and Electronic Engineering," Oxford University

DE- ECE 502 Electronic Circuit Switching

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Describe and apply fundamentals of telecommunication systems and associated technologies.
2. Solve problems and design simple systems related to tele-traffic and trunking efficiency.
3. Understand and explain the reasons for switching, and the relative merits of the possible switching modes
4. Understand the principles of the internal design and operation of telecommunication switches
5. Understand the Packet Switching & Routing Control Techniques.

Syllabus

Unit-1 (8 Hrs)
Evolution of switching systems: Introduction, Message switching, Circuits switching, Functions of a switching system, Register-transistor-senders, Distribution frames, Crossbar switch, A general trucking, Electronic switching, Reed- electronic system, Digital switching systems.

Unit-2 (8 Hrs)
Digital Switching: Switching functions, Space Division Switching, Time Division Switching, Two-Dimensional Switching, Digital Cross-Connect Systems , Digital Switching in an Analog Environment

Unit-3 (8 Hrs)
Telecom Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking models and Loss Estimates, Delay Systems

Unit-4 (8 Hrs)
Control of switching systems: Introduction, Call-processing functions, Common control, Reliability, availability and security; Stored-program control. Signalling: Introduction, Customer line signalling, Audio-frequency junctions and trunk circuits, FDM carrier systems, PCM signalling, Inter-register signalling, Common-channel signalling principles, CCITT signalling system no. 6 and 7, Digital customer line signalling.

Unit-5 (8 Hrs)
Packet Switching: Packet Switching, Statistical Multiplexing, Routing Control (dynamic routing, virtual circuit routing and fixed-path routing), Flow Control, X.25, Frame Relay, TCP/IP ATM Cells, ATM Service Categories, ATM Switching (ATM Memory Switch, Space-Memory Switch, Memory-Space Switch, Memory-Space-Memory switch, Banyan Network Switch).

Text/ Reference Books:

1. Thiagarajan Viswanathan & Manav Bhatnagar, Telecommunication Switching Systems & Networks, PHI.
2. J.E. Flood, “Telecommunication Switching, Traffic and Networks”, Pearson Education.
3. John C. Bellamy, “Digital Telephony”, John Wiley, 3rd Ed.

DE- ECE 503 Process Control

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. explain the concept of advanced control schemes used in process control.
2. explain the working of distributed control system
3. elaborate the use of artificial intelligence techniques in process control.
4. explain the fundamental concepts of PLC.
5. explain the concept of digital control system.

Syllabus

Unit-1 (8 Hrs)

Introduction to advanced Control Schemes: Cascade, Feed-forward, Feed-forward plus Feedback, Ratio control, Inferential control, Dead time and Inverse response compensation, Adaptive control, Model reference adaptive control, Self tuning regulator Interactions and Decoupling of Control Loops: Design of cross controllers and selection of loops using Relative Gain Array

Unit-2 (8 Hrs)

Distributed Control System (DCS): Evolution and advantages of computer control, Configuration of Supervisory, Direct digital control (DDC) and DCS.

Unit-3 (8 Hrs)

Artificial Intelligence in Process Control: Expert systems, Neural networks, Fuzzy logic, Neuro Fuzzy , Genetic algorithm, Virtual instrumentation.

Unit-4 (8 Hrs)

Programmable Logic Controllers: Comparison with hard wired relay and semiconductor logic, Hardware, Ladder diagram programming, Case studies, Introduction to CPLD, SPLD, FPGA

Unit-5 (8 Hrs)

Digital Control: Sampling and reconstruction, Discrete systems analysis, Stability and controller design using z transform and difference equations, Smoothing filter realization using difference equations

Text / Reference Books:

1. Stephanopoulos, G., Chemical Process Control, Prentice Hall of India Private Limited (1983).
2. Liptak, B.G., Instrument Engineers Handbook , Chilton Book Company (1994).
3. Deb, S.R., Robotics Technology and Flexible Automation, Tata McGraw Hill (1994).
4. Johnson, C.D., Process Control Instrumentation Technology, Prentice Hall of India Private Limited (2007).
5. Zaidi, A., SPC Concepts, Methodologies and Tools, Prentice Hall of India Private Limited (1995).

DE-ECE 504 Embedded Systems

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand the basic components of Embedded Systems
2. Identify the hardware and software components of an embedded system
3. Choose appropriate embedded system architecture for the given application
4. Write programs for optimized performance of an embedded system and validate

Syllabus

Unit-1 (9 Hrs)

Introduction: Embedded systems Overview, Characteristics of embedded computing applications. Design Challenges, Common Design Metrics.

Unit-2 (8 Hrs)

Processor Technology, IC Technology, Trade-offs, the development process, Requirements. Specification, Architecture Design, Designing Hardware and Software components. System Integration and Testing, Types of Hardware Platforms, Single board computers.

Unit-3 (8 Hrs)

PC Add-on cards, custom-built hardware platforms, ARM Processor, CPU performance. CPU power consumption, Bus-based computer systems. Memory devices, I/O devices, component interfacing, designing with microprocessors, system level performance analysis. components for embedded programs,

Unit-4 (9 Hrs)

Models of programs, Assembly, Linking, and loading, basic compilation techniques.

Unit-5 (9 Hrs)

Software performance optimization, program level energy and Power analysis, Program validation and Testing.

Text/Reference Books:

1. Wayne Wolf, Computers as Components-Principles of Embedded Computer System Design, Morgun Kaufmann Publisher, 2006.
2. David E-Simon, An Embedded software Primer, Pearson Education, 2007.
3. David Simon, "An Embedded Software Primer",Pearson Education.
4. Himanshu B.Dave, Embedded Systems: Concepts, Design and Programming, Pearson Education. 2015.
5. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
6. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

DE-ECE 505 Electronic Product Design

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Remember the different considerations of analog, digital and mixed circuit design.
2. Understand various stages of hardware, software and PCB design
3. Acquainted with methods of PCB design and different tools used for PCB Design.
4. Importance of product test & test specifications.
5. Special design considerations and importance of documentation.

Syllabus

Unit-1

Introduction to Electronic Product Design: Man machine dialog and Industrial design, user-centered design, five element of successful design, cognition, ergonomics. Packaging and factors, design for manufacture, assembly and disassembly, wiring, temperature, vibration and shock. Safety, noise, energy coupling, grounding, filtering and shielding.

Unit-2

Hardware Design & testing methods: Design process. Identifying the requirements, formulating specifications, design specifications, Specifications verses requirements, System partitioning, Functional design, architectural design, Functional model verses architectural model. Prototyping. Performance and Efficiency measures. Formulating a test plan, writing specifications, Test procedure and test cases, Egoless design, design reviews. Module debug and test: black box test, white box test, grey box test.

Unit-3

PCB design: Fundamental Definitions, Standards. Routing Topology Configurations, Layer Stack up assignment, Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning, Critical frequencies, Bypassing and decoupling. Design techniques for ESD Protection, Guard Band implementation.

Unit-4

Product Debugging and testing: Steps of Debugging, Techniques for troubleshooting, characterization, Electromechanical components, passive components, active components, active devices, operational amplifier, Analog-Digital Conversion, Digital Components, Inspection and test of components, Simulation, Prototyping and testing, Integration, validation and verification. EMI & EMC issues.

Unit-5

Documentation: Definition, need, and types of documentation. Records, Accountability, and Liability. Audience. Preparation, Presentation, and Preservation of documents. Methods of documentation, Visual techniques, Layout of documentation, Bill of material.

Text/Reference Books:

1. Kim Fowler," Electronic Instrument Design" Oxford university press.
2. Robert J. Herrick, Printed Circuit board design Techniques for EMC Compliance, 2nd edition, IEEE press.
3. Reference Books
4. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", Wiley publication
5. J C Whitakar," The Electronics Handbook", CRC press

DE-ECE 601 Power Electronics

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. analyze different types of power semiconductor devices and their switching.
2. demostrate the triggering circuit and snubber circuit and Classify the operation of choppers and basic topologies of DC-DC Switching regulators.
3. illustrate the operation of AC voltage controller and cyclo- converter and its application.
4. analyze operation, characteristics and performance parameter of controlled rectifiers.
5. analyze the operation of single phase and three phase inverters with and without PWM techniques and to understand harmonic reduction methods.

Syllabus

Unit-1 (8 Hrs)

Power Semiconductor Devices: Diode, Thyristors, BJT, Power MOSFET and Power IGBT and their characteristics. Firing Circuit for Thyristor. Two transistor analogy of SCR, Series and parallel connections of SCR's. Thyristor Commutation Technique. Gate drive Circuits for MOSFET and IGBT. GTO, MCT and TRIAC .

Unit-2 (8 Hrs)

Single phase half wave controlled, rectifier with resistive and inductive loads, effect of freewheeling diode. Single phase fully controlled and half controlled bridge converters. Three phase half wave converters, Three phase fully controlled and half controlled bridge converters, Effect of source impedance, Single phase and three phase dual converters. Resonant converters

Unit-3 (7 Hrs)

Choppers: Time ratio control and Current limit control strategies Step down choppers-Derivation of load voltage and currents with R, RL and RLE loads-Step up Chopper load voltage expression. Morgan's chopper Jones chopper Oscillation choppers (Principle of operation only) -waveforms AC Chopper Problems.

Unit-4 (6 Hrs)

Principle of On-Off and phase controls, Single phase ac voltage controller with resistive and inductive loads. Three phase ac voltage controllers (various configurations and comparison), Single phase transformer tap changer.

Cyclo -Converters, Basic principle of operation, single phase to single phase, three phase to single phase and three phase to three phase cyclo-converters, output voltage equation

Unit-5 (8 Hrs)

Single-phase voltage source inverter: Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Three-phase voltage source inverter: Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation. Harmonics reduction techniques, Single phase and three phase current source inverters.

Text/ Reference Books:

1. P.S.Bhimbra, "Power Electronics",Khanna publications

2. M.D.Singh&K.B.Kanchandhani, Power Electronics, Tata McGrawHill Publishing company, 1998.
1. VedamSubramanyam, Power Electronicsby New Age International (P) Limited, Publishers
2. P.C.Sen, Power Electronics, Tata McGraw-Hill Publishing.

DE-ECE 602 High Speed Semiconductor devices

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Knowledge of materials (compound semiconductor) used in high speed devices and their properties and the advanced technologies for high speed electron devices
2. Knowledge of high speed electron devices operation along with their descriptive models and the operation of selected optoelectronic devices
3. Exploit small-signal equivalent circuit models of high frequency electron devices (MESFETs, HEMTs, HBTs)
4. Knowledge of material and device processing techniques of High speed semiconductor devices

Syllabus

Unit-1 (8 Hrs)

Introduction: Important parameters governing the high speed performance of devices and circuits: Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature; important parameters governing the high power performance of devices and circuits: Break down voltage, resistances, device geometries, doping concentration and temperature

Unit-2 (7 Hrs)

Materials properties: Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials, electric field characteristics of materials and device processing techniques, Band diagrams, homo and hetro junctions, electrostatic calculations, Band gap engineering, doping, Material and device process technique with these III-V and IV – IV semiconductors.

Unit-3 (8 Hrs)

Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices: Native oxides of Compound semiconductors for MOS devices and the interface state density related issues. Metal semiconductor contacts, Schottky barrier diode, Metal semiconductor Field Effect Transistors (MESFETs): Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.

Unit-4 (8 Hrs)

High Electron Mobility Transistors (HEMT): Hetero-junction devices. The generic Modulation Doped FET (MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures: Hetero junction Bipolar transistors (HBTs): Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure and the surface passivation for stable high gain high frequency performance. SiGe HBTs and the concept of strained layer devices; High Frequency resonant – tunneling devices, Resonant-tunneling hot electron transistors.

Text/Reference Books:

1. C.Y. Chang, F. Kai, GaAs High-Speed Devices, Physics, Technology and Circuit Applications Wiley

2. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons
3. David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams& Co., 1985
4. Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices, Artech House, 1992.
5. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5
6. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5
7. SandipTiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-691740-X
8. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007, ISBN 978-0-86341-743-6.
9. Ruediger Quay, Gallium Nitride Electronics, Springer 2008, ISBN 978-3-540-71890-1, (Available on NITC intranet in Springer eBook section)
10. Prof. Dr. Alessandro Birolini, Reliability Engineering Theory and PracticeSpringer 2007, ISBN-10 3-540- 40287-X, Available on NITC intranet in Springer eBook section)

DE-ECE 603 Optical Networks

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Familiarize with basic concepts and theory of Optical Communication
2. Demonstrate optical components, assemble them and solve problems on Optical Communication system
3. Able to design, implements, analyse and maintains optical communication system
4. Gain knowledge of different source of light as well as receiver and their comparative study
5. To get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain

Syllabus

Unit-1 (8 Hrs)

Introduction to Optical Network: Telecommunication networks, First generation optical networks, Multiplexing techniques, Second generation optical networks, System and network evolution, optical layer, optical packet switching. Block diagram of optical fiber communication system, advantage of optical fiber communication, basic structure of optical fiber, light propagation in optical fiber using ray theory transmission, Total internal reflection, acceptance angle, numerical aperture.

Unit-2 (8 Hrs)

Optical Couplers, Isolators, Circulators, Multiplexers and filters, large optical switches, Crosstalk: Intra-channel crosstalk, inter-channel crosstalk, crosstalk in Networks, Absorption losses, scattering losses, bending losses, distortion in optical fiber communication system, optical power launching, coupling, power calculation, fiber to fiber joints, fiber splicing technique, fiber connectors.

Unit-3 (8 Hrs)

Transmitters, detectors, Switches, SONET/SDH Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure, Quality of service, WDM Network elements, LASER, LED: structures, characteristics, advantages, applications.

Unit-4 (8 Hrs)

WDM Network, Cost Trade-offs, Light path Topology, Routing and wavelength assignment problems, Network Survivability, Protection in SONET/SDH, Optical Layer Protection, Different Schemes, Interworking between Layers, Photodiodes, Phototransistors, Optical Power meter

Unit-5 (8 Hrs)

Optical Switching, Point to point link, system considerations, link power budget, rise time budget, modulation formats for optical communication system, introduction to WDM concepts, multiplexing strategies in optical network.

Text / Reference Books:

1. R. Ramaswami, & K. N. Sivarajan, Optical Networks a Practical perspective, Morgan Kaufmann Publishers.
2. U. Black, “Optical Networks: Third Generation Transport Systems”/ Pearson Educations.
3. G. Keiser: Optical Fiber Communication – MGH
4. J.M. Senior : Optical Fiber Communication – PHI

DE-ECE 604 Consumer Electronics

L-T-P-C
4-0-0-4

Course Outcomes: Student will be able to

1. Identify and explain basic working of electronics products like TV, Microphone, loudspeaker, AC, Microwave ovens.
2. learn various components of composite video signal and differentiate between line, brightness, saturation and to design the lower power consumption device, the primary challenge is how to minimize overall cost.
3. acquire ability to design different display screen so as effect of radiations on eyes will be reduced.
4. Understand the general importance of product safety to consumers & producers will reduce the various adverse impacts of these devices on common man.

Syllabus

Unit-1 (9 Hrs)

Monochrome TV (Introduction): Elements of a TV System, Picture transmission, Sound transmission, Picture reception, Sound reception, Synchronization, Receiver control, Image continuity, Scanning Process, Aspect Ratio, Flicker, Composite Video Signal, Picture Elements, Kell factor, Vertical Resolution, Horizontal Resolution, Video bandwidth, Interlacing, 625 Line System, Bandwidths for TV Transmission, Vertical and horizontal synch detail, Vestigial Side Band transmission (Advantages and Disadvantages)

Unit-2 (7 Hrs)

Monochrome TV (Picture and Camera Tubes): Monochrome picture tube, beam reflection, Beam focusing, Screen Phosphor, Face plate, Picture tube characteristics, picture tube circuit controls, Monochrome Camera Tubes: Basic principle, Image Orthicon, Vidicon, Plumbicon

Unit-3 (8 Hrs)

Colour TV Essentials: Compatibility , Colour perception,Three Colour theory, Luminance, Hue and Saturation, Dispersion and Recombination of light, Primary and secondary colours, luminance signal, Chrominance Signal, Colour picture tube,colour TV Camera, Colour TV display Tubes, colour Signal Transmission, Bandwidth for colour signal transmission, Colour TV controls. Cable TV, Block Diagram and principle of working of cable TV.

Plasma and LCD:

Introduction,liquid crystals,types of LCD's,TN,STN,TFT,Power requirements,LCD working,Principle of operation of TN display,Construction of TN display,Behaviour of TN liquid crystals,Viewing angle,colour balance, colour TN display, limitatons, advantages, disadvantages, applications.

Unit-4 (9 Hrs)

LED and DMD: Introduction to LED Television , comparison with LCD and Plasma TV's, schematic of DMD, introduction to Digital MicroMirror device, Diagram of DMD, principle of working, emerging applications of DMD.

Microwave Ovens and Air Conditioners: Microwaves, Transit Time, Magnetron, Waveguides, Microwave Oven, Microwave Cooking. Air conditioning, Components of air conditioning systems, all water Air conditioning systems, air conditioning Systems, Split air conditioner.

Unit-5 (10 Hrs)

Microphones: Introduction, characteristics of microphones, types of microphone: carbon, moving coil, wireless, crystal, introduction to tape recorder.

Loudspeaker: Introduction to ideal and basic loudspeaker, loudspeaker construction types of loudspeaker: Dynamic and permanent magnet, woofers, tweeters, brief introduction to baffles, equalisers.

Text/Reference Books:

1. Consumer Electronics by S. P. Bali Pearson Education.
2. Complete Satellite and Cable T.V by R.R Gulati(New Age International Publishers)
3. Monochrome and Colour Television by R. R. Gulati

DE-ECE 605 Computer Networks

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model. To understand the fundamentals and basics of Physical layer, and to apply them in real time applications.
2. Study and evaluate medium access layer protocols. To learn data link layer concepts, design issues, and protocols and demonstrate knowledge of various error detection, correction and flow control techniques in data link layer.
3. Classify the routing protocols, analyze how to assign the IP addresses for the given network and to evaluate different congestion control methods.
4. Understand, analyze and evaluate a number of Transport layer and presentation layer services, and protocols.
5. Understand the functions of Application layer paradigms and Protocols.

Syllabus

Unit-1

Introduction Concepts: Goals and Applications of Networks, Network structure and architecture, TCP/IP MODEL, The OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design.

Physical Level: Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch

Unit-2

Medium Access sub layer: Medium Access sub layer – Channel Allocations, LAN protocols , Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA.

Data Link Layer - Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ.

Unit-3

Network Layer: Network Layer - Point - to Pont Networks, routing, Congestion control, Internetworking -TCP / IP - IP packet, IP address, IPv6. '

Unit-4

Transport Layer: Transport Layer - Design issues, connection management, session Layer Design issues, remote procedure call. Presentation Layer-Design issues, Data compression techniques, cryptography - TCP – Window Management.

Unit-5

Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application, Example Networks - Internet and Public Networks.

Text / Reference Books:

1. Forouzan, Data Communication & Networking, McGrawhill Education
2. Lathi, B. P. & Ding, Z., 2010, Modern Digital and Analog Communication Systems, Oxford University Press.
3. Stallings, W., (2010), Data and Computer Communications, Pearson.
4. Andrew S. Tanenbaum, “Computer Networks” Pearson.
5. Ajit Pal, “Data Communication and Computer Networks”, PHI
6. Dimitri Bertsekas, Robert G. Gallager, “Data Networks”, Prentice Hall, 1992

DE-ECE 701 VLSI

L-T-P-C
3-0-0-3

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

1. Students are able to know how to place the blocks and how to partition the blocks while for designing the layout for IC.
2. Students are able to solve the performance issues in circuit layout.
3. Students are able to analyze CMOS & NMOS process technology.
4. Students are able to understand theSequential MOS logic circuit.
5. Students are able to analyze circuits using both analytical and CAD tools.

Syllabus

Unit-1 (10 Hrs)

VLSI design Introduction: Evolution of VLSI, VLSI designing methodology, design flow, design Hierarchy, VLSI design style, Design quality, computer aided design technology.

Introduction to MOS: MOS transistor theory, MOS structure, enhancement & depletion transistor, threshold voltage, MOS device design equations, MOSFET scaling and small geometry effects, MOSFET capacitances.

Unit-2 (8 Hrs)

NMOS inverter, CMOS inverter, DC characteristics, static load MOS inverter, pull up/pull down ratio, static & dynamic power dissipation, CMOS logic gate design: NAND, NOR, XOR and XNOR gates, Transistor sizing, combinational MOS logic circuits: pass transistor and transmission gate designs, Pseudo NMOS logic.

Unit-3 (7 Hrs)

CMOS & NMOS process technology: explanation of different stages in fabrication, body effect, latch up in CMOS.

Stick diagram and design rules, lambda-based design rules, switching characteristics & inter connection effects: rise time, fall time delays, noise margin.

Unit-4 (8 Hrs)

Sequential MOS logic circuits: SR latch, clocked latch and flip flop circuits, CMOS D latch and edge triggered flip flop, dynamic logic circuits; basic principle, non-ideal effects, domino CMOS logic, high performance dynamic CMOS circuits.

Unit-5 (8 Hrs)

Physical Design: Introduction to ECAD tools for first and back end design of VLSI circuits. Custom/ASIC design, Design using FPGA and VHDL. VHDL Code for simple Logic gates, flip-flops, shift registers

Text/Reference books:

1. S. M. Kang, Y. Lebiebici, CMOS digital integrated circuits analysis & design, Tata McGraw Hill.
2. Pucknell Douglas A., Eshraghian Kamran, Basic VLSI Design - PHI Learning Pvt Limited.
3. N.Weste and K. Eshraghian, Principles of CMOS VLSI, 2e, Pearson Education. 2011
4. VLSI Design , P PSahu , , McGraw. 2013
5. VLSI Design, D.P. Das, Oxford. 2011
6. Chip Design for Submicron VLSI: CMOS Layout & Simulation, Uyemura, cengage learning

DE- ECE 702 Nano-Electronics

L-T-P-C
3-0-0-3

Course Outcomes: At the end of this course, student will have the ability to:

1. Use the fundamental science and engineering principles relevant to materials that include the relationships between characterization, properties, performance and design of materials results in better applications.
2. Possess the skills and techniques necessary for handling dielectric materials.
3. Become leaders in IC fabrication and possibly become entrepreneur which will contribute in society upliftment.
4. Use lifelong learning skills to develop knowledge and skills to take advantage of nanomaterials in professional development opportunities in term reduce the size, cost and power requirement of existing devices and technology.

Syllabus

Unit-1 (10 Hrs)
Introduction to Electronic Materials: Thermodynamics of Materials; Mechanical Properties of Materials; Bonding, Structure and Crystallography; Advanced Fluid-Solid Reaction Engineering; Microstructural and Microchemical Characterization of Materials.
Material Basics: Ohms Law and Materials Properties; The Hall Effect; Conductors – Metals, Alloys, Non-metallic Conductors; Contacts, Resistors and Heating; Thermionic Emission, Tunneling, Thermoelectric Effects; Ionic conductors: Debye Length, Nernst Equation.

Unit-2 (11 Hrs)
Introduction to Dielectrics: Dielectrics – Mechanisms of Polarization; Frequency dependence of Dielectric constants; Dielectric Losses; Mechanisms of Electrical Breakdown; Piezo-electricity; Ferro-electricity; Dielectrics and Optics.
Basics of Magnetics: Magnetics – Origin of Magnetic dipoles; Types of Magnetisms: Diamagnetism, Para-magnetism and Ferro-magnetism; Magnetic data storage.

Unit-3 (13 Hrs)
Advanced Materials: MEMS; NEMS; CNTS; Novel semiconductors; Photovoltaic materials.
Materials for IC Fabrication: Materials and Processes for Silicon Technology; Si Oxide, LOCOS Process; Chemical Vapor Deposition: Silicon Epitaxy, Oxide CVD, CVD for Poly-Silicon, Silicon Nitride and Miscellaneous Materials; Etching Techniques: Chemical Etching, Plasma Etching; Lithography: Basic Lithography Techniques, Resist and Steppers; Electrochemistry of Silicon.

Unit-4 (8 Hrs)
Electronic Devices: Electronic Device Components: Wires & Cables, Semiconductors, Capacitors, PCBs, MEMS, Battery, CD-R, EMI/RFI, ITO, Electro-wetting, LCD &LED; CDs and DVDs.

Unit-5 (6 Hrs)
Nanotechnology in Electronics: Nanotechnology in Electronics: Magnetoresistive Random Access Memory (MRAM); Self-assembled nanostructures; Nano-photonics; Nano-ionics; Molecular electronics; Nanomaterials electronics; Nanofabrication.

Text/Reference Books:

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill,2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery,"Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007

3. Xin-she Yang (Ed.). Introduction to Computational Mathematics, World Scientific Publishing Co., 2nd Ed.
4. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education.
5. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1stEd., 2006
6. 2.Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB and Octave", Springer, 3rd Ed., 2010

DE-ECE 703 Information Theory & Coding

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Model the Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information
2. Design Data Compression, Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length
3. Identify the Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem.
4. Analyse Introduction to block codes, Single-parity-check codes, Product codes, Repetition codes, Hamming codes
5. Design Generator matrices for convolutional codes, Generator polynomials for convolutional codes

Syllabus

Unit-1 (8 Hrs)

Entropy: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality

Unit-2 (8 Hrs)

Asymptotic Equipartition Property: Asymptotic Equipartition Property Theorem, Consequences of the AEP: Data Compression, High-Probability Sets and the Typical Set Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding

Unit-3 (8 Hrs)

Channel Capacity: Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem

Unit-4 (8 Hrs)

Block Codes: Digital communication channel, Introduction to block codes, Single-parity check codes, Product codes, Repetition codes, Hamming codes, Minimum distance of block codes, Soft-decision decoding, Automatic-repeat-request schemes, Linear codes, Definition of linear codes, Generator matrices, Standard array, Parity-check matrices, Error.

Unit-5 (8 Hrs)

Convolution codes: Encoding convolutional codes, Generator matrices for convolutional codes, Generator polynomials for convolutional codes, Graphical representation of convolutional codes, Viterbi decoder

Text / Reference Books:

1. Bose, Inforrmation Theory, Coding and Cryptography, Mcgrawhill Education
2. Joy A. Thomas, Thomas M. Cover, Elements of information theory, Wiley-Interscience; 2edition (2006)
3. S. Gravano, "Introduction to Error Control Codes" OUP Oxford (24 May 2001)
4. Robert B. Ash, "Information Theory", Dover Publications (November 1, 1990)
5. Todd k Moon, "Error Correction Coding: Mathematical Methods and Algorithms " Wiley,2005

DE-ECE 704 Artificial Intelligence

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents. Apply concept of Natural Language processing to problems leading to understanding of cognitive computing.
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.
4. To study and apply the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as chaining, resolution, etc. that play an important role in AI programs.
5. To understand various machine learning techniques and models.

Syllabus

Unit-1 (10 Hrs)
Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of AI, Natural Language Processing, Robotics and Computer Vision, Intelligent Agents, Structure of Intelligent Agents.

Unit-2 (8 Hrs)
Searching for solutions State-Space Search, Problem Solving , Generate and Test, Means-Ends Analysis, search in AND/OR graphs Uniformed search strategies: Breadth First Search, Depth First Search and Depth limited Search, Iterative Deepening Search, Informed search strategies: Heuristic function: Best First Search, A* search, AO* search, Bidirectional Search, The Branch and Bound Algorithm

Unit-3 (7 Hrs)
Local search algorithms and optimistic problems: Hill Climbing, Local Beam Search, Simulated Annealing, Genetic Algorithms, Constraint Satisfaction Problem, Constraint Optimization Adversial Search, Game Playing − Optimal decisions in games − Minimax algorithm, Alpha Beta Pruning

Unit-4 (7 Hrs)
Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Unit-5 (8 Hrs)
Machine Learning: Supervised and unsupervised learning, Decision trees, Statistical learning models, learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning.

Text/Reference Books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill
3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education
4. Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall of India,

DE-ECE 705 Electromagnetic Interference

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand the basics of Electromagnetic Interference and Engineering Applications
2. Describe different coupling methods and transient sources
3. Analyze different mitigation techniques for electromagnetic interference control
4. Discuss different standards and regulations for EMI control
5. Descibe different testing methods and instruments for the measurement of electromagnetic interference

Syllabus

Unit-1 (7 Hrs)

Basic Theory : Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories, EMC Engineering Application.

Unit-2 (7 Hrs)

Coupling Mechanism: Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

Unit-3 (8 Hrs)

EMI Mitigation Techniques: Working principle of Shielding and Murphy‟s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.

Unit-4 (6 Hrs)

Standards And Regulation: Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

Unit-5 (8 Hrs)

EMI Test Methods And Instrumentation: Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

Text/ Reference Books:

1. V Prasad Kodali, “Engineering Electromagnetic Compatibility”, IEEE Press, Newyork, 2001.
2. Henry W. Ott, “Electromagnetic Compatibility Engineering”, John Wiley & Sons Inc, Newyork, 2009
3. Daryl Gerke and William Kimmel, “EDN‟s Designer‟s Guide to Electromagnetic Compatibility”, Elsevier Science & Technology Books, 2002

DE-ECE 801 Microwave and Radar Engineering

L-T-P-C
4-0-0-4

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

1. Understand various wave propagation modes of propagation
2. Design impedance matching network for any transmission line or system.
3. Analyze and find applications and limitations of microwave tube Generators and Amplifiers.
4. Understand equation, block diagram &Applications of radar.
5. Understand the different types of Radar systems with their applications.

Syllabus

Unit-1 (10 Hrs)

Introduction: Wave Propagation Modes of Propagation, Plane Earth Reflection, Surface Wave, Field strength, Elevated Dipole Antennas above a Plane Earth, Wave tilt of the Surface Wave, Spherical Earth Propagation, Tropospheric Wave. Ionosphere Propagation, Sky Wave Transmission Calculations, Effect of the Earth's Magnetic Field, Virtual Height, MUF/LUF, Skip distance, Ionospheric Variations and Fading. Space Waves: Radio Horizon, Microwave space wave Propagation, Duct Propagation.

Unit-2 (8 Hrs)

Wave Guides: Guided waves between parallel plates, Dielectric slab Waveguide, Rectangular, Circular waveguides, Transmission Line Analogy for waveguides ,Microwave Components Waveguide couplings, bends and twists, tees, transitions, matched load, Attenuators and phase shifters, wave guide discontinuities, windows Irises and tuning screws, Two-hole directional coupler, Isolators and circulators.

Unit-3 (7 Hrs)

Microwave Generation: Limitations of Conventional Vacuum Tubes, Klystron(Reflex and Multi-cavity), TWT, Magnetrons, and BWO, Negative conductance Microwave devices: Tunnel diode, Gunn diode, IMPATT diode.

Unit-4 (8 Hrs)

Introduction to Radar: Basic radar, The simple form of radar equation, Radar block diagram, Radar frequencies, Applications to radar

Unit-5 (8 Hrs)

Radar Equation: Introduction, Detection of signal in noise, Receiver **noise** and the signal to noise ratio, Probability density functions, Probabilities of detection and false alarm, Integration of Radar pluses, Radar cross section of targets, Radar cross section fluctuations, Transmitter power, Pulse repetition frequency, antenna parameters, system losses, Other Radar equation considerations.

Text/References Books:

1. Jordan and Balmian,'Electromagnetic waves and radiating sytems',PHI.
2. Liao,Y, "Microwave Devices and Cricuits", Prentice Hall of India.
3. S.Kulkarni," Microwave Engineering" ,Umesh Publication,2009.
4. Merrill I. Skolnik" Introduction to Radar Systems" Third Edition.
5. Reich, "Microwave principles", CBS, 1996.
6. Collin, "Foundation of Microwave Engineering", 2nd cd. McGraw Hill, 1992.
7. Watson, "Microwave Semiconductor Devices and Their Circuit Applications", McGraw Hill.
8. J.C. Toomay , Paul J. Hannen " Principles of Radar" Third Edition.

9. GottapuSasibhusanaRao, “Microwave and Radar Engineering, Pearson.

DE-ECE 802 Digital Image Processing

L-T-P-C
4-0-0-4

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

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques.
5. Interpret Image compression standards.
6. Interpret image segmentation and representation techniques.

Syllabus

Unit-1 (8 Hrs)

Introduction and Fundamentals: Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.

Unit-2 (9 Hrs)

Image Enhancement: Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier **Transform:** Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement Sharpening – The Laplacian

Unit-3 (9 Hrs)

Image Restoration, Image Enhancement in Spatial Domain: Introduction; Basic Gray Level Functions– Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction,Image Averaging; Basics of Spatial Filtering; A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

Unit-4 (8 Hrs)

Morphological Image Processing: Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing,
Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

Unit-5 (8 Hrs)

Registration: Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth Segmentation Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Text/ Reference Books:

1. Rafael C. Gonzalvez and Richard E. Woods, Digital Image Processing 2nd Edition,.Pearson Education.
2. R.J. Schalkoff, Digital Image Processing and Computer Vision,.: John Wiley and Sons, NY.
3. A.K. Jain, Fundamentals of Digital Image Processing,. Prentice Hall, Upper Saddle River, NJ.
4. Sonka, Digital Image Processing and Computer Vision, Cengage Learning
5. Gonzalez and Woods, Digital Image Processing, Addison Wesley.

DE-ECE 803 Opto Electronic Devices

L-T-P-C
4-0-0-4

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

1. Understand optical processes such as recombination and absorption in semiconductors.
2. Understand different LED structures with material properties.
3. Explain the principle and working of optical modulators.
4. Analyze different types of photo detectors.
5. Understand the principle and working of optical components.

Syllabus

Unit-1 (7 Hrs)

Optical processes in semiconductors, electron hole recombination, absorption, Franz-Keldysh effect, Stark effect, quantum confined Stark effect, deep level transitions, Auger recombination heat generation and dissipation, heat sources.

Unit-2 (8 Hrs)

Nitride light emitters, nitride material properties, InGaN/GaN LED, structure and working, performance parameters, InGaN/GaN Laser Diode, structure and working, performance parameters. White-light LEDs, generation of white light with LEDs, generation of white light by dichromatic sources, generation of white light by trichromatic sources, temperature dependence of trichromatic, 7generation of white light bytetrachromatic and penta chromatic sources, white-light sources based on wavelength converters

Unit-3 (7 Hrs)

Optical modulators using pn junction, electro-optical modulators, acousto- optical modulators, Raman-Nath modulators, Franz-Keldysh and Stark effect modulators, quantum well electro-absorption modulators, optical switching and logic devices, optical memory.

Unit-4 (9 Hrs)

Optical detection –PIN, APD, modulated barrier photodiode, Schottky barrier photodiode, wavelength selective detection, micro cavity photodiodes. Optoelectronic ICs, advantages, integrated transmitters and receivers, guided wave devices. Working of LDR, liquid crystal display, structure, TFT display, structure, polymer LED, organic LED.

Unit-5 (8 Hrs)

Introduction to optical components, directional couplers, multiplexers, attenuators, isolators, circulators, tunable filters, fixed filters, add drop multiplexers, optical cross connects, wavelength convertors, optical bistable devices.

Text/Reference Books:

1. Pallab Bhattacharya: Semiconductor Optoelectronic Devices, Pearson, 2009
2. Yariv, Photonics Optical Electronics in modern communication, 6/e ,Oxford Univ
3. Alastair Buckley, Organic Light-Emitting Diodes, Woodhead, 2013
4. B E Saleh and M C Teich, Fundamentals of Photonics:, Wiley-Interscience, 1991
5. Bandyopadhay, Optical communicatoion and networks, PHI, 2014.
6. Mynbaev, Scheiner, Fiberoptic Communication Technology, Pearson, 2001.

7. Piprek, Semiconductor Optoelectronic Devices, Elsevier, 2008.
8. Franz and Jain , “Optical Communications Components and Systems”,: Narosa

DE- ECE 804 IC Technology

L-T-P-C
4-0-0-4

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

1. Understand the fundamentals and areas of applications for the Integrated Circuits
2. Analyze important types of integrated circuits of day-to-day requirements.
3. Demonstrate the ability to design practical circuits that perform the desired operations.
4. Understand the differences among theoretical, practical & simulated results in integrated circuits.
5. Choose the appropriate integrated circuit modules to build a given application.

Syllabus

Unit-1 (8 Hrs)

Introduction to IC Technology: SSI, MSI, LSI, VLSI Integrated Circuits Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Epitaxy: Vapor -Phase Epitaxy, Molecular Beam Epitaxy.

Unit-2 (8 Hrs)

Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties. Lithography: Optical Lithography. Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: Deposition Processes, Polysilicon, Silicon Dioxide, Silicon Nitride.

Unit-3 (9 Hrs)

Diffusion: Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources, Sheet Resistance and its Measurement. Ion-Implantation: Ion-Implantation Technique,Implantation Equipment.

Unit-4 (8 Hrs)

Metallization: Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging Design Consideration

Unit-5 (8 Hrs)

VLSI Process Integration: Fundamental Considerations For IC Processing, NMOS IC Technology, CMOS IC Technology, Bipolar IC Technology, Monolithic and Hybrid Integrated Circuits, IC Fabrication.

Text/Reference Books:

1. S. M. Sze, "VLSI Technology", McGraw Hill Publication.
2. S.K. Ghandhi, "VLSI Fabrication Principles", Willy-India Pvt. Ltd
3. J. D. Plummer, M. D. Deal and Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, Practice and Modelling", Pearson Education Publication.
4. Stephen A. Campbell, "Fabrication Engineering at the Micro and Nano scale", Oxford University Press.

DE-ECE 805 Fuzzy Logic and Neural Network

L-T-P-C
4-0-0-4

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

1. Apply operations on Fuzzy sets
2. Develop Fuzzy logic controllers.
3. Apply Fuzzy relations to applications.
4. Understand the basic concepts of Neural Network.
5. Apply neural network techniques to applications.

Syllabus

Unit-1

Crisp set theory (CST): Introduction, Relations between sets, Operations on sets, Characteristic functions, Cartesian products of crisp sets, crisp relations on sets.

Fuzzy set theory (FST): Introduction, concept of fuzzy set (FS), Relation between FS, operations on FS, properties of standard operations, certain numbers associated with a FS, certain crisp sets associated with FS, Certain FS associated with given FS, Extension principle.

Unit-2

Fuzzy Logic (FL): Introduction, Three-valued logics, N-valued logics and infinite valued logics, Fuzzy logics, Fuzzy propositions and their interpretations in terms of fuzzy sets, Fuzzy rules and their interpretations in terms of FR, fuzzy inference, More on fuzzy inference, Generalizations of FL.

Unit-3

Applications: Introduction to fuzzy logic controller (FLC), Fuzzy expert systems, classical control theory versus fuzzy control, examples, working of FLC through examples, Details of FLC, Mathematical formulation of FLC, Introduction of fuzzy methods in decision making.

Unit-4

Neurophysiology: Introduction: Elementary neurophysiology-From neurons to ANNs - Neuron model McCulloch-Pitts model, Hebbian Hypothesis; limitations of single-layered neural networks.

Unit-5

Multi-Layer Feed forward Neural Networks: Multi-Layer Perceptrons. Supervised Learning. Approximation and interpolation of functions. Back-Propagation Learning law. Fast training algorithms. Applications of multilayer perceptrons: Image coding, Paint-quality inspection, Nettalk. Applications of Neural network.

Text/Reference Books:

1. M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI, 2001.
2. G.J. Klir and B.Yuan, Fuzzy sets and Fuzzy Logic–Theory and Applications, PHI, 1997.
3. T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1995.

List of Open Electives		
Open Elective – I		
1.	OEC 501	Environmental Pollution and Management
2.	OEC 502	Urban and Town Planning
3.	OEC 503	**Laser System and its Application**
4.	OEC 504	**Bio- Medical Engineering**
5.	OEC 505	Industrial Engineering & Automation
6.	OEC 506	Total Quality Management
7.	OEC 507	Production Planning and Control
8.	OEC 508	Value Engineering
9.	OEC 509	Operation Research
10.	OEC 510	Graph Theory
11.	OEC 511	Computer Based Numerical and Statistical Techniques
12.	OEC 512	VLSI Circuits
Open Elective – II		
1.	OEC 601	Water Resources Conservation
2.	OEC 602	Environmental Management
3.	OEC 603	**Robotics**
4.	OEC 604	Mechatronics
5.	OEC 605	Composite Materials
6.	OEC 606	Entrepreneurship
7.	OEC 607	Mechanical System Design
8.	OEC 608	Product Development & Design
9.	OEC 609	Modeling And Simulation
10.	OEC 610	**Internet of Things**
11.	OEC 611	Electrical and Hybrid Vehicles

12.	OEC 612	**Nanoelectronics**
Open Elective – III		
1.	OEC 701	Finite Element Analysis
2.	OEC 702	Environment Impact Assessment
3.	OEC 703	**Digital System Design using VHDL**
4.	OEC 704	**Micro Electro Mechanical System**
5.	OEC 705	Non-Conventional Energy Resources
6.	OEC 706	**Nanotechnology**
7.	OEC 707	Non-Destructive Evaluation
8.	OEC 708	Introduction to Mechanical Micro Machining
9.	OEC 709	Data Science
10.	OEC 710	Big Data Analytics
11.	OEC 711	**Machine learning and Python Programming**
12.	OEC 712	**Embedded Systems**
Open Elective – IV		
1.	OEC 801	Remote Sensing And Geographic Information System
2.	OEC 802	Infrastructure Engineering
3.	OEC 803	Advance Sensors and Transducer
4.	OEC 804	**Multimedia Communication**
5.	OEC 805	Power Plant Engineering
6.	OEC 806	Optimization Methods in Engineering
7.	OEC 807	Fracture Mechanics
8.	OEC 808	Machine Tool Design
9.	OEC 809	Block chain
10.	OEC 810	Computer Vision

11.	OEC 811	Metro Systems and Engineering
12.	OEC 812	**Speech and Audio Processing**

OPEN ELECTIVE – I

OEC	ENVIRONMENTAL POLLUTION & MANAGEMENT	OEC501	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Identify the impact of human on environment.			
CO2	Identify the water & thermal pollution sources. Apply the prevention of its causes.			
CO3	Identify the noise, land & air pollution sources. Apply the prevention of its causes.			
CO4	Apply the EIA			
CO5	Identify the contemporary issues.			

Unit 1

Impact of man on environment, consequence of population growth, energy problem, pollution of air, water and land, Global environmental issues.

Unit III

Air pollution: Sources and effects, meteorological aspects, control methods and equipments,

Land pollution: Types of land pollution, solid waste management-generation, storage, collection, transport, processing and disposal.

Noise pollution: Sources, effects, preventive and control measures.

Unit IV

EIA: Planning and management of environmentalimpact studies; Impact evaluation methodologies:baselinestudies, screening, scooping, checklist, overlays, Environmental impact assessment of water resources and environmental projects, Case study of power plant.

EA: Meaning, audit items, audit procedure, safety audit.

Unit V

Contemporary issues: Emission trading, discharge permits, international resource sharing issues, climate change, international environmental treaties and protocol.

Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Institutions for governance.

References :

1. Principles of environmental studies (Ecology, economics, management and law) by C. Manoharachary and P. Jayarama Reddy, B.S.Publications.
2. Text of Environmental Engineering by P.V. Rao, Prentice Hall pvt ltd.,Delhi
3. Environmental impact assessment methodologies by Y. Ananayulu and C.A. Sastry, B.S. Publications,Hyderabad

OEC	URBAN & TOWN PLANNING	OEC 502	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understanding the urban areas.			
CO2	Apply the Urban planning.			
CO3	Apply the town & country planning.			
CO4	Understand the traffic transportation systems.			
CO5	Understanding the Development plans.			

UNIT-I

Definition and classification of urban areas - Trend of urbanization - Planning process - Various stages of the planning process - Surveys in planning. Plans - Delineation of planning areas.utility of spaces, future growth etc. Role of "Urban Planner "in planning and designing inrelation with spatial organization, utility, demand of the area and supply

UNIT-II

Plan implementation- Urban Planning agencies and their functions - Financing- Public, private, Nongovernmental organizations- Public participation in Planning. Development controlregulations. sustainability and rationality in planning, Components of sustainable urban andregional development, Emerging Concepts: Global City, inclusive city, Safe city, etc. City of the future, future of the city.

UNIT-III

Town and country planning act- Building bye-laws. Elements of City Planning, Zoning and land use, Housing. Introduction to landscaping, importance , objectives, principles, elements, Urban Planning standards Urban renewal for quality of life and livability.

UNIT-IV

Traffic transportation systems: urban road, hierarchy, traffic management, Intelligent Transport Systems. Legal Issues in Planning and Professional Practice, Concepts and contents related to planning provision regarding property rights, Concept of Arbitration, State and Central government to deal with various matters concerning Town and Country Planning. mechanism for preparation of DP: Land Acquisition Rehabilitation and Resettlement Act 2013.

UNIT-V

Types of Development plans: Master Plan, City Development Plan, Structure Plan ,housing, land use, Water Supply & sanitation, etc., Planning agencies for various levels of planning. Their organization and purpose (CIDCO-MHADA-MIDC, MMRDA/ PMRDA etc).

Reference Books:-

1.Adib Kanafani.(1983). Transportation Demand Analysis. Mc Graw Hill Series in Transportation, Berkeley.

2. Hutchinson, B.G. (1974). Principles of Urban Transport Systems Planning. Mc Graw Hill

OEC 503 Laser Systems and its Application

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand quantum physics needed for describing Laser operation
2. Descibe Einstein's Coefficients and population inversion condition
3. Describe Components of Laser and explain its operating principles
4. Analyze Laser in different physical states
5. Appreciate numerous applications of Laser in Medical and Engineering field

Unit-1 (7 Hrs)
Introduction: Review of elementary quantum physics, Schrodinger equation, concept of coherence, absorption, spontaneous emission and stimulated emission processes,
Unit-2 (7 Hrs)
Equation: Relation between Einstein's A and B coefficients, population inversion, pumping, gain, optical cavities.

Unit-3 (8 Hrs)
Lasers: Main components of Laser, principle of Laser action, introduction to general lasers and their types. Three & four level Lasers, CW & Pulsed Lasers.

Unit-4 (6 Hrs)
Laser Systems: Atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and Measurement.

Unit-5 (8 Hrs)
Applications: Laser applications in medicine and surgery, materials processing, optical communication, metrology and LIDAR and holography.

Text/ Reference Books:

1. K.R. Nambiar, "Laser Principles, Types and Application" New AgeInternational.
2. S. A. Ahmad, "Laser concepts and Applications" New AgeInternational.

OEC 504 Bio-Medical Engineering

L-T-P-C
3-0-0-3

Course Outcomes: At the end of semester, student will be able to:

1. Relate biological world to electronics circuit and gain knowledge about implementation of different sensors in the circuits targeted for various medical devices used for curing of human and other living beings.
2. Related biological signal with electrical concepts and implement the knowledge in development of cardio vascular respectively and nervous system related bio electronics instruments.
3. Gain basic knowledge regarding requirements of ICU, CCU and OR.
4. Gain basic understanding about medical imaging equipment Like CT scan, MRI, PET etc. and will improve the existing designs also.

Unit-1 (10 Hrs)

Electrodes, Sensors and Transducers: Signal Acquisition, Transduction, Active v/s Passive sensors, Sensor error sources, sensor terminology, signal processing, electrodes for biophysical sensing, medical surface electrodes, microelectrodes, different types of transducers.

Electrocardiography: Generation of electric currents in heart, ECG waveform, standard lead system, ECG preamplifier, ECG readout devices, ECG machines, ECG machine maintenance, faults and troubleshooting.

Unit-2 (8 Hrs)

Cardio vascular measurements and Devices: Physiological pressure measurements, B.P. measurements, Oscillometric and Ultrasonic non-invasive pressure measurements, pressure transducers, pressure amplifiers, calibrations methods, detector circuits, dilution methods, blood flow measurements. Introduction to plethysmography, phonocardiograph, defibrillators, pacemakers, heart lung machine.

Unit-3 (7 Hrs)

Respiratory system measurements and Devices: Human respiratory system, gas laws, internal respiration, external respiration, mechanics of breathing, parameters and regulations of respiration, respiratory transducers, medical gases, introduction to spirometer and artificial ventilators.

Unit-4 (10 Hrs)

Nervous system measurements and Devices: Organization of Human nervous system, cerebral angiography, cranial X-rays, brain scans, system preamplifier and specifications of EEG, EEG electrodes, EEG telemetry system, typical EEG system artifacts, faults, trouble shooting and maintenance.

ICUs, CCUs and Operating Rooms (Ors): ICU/CCU equipments, Bedside monitors, central monitoring consoles, ECG and physiological telemetry, types of surgery, OR personal, sterilization, OR equipments.

Unit-5 (11 Hrs)

Medical Laboratory Instrumentation: Blood tests, Colorimeter, flame photometer, spectrophotometer, blood cell counters, pH and blood gas analyzers, auto analyzer, dialysis machine, Electrical safety precautions, typical faults.

Medical Imaging Equipments: Basic Principles and working of various medical imaging modality: X-ray, CT Scan, MRI, PET Scan, Ultrasonography, color Doppler, Echocardiography, nuclear medical imaging.

Text/Reference Books:

1. R.S.Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 2003, Edition-II.
2. Cromwell L, Weibell FJ, Pfeifer EA, Biomedical Instrumentation and Measurements, 2nd Edition, PHI
3. G.S. Sawhney, Fundamentals of Biomedical Engineering, New Age Publications
4. J. J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology",4th Edition, Prentice Hall, 2000.
5. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001.
6. Chatterjee, Biomedical Instrumentation Systems, Cengage learning 2011.

Industrial Engineering and Automation (OEC-505)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Workshop Practice.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyze and explain productivity concepts and measurements.
2. Explain various Industrial Layout and time study.
3. Exhibit skills towards program evaluation and review technique.
4. Analyze and perform Break even analysis.
5. Understand of High Volume Production Systems, Transfer Devices and Feeder.

Course Contents:

Unit I

Introduction: Engineering economy and costing, cost analysis, methods of depreciation, productivity concepts and measurements, job evaluation, methods of job evaluation, merit rating, wage incentive plan, types of wage incentive plans.

Unit II

Work measurement, time study,predetermined motion and time study(PMTS), work sampling, method study, micro motion study, principles of motion economy.

Unit III

Plant location, Types of Layout, Principles of Facility Layout, Objective Functions, Steps in PPC, Planning, Routing, Scheduling, Loading, Dispatching, Effectiveness of PPC.

Unit IV

PERT, CPM, Resource Allocation and GERT- Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), Scheduling with Resource Constraints. Introduction to quality management, Ergonomics.

Unit V

High Volume Production Systems- Transfer Devices, Feeder classification, Construction and Applications, Automated Flow lines, Analysis of Automated Flow lines for Reliability and Efficiency, Assembly Systems, Robot Technology, Flexible Manufacturing Systems (FMS).

Textbooks:

1. Industrial Engineering by M.S. Mahajan, DhanpatRai and Co. (P) Ltd.
2. Introduction to Robotics by S.K. Saha, Tata Magraw Hill

Reference Books:

1. Introduction to Industrial System Engineering by Turner w.c. et Al 1993,Prentice Hall
2. Motion and Time Study, Design and Measurement of Work by Ralph M. Barnes, Wiley Publishers**.**
3. Project Management for Business and Technology by John M Nicholas, PHI
4. Robotics by John M Nicholas, Pearson Education.

Total Quality Management (OEC-506)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering

Course Outcomes (COs):

After completing this course a student will be able to:

1. Describe the dimensional barrier regarding Quality.
2. Summarize the Total quality principles.
3. Demonstrate the tools utilization for quality improvement. Analyze the various types of techniques are used to measure quality
4. Discover the new decision of principle in real time projects.
5. Apply the various quality systems in implementation of Total quality management.

Course Contents:

Unit I

Quality Concepts: Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality: Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

Unit II

Quality Management: Organization structure and design, Quality function, DE-CEntralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

TQM Principles: Leadership, strategic quality planning; Quality councils- employee involvement, motivation;Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

Unit III

Tools and Techniques: Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

Unit IV

Defects Diagnosis and Prevention: Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit V

IS0 and its concept of Quality Management: Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements,documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Textbooks:

1. Total Quality Management by Mukherjee, P.N.
2. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
3. Total Quality Management, by Dale H. Bester field, Pearson India.

Reference books:

1. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
2. Bester field D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
3. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
5. TQM in New Product manufacturing, H. G. Menon, McGraw Hill.

Production Planning and Control (OEC-507)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completion of this course student will be able to:

1. Understand the role Production Planning and control activities in Manufacturing and Services.
2. Understand and perform various Forecasting techniques and problems.
3. Understand and perform various Inventory Management techniques and apply in real manufacturing scenario/How to use MRP/ERP.
4. Demonstrate various Scheduling procedures/Balancing concepts.
5. Understand and Evaluate Dispatching procedures.

Course Contents:

UNIT I

Introduction: Definitions – objectives of production planning and control functions of production planning and control-elements of production control types of production- organization of production planning and control – internal organizations department.

UNIT II

Forecasting: Importance of forecasting – types of forecasting, their uses general principles of forecasting techniques- Qualitative methods and quantitative methods.

UNIT III

Inventory management: Functions inventory- Relevant inventory cost- ABC analysis- VED Analysis- EOQ model – Inventory control systems – P- Systems and Q – Systems Introduction to MRP and ERP, LOB (Line of balance), JIT inventory, Japanese concepts.

UNIT IV

Routing: Definition **–** routing procedure- Route sheets – Bill of material factors affecting routing procedure.Schedule – definition – difference with loading. Scheduling polices – techniques, standard scheduling methods- job shop, flow shop, Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects.

UNIT V

Dispatching: Activities of dispatcher- Dispatching procedure - follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning and control

Textbooks:

1. K C Jain and L N Agarwal, Production Planning and Control, 6th edition, Khanna Publishers, 2008.
2. M Mahajan, Production Planning and Control, DhanpatRai& Co., 2010.

Reference Books:

1. R Paneerselvam, Production & Operations Management, 2nd edition, PHI Publications, 2006.
2. E S Baffa and R K Sarin, Modern Production & Operation Managements, 8th edition, Wiley Publications, 2009.
3. O P Khanna, Industrial Engineering and Management, DhanpatRai& Co., 2009.
4. Samuel Eilon, Elements of Production Planning and Control, The Macmillan Company, New York.
5. S D Sharma, Operations Research, KedarnathRamnath Publishers, 1996.
6. J K Sharma, Operations Research, 4th edition, Macmillan India Limited, 2009.
7. P Ramamurthy, Production and Operations Management, New Age International Publications, 2007
8. K L Narayana, P Kannaiah and K Venkata Reddy, Machine Drawing, 3rd edition, New Age Publications, 2006.

Value Engineering (OEC-508)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs): After completing this course a student will be able to:

1. Understand concepts of value engineering and value analysis.
2. Understand the evaluation techniques of function and problem setting and solving systems.
3. Describe various phases involved in value engineering job plan and techniques of value engineering.
4. Understand the applications of value Analysis of management practice in different organizations.
5. Demonstrate their ability to apply value analysis in various fields.

UNIT I

Introduction to value analysis: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

Type of values: Reasons for unnecessary cost of product, peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation.Detailed case studies of simple products.

UNIT II

Functional cost and its evaluation: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

Problem setting & solving system: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

Goods system contains everything the task requires. Various steps in problem solving, case studies.

UNIT III

Value engineering job plan: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgments phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

Value engineering techniques: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the techniques.

UNIT IV

Advanced value analysis techniques: Functional analysis system technique and case studies, Value Analysis of Management Practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

Unit V

Total value engineering: Concepts, need, methodology and benefits.

Application of value analysis: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

Textbooks:

1. Techniques of Value Analysis and Engineering – Lawrence D. Miles - McGraw Hill Book Company - 2nd Edition.
2. Value engineering for Cost Reduction and Product Improvement – M.S. Vittal – Systems Consultancy Services – Edn.1993.
3. Value Management, Value Engineering and Cost Reduction – Edward D Heller – Addison Wesley Publishing Company-1971.

Reference books:

1. Value Analysis for Better Management – Warren J Ridge – American Management Association - Edition1969.
2. Getting More at Less Cost (The Value Engineering Way) – G. Jagannathan - Tata McGraw Hill Pub. Comp Edition1995.Value Engineering – Arther E Mudge - McGraw Hill Book Comp.- Edn1981.

Operation Research (OEC 509)

L T P C

3 0 0 3

COURSE OUTCOME:

After completion of the course students will be able to:

1. Express objective function and resource constraints in LP model in terms of decision variables and parameters.

2. Construct the initial transportation table for a trans-shipment problem and to solve a profit maximization transportation problem using suitable changes in the transportation algorithm.

3.Appreciate application of integer LP problem in several areas of managerial decision- making and to use linear programming approach to compute the value of the game when dominance rule do not apply.

4. Derive replacement policy for items whose running cost increases with time and to use various selective inventory control techniques to classify inventory items into broad categories.

5.Derive relationship among variety of performance measures using Probability Distributions and Dynamic Programming are used for Optimization.

DETAIL SYLLABUS

UNIT-1 Introduction To Linear Programming : Definition and scope of operations research (OR), OR model, Problem Formulation and Application of LPP model, Graphical LPP solution, Simplex method, Big M-method, Two phase method, Special cases in Simplex method application, Duality in Linear Programming, Dual Simplex method, Sensitivity analysis, various industrial application of Linear Programming

UNIT-2 Linear Programming Extension -Transportation Models: Formulation and Optimal solution of Transportation problem, Method of finding Initial Solution – **NWCM,, LCM, VAM**, Close loop in Transportation Table and its properties, Variation in Transportation problem – Degeneracy and its resolution, Trans Shipment models, Assignment models - Hungarian method for solving Assignment Problem, Travelling Salesman problem.

UNIT-3 Integer Programming ,Game Theory ,Sequencing and Project Management:

Integer Programming -Formulation and solution of Integer linear programming problems, Enumeration and cutting plane solution concept, Branch and Bound algorithm. **Game Theory** : Introduction, Two person Zero Sum Game, Minimax and, Maximin Principles Rules of Dominance. **Sequencing problems**- Travelling Salesman problem, Machine-scheduling problem (Job shop). **Project Management**- Objectives of **CPM** and **PERT,** Characteristic of **CPM/PERT** projects**..**

UNIT-4 Replacement and Inventory models.

Replacement Problems- Optimal age of equipment replacement, Replacement of items that fail, Individual and group replacement policies.

Inventory models- Deterministic Inventory models, Classic **EOQ** model, **EOQ** with price breaks, single item Inventory control models without/with shortage, multi-item Inventory control models with constraints, single item Inventory control models with quantity discounts.

UNIT-5 Queuing Theory and Dynamic Programming:

Queuing Theory – Structure of a Queuing system,Probability Distribution in Queuing System, classification of Queuing models - Single server Queuing models/Multi server Queuing models.

Dynamic Programming- Dynamic Programming formulations, Bellman's principle of optimality, computation in Dynamic Programming, Forward and Backward recursions.

References:

Text / Reference Books:

1. Wayne L. Winston, "Operations Research" Thomson Learning,2003.
1. **2.**Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.
2. R. PanneerSeevam, "Operations Research" PHI Learning, 2008.
3. V. K .Khanna, "Total Quality Management" New Age International, 2008.
4. Rao S.S. " Optimization Theory and Applications ", Willey Eastern Limited.
5. Taha H.A., " Operation Research-An Introduction ", Macmillan.
6. J .K. Sharma," Applied Operations Research", Trinity

Graph Theory (OEC 510)

L T P C

3 0 0 3

Course outcomes:

After the course the student will have a strong background of the graph theory which has diverse applications in the area of computer science, biology, chemistry, physics & engineering.

DETAIL SYLLABUS

UNIT 1. Graphs: Graphs, Sub graphs, some basic properties, various example of graphs & their sub graphs, walks, trails, path & circuits, connected graphs, disconnected graphs and its components, various operation on graphs, unicursal line, Euler graphs, Hamiltonian paths and circuits, Hamiltonian graph, traveling salesman problem, Chinese Postman problem. Fleury's algorithm for constructing an Euler line in a graph G, directed graphs, types of directed graphs, directed paths and connectedness, circuits in digraph, Hamiltonian and Euler digraphs.

UNIT 2. Trees: Trees and its characterization, distance, eccentricity and centre, diameters, radius of a tree and pendent vertices, rooted and binary trees, spanning trees, height of a binary tree, traversing binary tree, depth-first search and breath first search in a graph. Branches and chord, rank and nulity, on counting trees, trees with directed edges, fundamental circuits, finding all spanning trees of a graph and a weighted spanning tree, minimum weight spanning tree algorithm, , Prim's, Kruskal's and Dijkstra's algorithm.

UNIT 3. Cut sets & Network flow, Planar Graphs: Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets, connectivity in a graph and separable graph.

Transportation Networks: Networks flows, Max-flow-min cut theorem.
Planar Graphs: planar graphs, region and its degree, Euler's formula, Kuratowski's theorem and its application to planarity detection of graphs,dual graphs, combinational and geometrical dual, thickness and crossings.

UNIT 4. Matrix Representation and Colouring of Graphs: Incidence matrix of graph, sub matrices of A(G), circuit matrix, cut set matrix, fundamental circuit matrix and rank of matrix B, path matrix ,adjacency matrices, adjacency matrix of a digraph and their properties .
Colouring Of Graphs : Colouring, , chromatic number, colour critical graph, chromatic partitioning, chromatic polynomials, matching, maximal matching, augmenting path, covering, minimal covering , Four colour problems, five colour theorem.

UNIT 5. Enumeration of graphs: Enumeration: types of enumeration, counting of labelled and unlabelled graphs and trees, cycle index of permutation group, Cayley's theorem, statement of Burnside's theorem, figure counting series and configuration series, Polya's Enumeration(or counting)theorem, Application of Polya's theorem in Graph Enumeration.

Text / Reference Books:

1. Deo N., Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, Inc.

2. Bondy and Murthy: Graph theory and application. Addison Wesley.
3. John M. Aldous and Robin J. Wilson: Graphs and Applications-An Introductory Approach, Springer
4. Robin J, Wilson: Introduction to Graph Theory, Addison Wesley
5.KalikaPatraj: Graph theory, S.K. Kataria& Son's, N .Delhi.

Computer based numerical and statistical techniques (OEC 511)

L T P C

3 0 0 3

Course Outcomes:

1. Gain insight about design and analysis of standard searching and sorting algorithms. Learn various algorithm Analysis techniques.
2. Able to compare between different data structures i.e., trees, heaps etc. also, pick an appropriate data structure for a design situation.
3. Learn divide and conquer, Greedyparadigms and understand and analyze when an algorithmic design situation calls for them.
4. Developing and analyzing the solutions for the problems using Dynamic programming, backtracking and Branch and bound approaches..
5. Understand NP completeness and difference between NP-Hard & NP-complete problems..

Unit 1: Introduction: Numbers and their accuracy,Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation.

Solution of Algebraic and Transcendental Equation:

Bisection method, Iteration method, Aitken's Δ^2 method, method of False position, Newton-Raphson method, methods of finding complex roots, Rate of convergence of Iterative methods.

Unit 2: Sorting and Order Statistics: Heapsort, Priority queues, Quicksort, Merge sort, Sorting in linear time.

Advanced Design and Analysis Techniques: Dynamic programming – Elements, Matrix-chain multiplication, longest common subsequence, Travelling Salesperson problem, Greedy algorithms – Elements, activity-selection problem, Huffman codes, task scheduling problem, Knapsack Problem, Backtracking – Elements, 8 – Queens, Graph Coloring, Hamiltonian Cycles.

Unit 3: Advanced Data Structures: Operations in B-Trees, Binomial heaps, Fibonacci heaps, data structures for disjoint sets, strings.

Unit 4: Graph Algorithms: Review of graph algorithms, topological sort, strongly connected components, minimum spanning trees – Kruskal and Prim's, Single source shortest paths, relaxation, Dijkstra's algorithm, Bellman-Ford algorithm, single source shortest paths for directed acyclic graphs.

Unit 5: P – Hard & NP – Complete problems: Basic concepts, Clique Decision problem, Node Cover decision problem, Travelling Salesperson decision problem, Introduction to approximation algorithms Planer Graph Coloring, Maximum programs stored problem.

Suggested reference books:

1. Cormen, Leiserson and Rivest: Introduction to Algorithms, 2/e, PHI.
2. Horowitz, Sahni, and Rajasekaran: Fundamentals of Computer Algorithms, Second Edition, Universities Press, Hyderabad.
3. Aho, Hopcroft, and Ullman: The Design and Analysis of Computer Algorithms, Addison Wesley.

VLSI Circuits (OEC 512)

L T P C
3 0 0 3

Course Outcomes: At the end of this course students will demonstrate the ability to	
CO1	Comprehend IC Fabrication Techniques
CO2	Analyse and design MOSFET logic circuits
CO3	Analyse and design CMOS logic circuits
CO4	Design Read Only Memory, Random Access Memory
CO5	Design Adders, multipliers

UNIT-I

Material Preparation- Purification, Crystal growth (CZ and FZ process), wafer preparation Thermal Oxidation-Growth mechanisms, Dry and Wet oxidation, Deal Grove model.

Diffusion- Fick's Laws, Diffusion with constant surface concentration and from a constant source, diffusion techniques.

Ion implantation-Technique, Range Theory, annealing

UNIT-II

Epitaxy: Vapour phase epitaxy and molecular beam epitaxy

Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition

Methods of isolation, Circuit component fabrication: transistor, diodes, resistors, capacitors, N-well CMOS IC Fabrication Sequence

UNIT-III

CMOS inverters- DC characteristics, switching characteristics, power dissipation

Layout Design rules, Stick Diagram and layout of CMOS Inverter, two input NAND and NOR gates

MOSFET Logic Design -Pass transistor logic, Complementary pass transistor logic and transmission gate logic, realization of functions

UNIT-IV

Read Only Memory- 4x4 MOS ROM Cell Arrays (OR,NOR,NAND)

Random Access Memory – SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell

Sense amplifiers – Differential Voltage Sensing Amplifiers Introduction to PLDs and FPGAs, Design of PLAs

UNIT-V

Adders - Static adder, Carry-By pass adder, Linear Carry- Select adder, Square- root carry- select adder

Multipliers - Array multipliers

Text Books:

1. John P Uyemura, Introduction to VLSI Circuits and Systems, Wiley India, 2006

2. S.M. SZE, VLSI Technology, 2/e, Indian Edition, McGraw-Hill,2003

References:

1. Jan M.Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005.

2. Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005

3. Razavi - Design of Analog CMOS Integrated Circuits,1e, McGraw Hill Education India Education, New Delhi, 2003.

4. Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Design, McGraw-Hill, Third Ed., 2003.

5. Yuan Taur&Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2008

OPEN ELECTIVE –II

OEC	WATER RESOURCES CONSERVATION	OEC 601	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Explain water hydrology and environmental influence.			
CO2	Outline the concepts of Artificial Ground Water Recharge.			
CO3	Learn the Concept of Water Harvesting.			
CO4	Explain Reuse & Recycle of Waste Water and Watershed Management.			

UNIT-I

Ground and Surface Water Utilization- Historical background, Hydrologic Cycle, Water Budget, Ground Water level fluctuations and Environmental influence.

UNIT-II

Artificial Ground Water Recharge: Concept & methods of artificial ground water recharge, recharge mounds & induced recharge, wastewater recharge for reuse, Water Spreading, Farm Ponds and Percolation Tanks.

UNIT-III

Water Harvesting: Rainwater harvesting, Catchment Harvesting, Harvesting Structures, Soil Moisture Conservation, Check Dams.

UNIT-IV

Reuse & Recycle of Waste Water: Types of reuse, Application of treated waste water, Purity of reclaimed water, Guidelines and Regulations, New technologies used in recycling of Waste Water.

UNIT-V

Watershed management- Introduction, Concept of watershed Management, Watershed Management policies and decision making.

REFERENCES

1. Ramakrishnan S.(1996),"Ground water", Scitech Publications, 2nd Edition.
2. Todd D.K. & Mays L. F.(2006),"Groundwater Hydrology", John Wiley and sons, 2nd Edition.
3. Murthy J.V.S.(1998), “Watershed Management”, New Age International Publishers, 2nd Edition.
4. Murthy V.V.N.(2013), “ Land and Water Management”, Kalyani Publications, 6th Edition.
5. US Environment Protection Agency, 1992. “Guidelines for Water Reuse”.

0EC	ENVIRONMENTAL MANAGEMENT	OEC 602	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Identify the various environmental issues.			
CO2	Apply Environmental impact assessment.			
CO3	Apply the Environmental policies & technology for environment management.			
CO4	Identify the Contemporary issues.			
CO5	Apply the Environmental legislation.			

Unit I

Introduction: Need for environmental awareness, protection of natural and manmade systems, Impact of man on environment.

Emerging global environmental issues: Population growth, climate change and global warming effects, aid rain, ozone layer depletion, urbanization, automobile pollution

Unit II

EIA: Planning and management of environmental impact studies; Impact evaluation methodologies: base line studies, screening, scooping, checklist, overlays, Environmental impact assessment of water resources and environmental projects, Case study of power plant, Hydro power plant

EA: Meaning, audit items, audit procedure, safety audit.

Unit III

Sustainable development, Environmental economics, environmental policy in planned, mixed and market economies,

Emerging technologies for environmental management; Life cycle analysis- methodology, tools and problems, Concept of ISO and ISO 14000; Environmental cost benefit analysis, Decision methods for evaluation of alternatives, Environment risk assessment, Environmental valuation: Approaches to valuation.

Unit IV

Contemporary issues: Emission trading, discharge permits, international resource sharing issues, international environmental treaties and protocol.

Unit V

Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Issues involved in the enforcement of environmental legislation, Initiatives by NGO's, Initiatives by Governments, CPCB, Other institutions ofgovernance.

Unit II

Water pollution: Sources and classification of water pollutants, wastewater treatment, control strategies, Eutrophication of lakes, self purification capacity of streams. Waste load allocation.

Thermal pollution: Sources, effects and control measures.

References :

- Principles of environmental studies (Ecology, economics, management and law) by C. Manoharachary and P. Jayarama Reddy, B.S.Publications.
- Environmental Impact Assessment Methodologies by Y. Ananayulu and C.A. Sastry, B.S.

OEC 603 Robotics

L-T-P-C
3-0-0-3

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

1- Understand the basics of robotic systems and different types of robots.
2- Perform kinematic and dynamic analyses with simulation.
3- Know about different types of sensors and robotic eye: geometry of image formation.
4- Know different types of actuators and grippers in robotics.
5- Select a robotic system for given industrial application.

Unit-1 (8 Hrs)

Introduction to Robotics: Types and components of a robot, Classification of robots,Different types of joints are used in robots, Kinematics systems, Definition of mechanisms and manipulators, Degrees of Freedom.

Unit-2

Robot Kinematics: Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity,

Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.

Unit-3

Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc., Introduction to Cameras, Camera calibration, Geometry of Image formation, Vision applications in robotics.

Unit-4

Robot Actuation and gripper Systems: Types of Actuators: Electric, Hydraulic and Pneumatic. **Transmission:** Gears, Timing Belts and Bearings, Parameters for selection of actuators, grippers.

Unit-5

Robot Control: Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID, Linear and Non-linear controls, Application of robotics systems: defence, medical, industries, etc., Robotics and Automation for Industry 4.0, Robot safety and social robotics.

Text/Reference Books:

1- Introduction to Robotics : J. Craig , Pearson
2- Robot Dynamics and Control, Spong&Vidyasagar, Mc Graw Hill
3- Robotics Engineering : R. Klafter, PHI - Robotics : Subir K Saha , McGrawHill
4- Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill

OEC 604 Mechatronics

L-T-P-C
3-0-0-3

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

1. Identification of key elements of mechatronics system..
2. Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O.
3. analyze the Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
4. Understanding the concept of Time and Frequency domain analysis of system model (for control application)
5. Understanding the concept of PID control implementation on real time systems

Unit-1

Introduction: Introduction, scope and applications of Mechatronics systems. Process control automation, FMS and CNC Machines. MEMS: Basics of Micro- and Nanotechnology, microprocessor-based controllers and Microelectronics.

Unit-2

Introduction to Sensors: Linear and Rotational Sensors, Acceleration, Force, Torque, Power, Flow and Temperature Sensors, Light Detection, Image, and Vision Systems, Integrated Micro-sensors,

Introduction to Actuators: Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, MEMS: Micro-transducers Analysis, Design and Fabrication.

Unit-3

Electronics elements in mechatronics, conductors, insulators and semiconductors, passive electrical components, resistors, capacitor and inductor, transformer, active elements, semiconductor devices, transistors and integrated circuits, digital electronics components like logic gates, flip-flops, shift register, multiplexer and counter. Computing elements in mechatronics, analog computer, timer, analog to digital converter, digital to analog converter,

Unit-4

System modeling and analysis, control system concepts, transfer function of physical systems, block diagrams representation of systems, transfer function of a system, standard input signals, time response of a first to a step input, frequency response analysis, automatic control systems,

Unit-5

Design of Mechatronics systems: Introduction of mechatronics systems: Home appliances, ABS (anti-lock braking system) and other areas in automotive engineering, Elevators and escalators

Data Acquisition and related Instrumentation: Introduction to Data Acquisition Measurement Techniques: Sensors and Transducers, Quantizing theory, Analog to Digital Conversion, Digital to

Analog (D/A) conversation, Signal Conditioning. Real time Instrumentation: Computer-Based Instrumentation Systems, Data Recording and Logging.

Text/Reference books:

1. Bolton, W., "Mechatronics: Electronic Control Systems in Mechanical and 2011 Electrical Engineering
2. Ramachandran K. P., Vijayaraghavan G. K., Balasundaram M.S. "Mechatronics: Integrated Mechanical Electronic Systems", Wiley
3. A Kuttan, "Introduction to Mechatronics, Oxford University Press, 2010.
4. Mechatronics HMT Hand Book, Tata McGraw Hill.
5. Alciatore and Histand, "Introduction to Mechatronics an Measurement Systems", Tata McGraw Hill.
6. Smaili and Mrad, "Mechatronics: Integrated Technologies for Intelligent Machines" Oxford
7. Mahalik N.P., "Mechatronics: Principles, Concepts and applications", Tata McGraw Hill.

Composite Materials (OEC 605)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

1. Knowledge of the different types of engineering materials.
2. Knowledge of the types of reinforcements and fibers.
3. Understand the various types of composites used in engineering and their properties.
4. Describe the processing of composite materials and manufacturing techniques.
5. Understand and analyze the various methods of testing the composites.

Course Contents:

UNIT I

Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions ofa Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermoset sand Thermoplastics), Metalmatrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT II

Types of Reinforcements/Fibers: Role and Selection of reinforcement materials, Types of fibers, Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc. Mechanical properties of fibres. Material properties that can be Improved by forming a composite material and its engineering potential.

UNIT III

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC),Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramicmatrix composites (CMC);Classification based on reinforcements: Fiber Reinforced Composites, FiberReinforced Polymer(FRP) Composites, Laminar Composites, Particulate Composites.

UNIT IV

Fabrication methods: Processing of Composite Materials: Overall considerations, Auto clavecuring, Other ManufacturingProcesses like filament welding, compression moulding, resin transplant method,

pultrusion, pre-peglayer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling andSpecialty materials, Release agents, Peelplies, release films and fabrics, Bleeder and breather plies, bagging films, maximum stress and strain criteria, Von Mises Yield criterion for isotropic materials.

UNIT V

Testing of Composites and Analysis: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Text Books:

1. Mechanical Metallurgy, by G. Dieter, McGraw Hill.
2. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava Prentice Hall India.
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.

Reference Books:

1. Materials characterization, Vol. 10, ASM hand book.
2. Thermal Analysis of Materials, by R.F. Speyer, Marcel Decker.
3. Engineering Mechanics and Composite Materials, by Daniels, Oxford University Press.
4. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill.
5. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.

Entrepreneurship (OEC 606)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of industrial management.

Course Outcomes (COs):

1. Understand entrepreneurship and its related theory and government policies
2. Understand variousBusiness Enterprises and Ownership Structure
3. Prepare project report and able to understand project evaluation method.
4. Understand various strategies and policies in management and enterprises.
5. Understand Institutional support towards the development of entrepreneurship.

Course Contents:

Unit I

Entrepreneurship: Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

Entrepreneurial Motivation: motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programme.

Unit II

Business Enterprises and Ownership Structure Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.

Unit III

Project Management: Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Unit IV

Management of Enterprises: Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

Unit V

Institutional Support and Policies: Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises.

Text Books:

1. Khanka, S S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi.
2. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
3. Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.

Reference Books:

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
3. Holt, Davis, 'Entrepreneurship: New Venture Creations, PHI.

Mechanical System Design (OEC 607)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the attributes characterizing a system and case study.
2. Explain the system modelling and case study compound bar system.
3. Differentiate and understand the graph modelling, graph analysis and materials handling systems.
4. Understand the method for optimization model with single system.
5. Justify the inventory control in production plant.

Course Contents:

UNIT I

Engineering process and System Approach Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation: Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system.

UNIT II

System Theories: Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system.

System modeling Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system.

UNIT III

Graph Modeling and Analysis Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system.

Optimization Concepts Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminum extrusion system.

UNIT IV

System Evaluation Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system. 4 Calculus Method for Optimization Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.

UNIT V

Decision Analysis Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery. 4 System Simulation Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant.

Text Books:

1. Engineering Design, by Dieter, McGraw Hill.
2. Optimization Techniques-SS Rao.
3. Design Engineering-JR Dixon, TMH, New Delhi.
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow.

Reference Books:

1. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi.
2. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse.
3. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

Product Design and Development (OEC 608)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand how to create new product based on mechanical design engineering.
2. Understand all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.
3. Solve open-ended problem belongs to design engineering that meet the requirements.
4. Understand various product designing methods.
5. Understand human factors and cost evaluation in industrial design concepts.

Course Contents:

Unit I

Design Fundamentals:

The importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research.

Unit II

Customer oriented design & Societal Considerations: Identification of customer needs- customer requirements- Quality Function Deployment Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

Unit III

Material selection processing and Design: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

Unit IV

Design Methods: creativity and problem solving- creative thinking methods- generating design concepts - systematic methods for designing –functional decomposition – physical decomposition – functional representation – morphological methods-TRIZ- axiomatic design. Decision making theory-utility theory –decision trees –concept evaluation methods.

Unit V

Industrial Design concepts: Human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost –overhead costs – activity based costing – methods of developing cost estimates – manufacturing cost –value analysis in costing.

Text books:

1. Product Design & Manufacturing by A. K. Chitab& R. C. Gupta, PHI (EEE).
2. Product Design and Development by Karl T Ulrich, Steven D. Eppinger.
3. Product Design, by Kevin Otto, Kristin wood, Pearson Education Inc.

Reference books:

1. The Technology of Creation Thinking by R.P. Crew ford, Prentice Hall.
2. The Art of Thought by Grohem Walls, Bruce & Co., New York.
3. Product Design & Decision Theory by M.K. Starr, Prentice Hall.
4. Human Factor Engg. byMccormick E.J., McGrawHill.
5. Engineering: An Introduction to Creative profession by G.C. Beakley, H.W. Leach, Macmillan.
6. Industrial Design In Engineering – A marriage of Techniques by Charles H.Flurscheim, The Design Council - London.
7. Quality Control & Reliability Analysis by Bijendra Singh, Khanna Publications.

MODELING AND SIMULATION (OEC 609)

L T P C

3 0 0 3

Course Outcomes:

Upon completion of the subject, students will be able to:

CO1: Understand the basics of simulation modeling and replicating the practical situations in organizations.

CO2: Realize Concepts in Discrete-Event Simulation and analyze and develop a number of simulation softwares.

CO3: understand and simulate various statistical and mathematical models

CO4: Generate random numbers and random variates using different techniques.

CO5: Analyze simulation data using input modelling as well as Understand Verification and Validation of simulation model.

Detail content

Unit 1: Introduction- advantages and disadvantages of simulation, application areas in communication, computer and software design, systems and systems environment, components of a system, discrete and continuous systems, model of a system, types of models, discrete-event simulation, steps in a simulation study. Simulation Examples- Simulation of queueing systems, on-demand and inventory systems, simulation for reliability analysis etc.

Unit 2: General Principles: Concepts in Discrete-Event Simulation, List Processing: properties and operations, data structures and dynamic allocation, techniques. **Simulation Software:** Selection of Simulation Software, review of some existing softwares like: Arena, AutoMod, Extend, Flexsim, Micro Saint, ProModel, Quest, SIMUL8, WITNESS etc., Experimentation and Statistical-Analysis Tools.

Unit 3: Statistical Models in Simulation: Useful Statistical Models, Discrete Distribution s, Continuous Distributions, Poisson Process, Empirical Distributions. **Queuing Models:** Characteristics of Queuing systems, Queuing Notation, Long Run Measures of performance of Queuing Systems, Steady State Behavior of infinite Population Markovian Models, Steady State Behavior of finite Population Models, Networks of Queues.

Unit 4: Random Number Generation: Properties of Random Numbers, Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers, Inverse transform Techniques, Convolution Methods, and Acceptance –Rejection Techniques.

Unit 5:Input Modeling: Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile-Quantile Plots. Parameter Estimation:

Sample Mean and Sample Variance and various biased and unbiased Estimators. Goodness of Fit Tests, Multivariate and Time-Series Input Models .**Verification and Validation of Simulation Models:** Model Building, Verification & Validation, Verification of simulation Models, Calibration & Validation of Models.

Suggested Readings/ Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, Discrete-Event System and Simulation, Prentice Hall of India, New Delhi, 2005.

2. Deo Narsingh, "System Simulation with Digital Computers", PHI, New Delhi 1993.

3. Gordon G, "System Simulation", PHI 2nd Edition 1998.

4. Gabriel A. Wainer, Discrete-event modeling and simulation: a practitioner's approach, CRC Press, 2009.

5. K S Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application", PHI

6. Kleinrock, L.: Queuing Systems Vol.I, Vol.II, Wiley & Sons, London, 1975

INTERNET OF THING (OEC 610)

L T P C

3 0 0 3

Course Outcomes:-

CO1:-To understand the fundamental concepts of IoT and apply them.

CO2:-To know the different hardware's used to embed them with IoT for the development of embedded applications.

CO3:-To learn the networking and communication aspects in IoT and analysis of different protocol used in IoT.

CO4:-Design and develop an application of IOT using ardunio platform.

CO5:-To comprehend the challenges faced for the development of an IoT application.

Unit I: Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples . Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.

Unit II: Hardware for IoT: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

Unit III: Network & Communication aspects in IoT: Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Unit IV: Programming the Ardunio: Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, programming the ardunio for IoT.

Unit V: Challenges in IoT Design challenges: Development Challenges, Security Challenges, Other challenges IoT Applications : Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, Communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.

References:

1.OlivierHersent,DavidBoswarthick, Omar Elloumi"The Internet of Things key applications and protocols", willey

2. Jeeva Jose, Internet of Things, Khanna Publishing House

3. Michael Miller "The Internet of Things" by Pearson

4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016

5. ArshdeepBahga, Vijay Madisetti" Internet of Things(A hands on approach)" 1ST edition, VPI publications,2014

6. Adrian McEwen,HakinCassimally "Designing the Internet of Things" Wiley India

Electrical and Hybrid Vehicles (OEC 611)

L T P C
3 0 0 3

Course Outcomes: At the end of this course students will demonstrate the ability to	
CO1	Understand the models used to describe hybrid vehicles and their performance.
CO2	To comprehend electric and hybrid drive train topologies
CO3	To realize different possible ways of energy storage
CO4	Understand the different strategies of energy management

UNIT I Introduction

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT II Electric Trains

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency

UNIT III Energy Storage

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT IV Energy Management Strategies

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different

energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", DhanpatRai and Sons, 1970.

2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.

4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.

5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.

6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Nano-electronics (OEC 612)

L T P C
3 0 0 3

Course Outcomes: At the end of this course students will demonstrate the ability to	
CO1	Understand various concepts of nano-technology
CO2	Comprehend the processes involved in making nano components and material
CO3	Leverage advantages of the nano-materials and appropriate use in solving practical problems

UNIT I

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States.

UNIT II

Particle in a box Concepts, Degeneracy- Band Theory of Solids. KronigPenny Model. Brillouin Zones.

UNIT III

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

UNIT IV

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/ Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.

3. K.E. Drexler, Nanosystems, Wiley, 1992.

4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

OPEN ELECTIVE –III

PEC	Finite Element Analysis	OEC 701	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Develop the ability to solve complex problems using finite no of elements by any standard FEM software or even by self developed programs.			
CO2	Implement numerical methods to solve mechanics of solids problems.			
CO3	Formulate and Solve axially loaded bar Problems.Formulate and analyze truss and beam problems.			
CO4	Implement the formulation techniques to solve two-dimensional problems using triangle and quadrilateral elements.			
CO5	Formulate and solve Axi-symmetric and heat transfer problems.			

UNIT - I

Introduction to Finite Element Analysis: Introduction Basic Concepts of Finite Element Analysis Introduction to Elasticity Steps in Finite Element Analysis
Finite Element Formulation Techniques: Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions

UNIT - 2

Element Properties: Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Iso parametric Formulation, Stiffness Matrix of Iso parametric Elements, Numerical Integration: One Dimensional. Numerical Integration: Two and Three dimensional

UNIT - 3

Analysis of Frame Structures: Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame

UNIT – 4

FEM for Two and Three Dimensional Solids: Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation

UNIT - 5

Axi symmetric Element: Finite Element Formulation of Axi symmetric Element, Finite Element Formulation for 3 Dimensional Elements Introduction to Plates and Shells

Text Book:

- C.S.Desai&J.F.Abel Introduction to Finite Element Method, CBS Publishers & Distributors – Volume 58, Issue 1 (2001). Reference Books:
- O.C.Zienkiewicz Finite Element Method for Engineers and scientists McGraw-Hill (2013).
K.J.Bathe&E.L.Wilson Numerical Methods in Finite Element Analysis – (2014).
- S.S. Rao Finite Element Method in Engineering Butterworth-Heinemann (2011)

OEC	Environmental Impact Analysis	OEC 702	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand various EIA factors. Learn the basics relationship of Environment Impact Analysis			
CO2	Understand the EIA methodologies. Learn different aspects of Environmental Audit			
CO3	Understand the Different Environmental Management Plan			
CO4	Understand the concept of Ecological Foot Print and Carbon Trading			

Unit I

Environmental impact assessment (EIA), definitions and concepts, rationale and historical development of EIA, EIA in Civil Engineering,

Unit II

Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India

Unit III

Environmental Management:- principles, problems and strategies; Review of political, ecological and remedial actions; future strategies; multidisciplinary environmental strategies, the human, planning, decision-making and management dimensions.

Unit IV

Environmental audit, definitions and concepts, partial audit, compliance audit, methodologies and regulations; introduction to ISO and ISO 14000; Life cycle assessment; Triple bottom line approach; Industrial Ecology; Ecological foot printing; Carbon trading; Sustainable development

Reference/ Text Books:

- Rau, G.J. and Wooten, C.D., Environmental Impact Analysis Handbook, New York: McGraw Hill; 1980.
- Canter R.L. "Environmental Impact Assessment" New Delhi: McGraw Hill Inc.; 1996.
- Shukla S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", New Delhi: Common Wealth Publishers; 1992.

OEC 703 Digital System Design using VHDL

L-T-P-C
3-0-0-3

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

1. Develop a digital logic and apply it to solve real life problems.
2. Analyze, design and implement combinational logic circuits.
3. Classify different semiconductor memories.
4. Analyze, design and implement sequential logic circuits.
5. Simulate and implement combinational and sequential circuits using VHDL systems.

Unit-1

Principles of combinational logic: Review of Boolean Algebra. Definition of combinational, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables. Incompletely specified functions (Don't care terms). Simplifying max – term equations. Quine -McClusky minimization technique, Quine – McClusky using don't care terms, Reduced Prime Implicant tables, Map entered variables

Unit-2

Analysis and design of Combinational Logic: General approach, Decoders-BCD decoders, Encoders. Digital multiplexers-using multiplexers as Boolean function generators. Adders and Subtractors-Cascading full adders, Look ahead carry adder, Binary comparators.

Unit-3

Sequential Circuits: Basic Bi-stable element, Latches, SR latch, Application of SR latch, A Switch debouncer. The SR latch, The gated SR latch. The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The master-slave SR Flip-Flops, The master-slave JK Flip-Flop, Edge Triggered Flip-flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop. Characteristic equations, Registers, Counters-Binary Ripple Counter, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-N counters using clocked JK Flip-Flops Design of a Synchronous Mod-N counter using clocked D, T, or SR Flip-Flops

Unit-4

Sequential Design: Introduction, Mealy and Moore models, State machine notation, synchronous sequential circuit analysis and design. Construction of state Diagrams, Counters Design.

Unit-5

HDL: Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis, Brief comparison of VHDL and Verilog. Data-Flow Descriptions: Highlights of Data flow descriptions, Structure of data-flow description, Data type-vectors.

Text/Reference Books:

10. Digital Logic Applications and Design John M Yarbrough Cengage Learning 2011
11. Digital Principles and Design Donald D Givone McGraw Hill Education 1 st Edition, 2002
12. Logic and computer design Fundamentals M. Morries Mano and Charles Kime Pearson Learning 4 th Edition, 2014
13. Circuit Design and Simulation with VHDL Volnei A Pedroni PHI 2nd Edition,
14. Fundamentals of logic design Charles H Roth, JR and Larry L. Kinney Cengage Learning 6th Edition, 2013
15. Fundamentals of Digital Circuits A. Anand Kumar PHI 3rd Edition, 2014
16. Digital Logic Design and VHDL A.A.PhadkeS.M.Deokar Wiley India 1st Edition, 2009
17. Digital Circuits and Design D.P.KothariJ.S.Dhillon Pearson First Print 2015
18. HDL Programming (VHDL and Verilog) Nazeih M. BotrosCengage Learning 1st Edition, 2011

OEC 704 Micro-Electro Mechanical Systems

L-T-P-C
3-0-0-3

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

1. Gain knowledge of basic approaches for micro/Nano system design.
2. Understanding the concept of state-of-the-art lithography techniques for micro/Nano systems.
3. Aanalyze the Interfacing of Sensors, Actuators using appropriate DAQ micro-controller.
4. Learn new materials, science and technology for micro/Nano system applications.
5. Understand state-of-the-art micromachining and packaging technologies.

Unit-1

Introduction: Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Micro-fabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets

Unit-2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.

Unit-3

Material Processing: Silicon Wafer processing, Lithography, Thin-Film Deposition, Etching (Wet and Dry), Wafer Bonding and Metallization, Thick film processing, Smart Material processing, Emerging trends

Unit-4

Electronic circuit and Control: Carrier concentration, semiconductor diodes, transistor, MOSFET, Introduction to operational amplifier, Examples from Micro system, Transfer Function, state space modeling model order reduction, examples from smart systems

Unit-5

Micro-manufacturing, Integration and Packaging: Introduction, Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process Integration and Packaging of Micro-electromechanical systems.

Text/Reference Books:

1. MEMS, NitaigourPremchandMahalik, TMH Publishing co.
2. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
3. MEMS and NEMS, Sergey EdwrdLyshevski, CRC Press, Indian Edition.
4. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
5. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Non-Conventional Energy Resources (OEC 705)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Power Plant Engineering.

Couse Outcomes (COs):

1. Illustrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.
2. Study the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
3. Study the working principle of geothermal energy,Magneto-hydrodynamics (MHD) and fuel cell technology for energy generation.
4. Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
5. Study the working principle of bio mass, wave and tidal wave and OTEC.

Course Contents:

Unit I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT V

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text Books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
3. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

Reference Books:

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
2. M.V.R. KoteswaraRao, "Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.

Nanotechnology (OEC 706)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Explain the fundamental principles of nanotechnology and their application to engineering.
2. Apply engineering and physics concepts to the Nano-scale and non-continuum domain.
3. Study the properties of individual Nano particles, metal Nano clusters and semi conducting nanomaterial.
4. Discuss and evaluate state-of-the-art characterization methods for nanomaterial, and determine nanomaterial safety and handling methods required during characterization.
5. Explain methods of fabricating nanostructures of carbon Buckey Ball, Carbon nano-tubes

Course Contents:

Unit I

Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

Introduction to Physics of Solid State:Structure: Size dependence of properties; crystal structures, face centered cubic nanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations.

Energy Bands: Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.

Localized Particles: Acceptors and deep taps; mobility; Excitons.

Unit II

Quantum Theory For Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box(Trapped particle in 3D:Nanodot), Electron trapped in 2D plane(Nano sheet), Quantum confinement effect in nano-materials.

Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermigas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared etectors; Quantum dot laser Superconductivity.

Properties of Individual Nano particles,Metal Nano clusters: Magic Numbers; Theoretical Modelling of Nanopraticles; geometric structure; electronic structure; Reactivity; Fluctuations Magnetic Clusters; Bulle to Nano structure.

Semi conducting Nanoparticles: Optical Properties; Photofragmentation; Coulmbic explosion.

Rare Gas & Molecular Clusters: Inert gas clusters; Superfluid clusters molecular clusters.

Unit III

Growth Techniques of Nanomaterials: Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-$CuAlO_2$ deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitoxy, Sol-Gel Techniuqe (No chemistry required), Synthesis of nanowires/rods, Electrodeposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nanowires. **8**

Unit IV

Methods of Measuring Properties:Structure: Crystallography, particle size determination, surface structure,

Microscopy: Scanning Prob Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Elecrtron Microscopy (TEM)

Spectroscopy: Infrared and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luninscence.

Unit V

Buckey Ball: Nano structuresofcarbon(fullerene): **Carbon nano-tubes:** Fabrication , structure. electrical, mechanical, and vibrational properties and applications. Nano diamond, Boron Nitride Nano-tubes, single elecron transistors, Moelcular machine, Nano-Biometrics, Nano Robots.

Text Books:

1. A.K.Bandyopadhyay, “Nano Materials” New Age International.
2. “Introduction to S.S. Physics” - (7^{th} Edn.) Wiley 1996.

Reference Books:

1. C.P.PooleJr F.J. Owens, “Introduction to Nanotechnology”. (5).
2. S. Sugano & H. Koizuoni, “Microcluster Physics” –Springor 1998.
3. “Handboole of Nanostructured Materials & Nanotechnology” vol.-5. Academic Press 2000.

Non-Destructive Evaluation (OEC 707)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Material Science and Engineering.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Obtain the fundamental knowledge about different NDT methods and visual inspection.
2. Explain the principles and testing knowledge of DPT(liquid penetrate inspection) and MPT for product testing.
3. Explain the principles and techniques in Radiography Testing.
4. Describe the knowledge about Ultrasonic Testing for products.
5. Understand the materials and testing procedure for Eddy Current Inspection&Thermography Testing.

Course Contents:

Unit I

Introduction:Scope and advantages of NDT, Comparison of NDT with Destructive Testing, some commonNDT methods used since ages, Terminology, Flaws and Defects, Visual inspection, Equipmentused for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspectiontests in detecting surface defects and their interpretation, advantages &limitations of visual inspection.

Unit II

Tests: Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Test stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples andinterpretation of defects.Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Nonferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results,DC& AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing,different methods to generate magnetic fields, Applications.

Unit III

Radiographic methods: Introduction to electromagnetic waves and radioactivity, various decays, Attenuation ofelectromagnetic radiations, Photo electric effect, Rayleigh's scattering (coherent scattering),Compton's scattering (Incoherent scattering), Pair production, Beam geometry and

Scatteringfactor. X-ray radiography: principle, equipment & methodology, applications, types of radiations andlimitations. γ-ray radiography – principle, equipment., source of radioactive materials &technique, advantages of γ-ray radiography over X-ray radiography Precautions against radiationhazards. Case Study - casting and forging.

Unit IV

Ultrasonic testing methods: Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques,advantages, Limitation & typical applications. Applications in inspection of castings, forgings,Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body.

Unit V

Special NDT Techniques: Eddy Current Inspection: Principle, Methods, Equipment for ECT, Techniques, Sensitivity,advanced ECT methods. Application, scope and limitations, types of Probes and Case Studies.Introduction to Holography, Thermography and Acoustic emission Testing.

Text Books:

1. Non-Destructive Testing and Evaluation of Materials, by- Prasad, McGraw Hill Education
2. Practical Non-destructive Testing, by- Baldev Raj, T. Jayakumar, M. Thavasimuthu, WoodheadPublishing.
3. Non-Destructive Testing Techniques, by- Ravi Prakash, New Age International.

Reference Books

1. Nondestructive Testing Handbook,by Robert C. McMaster, American Society for Nondestructive.
2. Introduction to Nondestructive Testing: A Training Guide, by- Paul E. Mix, wiley.
3. Electrical and Magnetic Methods of Non-destructive Testing, by- J. Blitz, springer.
4. Practical non destructive testing by Raj, Baldev.
5. Basics of Non-Destructive Testing, by Lari& Kumar, KATSON Books.

Introduction to Mechanical Micro Machining (OEC 708)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Conventional machining processes..

Course Outcomes (COs):

1. Understand of process of Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining etc.
2. Explain the Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining etc.
3. To understand the Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining etc.
4. Understand of Micro bending with LASER, LASER micro welding, Electron beam for micro welding.
5. Understand the Metrology for micro machined components and Machining of Micro gear, micro nozzle, micro pins, Applications.

Course Contents:

UNIT I

MICRO MACHINING: Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining, Abrasive Water Jet Micro Machining, Micro turning, Chemical and Electro Chemical Micro Machining, Electric discharge micro machining.

UNIT II

MICRO MACHINING: Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining, Ion Beam Micro Machining, Plasma Beam Micro Machining, Hybrid Micro machining, Electro Discharge Grinding, Electro Chemical spark micro machining, Electrolytic in process Dressing.

UNIT III

NANO POLISHING: Abrasive Flow finishing, Magnetic Abrasive Finishing, Magneto rheological finishing, Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining, chemo-mechanical Polishing.

UNIT IV

MICRO FORMING AND WELDING: Micro extrusion, Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting, Micro bending with LASER, LASER micro welding, Electron beam for micro welding.

UNIT V

RECENT TRENDS AND APPLICATIONS: Metrology for micro machined components, Ductile regime machining, AE based tool wear compensation, Machining of Micro gear, micro nozzle, micro pins, Applications.

Text Books:

1. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012.
2. Jain V.K., _Introduction to Micro machining' Narosa Publishing House, 2011
3. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002.

Reference Books:

1. Janocha H., Actuators – Basics and applications, Springer publishers – 2012
2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
3. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.
4. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.

Data science (OEC 709)

L T P C

3 0 0 3

Course Outcomes

CO1.Describe what Data Science is and the skill sets needed to be a data scientist. • Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.

CO2. Use R to carry out basic statistical modeling and analysis.

CO3. Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA.

CO4. Describe the Data Science Process and how its components interact

CO5 Use APIs and other tools to scrap the Web and collect data. And Apply EDA and the Data Science process in a case study.

Unit 1. Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed . Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R

Unit 2. Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm) Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means

Unit 5. One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

Unit 4 Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system 8. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs

Unit 5. Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset 10. Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

References

Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.

• Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)

• Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.

• Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.

• Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. ISBN 0387952845. 2009. (free online)

• Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science

• Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.

• Jiawei Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011.

BIG DATA ANALYTICS (OEC 710)

L T P C

3 0 0 3

COURSE OUTCOMES:

CO1:- To know the fundamental concepts of big data and analytics.

CO2:- To understand the different way to classify the given data using different techniques.

CO3:- To explore tools and practices for working with big data

CO4:- To learn about stream computing.

CO5:- To know about the research that requires the integration of large amounts of data.

UNITI

INTRODUCTION TO BIGDATA

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - A General Overview of High- Performance Architecture - HDFS - MapReduce and YARN - Map Reduce Programming Model

UNITIII

ASSOCIATION AND RECOMMENDATIONSYSTEM

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation ofCandidateRules - Applications of Association Rules - Finding Association& finding similarity.

Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid RecommendationApproaches.

UNIT IV

STREAMMEMORY

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications -

Case Studies - Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: GraphAnalytics

UNIT V

NOSQL DATA MANAGEMENT FOR BIG DATAAND VISUALIZATION

NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive - Sharding –- Hbase – Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

TEXT BOOKS:

1. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.

OEC-711	Machine learning and Python Programming	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Do progamming with Python	
CO2	Apply Statistics to machine learning and know how it is different than descriptive statistics	
CO3	Build features that meet analysis needs and understand different approaches for creating predictive models	
CO4	Create and evaluate data clusters	
CO5	Apply Python for NLP	

UNIT I Python Fundamentals

The basic foundation of variables– Data types – Arithmetic, logical and comparison operator – Data types of Python List – Data Cleansing – Dictionary– Conditional and Iterative loops - Numpy Library - Data Manipulation using Pandas Library - Data Visualization - visualizations using Matplotlib and Seaborn Python libraries – Merging multiple datasets - Melting/changing dimensions of datasets

UNIT II Fundamentals of Statistics

Graphically Displaying Single Variable -Measures of Location - Measures of Spread - Displaying relationship – Bivariate Data – Scatterplot - Measures of association of two or more variables - Covariance and Correlation - Probability - Joint Probability and independent events - Conditional probability - Bayes' Theorem - Prior, Likelihood and Posterior - Discrete Random Variable - Probability Distribution of Discrete Random Variable - Binomial Distribution - Continuous Random Variables - Probability Distribution Function - Uniform Distribution - Normal Distribution - Point Estimation – Interval Estimation - Hypothesis Testing

UNIT III Machine learning with Python

Supervised and Unsupervised Learning - Python libraries suitable for Machine Learning

Regression – Features and Labels– Training and Testing– Forecasting and Predicting– Theory and how it works– to program Best Fit Slope – to program the Best Fit Line– R Squared and Coefficient of Determination Theory - Model evaluation methods

Classification: Applying K Nearest Neighbors to Data -Euclidean Distance theory -Decision Trees - Regression Trees - Random Forests - Boosting Algorithm - Principal Component Analysis - Linear Discriminant Analysis

Support Vector Machine Fundamentals - Constraint Optimization with Support Vector Machine - SVM Optimization in Python - Visualization and Predicting with our Custom SVM - Kernels - Soft Margin Support Vector Machine

UNIT IV Clustering

Handling Non-Numerical Data for Machine Learning - K-Means with Titanic Dataset - K-Means in Python - Hierarchical Clustering with Mean Shift Introduction - Naive Bayes Classifier - Naive Bayes Classifier with Scikit - Introduction into Text Classification using Naive Bayes - Python Implementation of Text Classification

UNIT V Introduction to NLP

Text Pre-processing, Noise Removal, Lexicon Normalization, Lemmatization, Stemming, Object Standardization- Text to Features (Feature Engineering on text data)-Syntactical Parsing, Dependency Grammar- Part of Speech Tagging - Entity Parsing- Phrase Detection - Named Entity Recognition - Topic Modelling - N-Grams - Statistical features - TF – IDF- Frequency / Density Features: Readability Features, Word Embedding

Important tasks of NLP: Text Classification, Text Matching, Levenshtein Distance, Phonetic Matching, Flexible String Matching - Important NLP libraries

Reference Books:

1. Introduction-to-Machine-Learning-with-Python, Andreas C. Muller and Sarah Guido, O'Reilly Books
2. Beginning Programming with Python For Dummies, John Paul Mueller

OEC-712	Embedded Systems	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Choose between design approaches using advanced controllers to real-life situations	
CO2	Design interfacing of the systems with other data handling / processing systems	
CO3	Appreciate engineering constraints like energy dissipation, data exchange speeds etc	
CO4	Understand software aspects of Embedded Systems	

UNIT I

The concept of embedded systems design, Embedded microcontroller cores, embedded memories. Examples of embedded systems.

UNIT II

Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing.

UNIT III

Sub-system interfacing, interfacing with external systems, user interfacing

Design tradeoffs due to process compatibility, thermal considerations, etc.,

UNIT IV

Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Text/Reference Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.

2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.

4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.

5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

OPEN ELECTIVE –IV

OEC	REMOTE SENSING AND GIS APPLICATION	OEC 801	4 0 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Retrieve the information content of remotely sensed data			
CO2	Understand characteristics of multi concept of remote sensing.			
CO3	Interpret the images for preparation of thematic maps.			
CO4	Understand the concept & terminology of GIS.			
CO5	Apply the RS & GIS in real world problems.			

Unit I

Remote Sensing: Introduction, sources of energy for remote sensing, active and passive sources, electromagnetic radiation, and their characteristics, thermal emission, Interaction of EMR with atmosphere, atmospheric windows, interaction of EMR with earth surface- spectral reflection curves.

Unit II

Multi concept of remote sensing, idealisms and real sequence of remote sensing, sensors and orbital characteristics, various sensing platforms for remote sensing, characteristics of various satellite, remote sensing data products and their uses.

Unit III

Digital image processing: Introduction, digital image representation, and Characterization, histograms and scatter plot, image enhancement, contrast stretching, Pattern recognition, and feature extraction, image classification: unsupervised and Supervised techniques

Unit IV

Geographic Information system: Introduction, concept and terminology, components of GIS, raster and Vector formats, scanners and digitizers, methods of digitization, data Preprocessing, form conversion, data reduction, and generalization

Unit V

Data merging, edge matching, registration and re-sampling, data manipulation and Analysis representation of real-world problems, problem solving and spatial modeling, classification, aggregation, overlay, buffers and

indivisibility and its applications in planning of utility lines, flood studies, ground water recharge, erosion modeling,

References:

1. Remote Sensing and Image Interpretation – Lillesand and Kiefer, John Wiley &Sons Ltd.
2. Introduction to the physics and techniques of Remote Sensing – Elachi, John Wiley& SonsLtd.
3. Geographical Information System Vol. I and II– Longley, John Wiley & SonsLtd.
4. An Introduction to GIS – Ian Haywood, Dorlling Kindersley Pvt.Ltd.
5. Advanced Surveying by Satheesh, G., Sathikumar, R., and Madhu, N., Pearsons Educations

OEC	INFRASTRUCTURE ENGINEERING	OEC802	4 0 0	4 CREDITS

COURSE OUTCOMES:	
CO1	Identify the elements of Building.
CO2	Identify waste water & water supply sources.
CO3	Understand about transportation infrastructure(Road, rail and air).
CO4	Analysis the various characteristics of Dam, Canal, Port, Hourber and Hydroelectric projects.
CO5	Introduction to architecture, land use planning.

Unit I

Building-

Elements- slab, beam, column, footing Types- Residential, Institutional, Commercial, Industrial Types of structure- Load bearing, framed, combined

Unit II

Water Supply and Wastewater Infrastructure

Water Supply- Source, demand, intake, transport, conduits, treatment, distribution, household plumbing

Waste Water- Collection, transport, treatment and disposal

Unit III

Transport Infrastructure: Road, rail and air

Road- Elements, types, traffic studies Rail- Gauge, components Air- Runway, planning, helipad

Unit IV

Irrigation, hydropower and navigation

Dam, canal, port, harbor, hydroelectric projects

Unit V

Miscellaneous

Introduction to architecture, land use planning

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024 02:26

References:

1. Peurify,RL,–Construction,Planning,EquipmentandMethods‖,TataMcGrawHillEducation
2. NPTEL E Learning course on Infrastructure Planning&Mangament.

OEC 803 Advance Sensors and Transducers

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
2. Analyze the problems related to sensors & transducers.
3. Select the appropriate sensor/transducer for a given application.
4. Determine the static and dynamic characteristics of transducers using software packages.
5. Understand fiber optic sensor and applications. Ability to understand smart traducer and its standard.

Unit-1 (8 Hrs)

Science of measurements and classification of transducers: Units and standards, Static calibration, Classification of errors, Limiting error and probable error, Error analysis, Statistical methods , Odds and uncertainty, Classification of transducers, Selection of transducers.

Unit-2 (8 Hrs)

Characteristics of transducers: Static characteristics, Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics, Mathematical model of transducer, Zero, I and II order transducers.

Unit-3 (8 Hrs)

Variable resistance transducers: Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

Unit-4 (8 Hrs)

Variable inductance and variable capacitance transducers: Inductive transducers, Principle of operation, construction details, characteristics and applications of LVDT, capacitive transducers, characteristics of capacitive transducers, Different types, Signal Conditioning, Applications, Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

Unit-5 (8 Hrs)

Other transducers: Piezoelectric transducer, Hall Effect transducer, Magneto elastic sensor, Digital transducers, Fiber optic sensors, Thick & Thin Film sensors (Bio sensor & Chemical Sensor), Environmental Monitoring sensors (Water Quality & Air pollution), Introduction to Smart transducers and its applications.

Text/ Reference Books:

1. D. Patranabis, Sensors and Transducers, Prentice Hall of India.
2. Ian Sinclair, Sensors and Transducers, Elsevier.
3. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India.

OEC 804 Multimedia Communication

L-T-P-C
4-0-0-4

Course Outcomes: After completing this course the students will have the ability to:

1. Understand different types of media for information representation and Communication; representation of multimedia information in applications.
2. Interpret and process multimedia information as per requirement for society considering ethical issues.
3. Analyze and represent sound, speech, images, videos and also to store and communicate these efficiently.
4. Processing and transforming multimedia information as per requirement. Understanding and using standards for multimedia information.

Unit-1 (18 Hrs)

Multi-Dimensional Signals: Multi Dimensional signals-Finite Extent Signals and Periodic signals, Symmetric signals, special multi dimensional signals; Multi Dimensional Transforms-Fourier Transform, DFT, DCT;

Unit-2 (6 Hrs)

Multi Dimensional systems:-Impulse response and 2D convolution, Frequency response, FIR Filters and symmetry, IIR filters and partial difference equations, 2D sampling and reconstruction, Image digitization, Digital Image representation and storage, Pixels and its neighbors.

Unit-3 (9 Hrs)

Human Visual System and Color: Color Vision and Models, Contrast Sensitivity, Spatio-Temporal Frequency Response, Stereo/Depth Perception, Analog Video, Progressive vs. Interlaced Scanning, Analog-Video Signal Formats, Analog-to-Digital Conversion, Digital Video, Spatial Resolution and Frame Rate, Color, Dynamic Range, and Bit-Depth, Color Image Processing, Digital-Video Standards.

Unit-4 (10 Hrs)

Image Filtering: Image Smoothing, Linear Shift-Invariant Low-Pass Filtering; Image Enhancement, Pixel-Based Contrast Enhancement, Spatial Filtering for Tone Mapping and Image Sharpening, Image Denoising, Image and Noise Models, Linear Space-Invariant Filters in the DFT Domain, Local Adaptive Filtering, Nonlinear Filtering: Order-Statistics.

Unit-5 (9 Hrs)

Video Filtering: Theory of Spatio-Temporal Filtering, Frequency Spectrum of Video, Motion-Adaptive Filtering, Motion-Compensated Filtering, Video-Format Conversion, Down-Conversion, De-Interlacing, Frame-Rate Conversion, Multi-Frame Noise Filtering, Motion-Adaptive Noise Filtering, Motion-Compensated Noise Filtering.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education, 2016.
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Pearson Education, 2015.

Power Plant Engineering (OEC 805)

L T P C

4 0 0 4

Prerequisite: Basic Knowledge of Thermodynamics and I C Engines.

Course outcomes (COs):

1. Understand the basics of power plants.
2. Analyze the working and layout of the of steam power plant.
3. Define the working principles of Diesel power plant, its layout, safety principles and compare it with other types of plants.
4. Discuss the working principle and basic components of the nuclear power plants and Hydro-electric power plants and safety precautions involved with it.
5. Discuss and analyze the mathematical and working principle of different electrical equipment involved in the generation of the power.

Course Contents:

Unit I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units.Power plant economics and selection.Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates.Economics of plant selection, other considerations in plant selection.

Unit II

Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit III

Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit IV

Nuclear power plant: Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants. Hydroelectric and Non-Conventional Power Plant: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit V

Electrical system: Generators and generator cooling, transformers and their cooling, bus bar, etc. Energy Saving and Control: Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
2. Steam & Gas Turbines & Power Plant Engineering by R. Yadav, Central Pub. House.
3. Power Plant Engineering by Gupta, PHI India.

Reference Books:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

Optimization Method in Engineering (OEC 806)

L T P C

4 0 0 4

Prerequisite: Course on calculus, matrix

Course Outcomes (COs):

After completion of the course a student will be able:

1. Learn one dimensional optimization methods.
2. Learn constrained optimization of multi-variable function.
3. Apply integer programming methods.
4. Dynamic programming and operation research problems
5. Learn soft computing based optimization.

Course Contents:

Unit I

Unconstrained Optimization: Optimizing Single-Variable Functions, Conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit II

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit III

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss Newton, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linar Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratic Programming (SQP), Constrained Optimization, Multi-Objective Optimization, Branch and Bound Approaches.

Unit IV

Optimization in Operation Research: Dynamic Programming, Minimax and Maximax Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Goal Programming, Integer Linear Programming.

Unit V

Soft computing based optimization, Practical aspects of optimization.

Text books:

1. Engineering Optimization Theory and Practice by Rao S.S.
2. Methods of Optimization by Walsh G R.
3. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey.
4. Operations Research: Applications and Algorithms by Winston W L

Reference books:

1. Model Building in Mathematics Programming by Williams H.P.
2. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey
3. Discrete Optimization by R.G. Parker and R.L. Rardin.
4. Combinational Optimization: Algorithms and Complexity by C.H. Papadimitrious and K.Stegilite
5. Multi-objective evolutionary optimization for Product Design and Manufacturing by LihuiWang
6. Genetic Algorithms by Kalyanmoy Deb
7. Genetic Algorithms in search, optimization and machine learning by David E Goldberg, Pearson Springer.

Fracture Mechanics (OEC 807)

L T P C

4 0 0 4

Prerequisite: Basic Knowledge of Mechanics of Solids and Theory of Elasticity.

Course Outcomes (COs):

1. Basic Understanding of Crack in a Structure, Fracture Toughness, Types of Fracture.
2. Analyze elastic and elastic-plastic stress fields at the crack-tip in a solid material..
3. Estimate crack growth based on energy balance.
4. Demonstrate standard fracture mechanics tests for finding J-Integral and Crack Opening Displacement.
5. Inspect a solid material for the presence of crack.

Course Contents:

Unit I

Introduction: A Crack in a Structure, Fracture Toughness. Micro and Macro Phenomena of Fracture - Microscopic Aspects: Surface Energy, Theoretical Strength, Microstructure and Defects, Crack Formation - Macroscopic Aspects: Crack Growth, Types of Fracture, Mechanisms of Fracture and Crack Growth - Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment Assisted Cracking, Creep Fracture, Service Failure Analysis

Unit II

Linear Elastic Stress Fields in Cracked Bodies • Introduction • Crack Deformation Modes and Basic Concepts, Westergaard Method, Singular Stress and Displacement Fields,Stress Intensity Factor Solutions,Three-Dimensional Cracks

Linear Elastic-Plastic Stress Fields in Cracked Bodies: Approximate Determination of the Crack-Tip Plastic Zone, Irwin's Model, Dugdale's Model

Unit III

Crack Growth Based on Energy Balance: Introduction, Energy Balance During Crack Growth, Griffith Theory, Graphical Representation of the Energy Balance Equation, Equivalence between Strain Energy Release Rate and Stress Intensity Factor, Compliance, Crack Stability.

Unit IV

Fracture Criteria: Critical Stress Intensity Factor Fracture Criterion, J-Integral and Crack Opening Displacement Fracture Criteria, Strain Energy Density Failure Criterion: Mixed-Mode Crack Growth.

Dynamic Fracture Introduction, Mott's Model , Stress Field around a Rapidly Propagating Crack , Strain Energy Release Rate, Crack Branching, Crack Arrest ,Experimental Determination of Crack Velocity and Dynamic Stress Intensity

Unit V

Introduction to Fatigue Fracture, Environment-Assisted Fracture, Creep Fracture and Crack Detection Methods such as Dye Penetration, Magnetic Particles, Eddy Current, Radiography, Ultrasonic, and Acoustic Emission**.**

Text Books:

1. Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill Education Pvt. Ltd.
2. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", CRC - Taylor and Francis.

Reference Books:

1. E.E. Gdoutos, "Fracture Mechanics - An Introduction", Springer.
2. D. Broek, "Elementary Engineering Fracture Mechanics", Kluwer Academic Publishers.
3. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", Wiley India Pvt. Ltd.

Machine Tool Design (OEC 808)

L T P C

4 0 0 4

Prerequisite: Basic Knowledge of Workshop Technology.

Course Outcomes (COs):

After successful completion of this course students will be able to

1. Understand classification of machine tools with their nomenclature, specification and uses.
2. Explain working of various drives mounted in machine tools.
3. Analyze the speed and feed box with the regulation of speed and feed rates.
4. Design components like structural bed, column, power screws etc.
5. Apply knowledge to study dynamics of machine tool and its control.

Course Contents:

UNIT I

Introduction: Developments is machine tools, types of machine tools surface, profits and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc.General requirement of machine tool design.Machine tool design process. Tool wear, force Analysis.

UNIT II

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, Slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc., Fundamentals of Kinematics structure of machine tools.

UNIT III

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standardprogression ratio, selection of best possible structural diagram, speed chart, Design of feed box,developing gearing diagrams. stepless regulation of speed and feed in machine tool, speed and feedcontrol.

UNIT IV

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures,selection of material Basic design procedure for machine tool structures, design of bed, column andhousing, Model technique in design.

Design of guide ways and power screws: Basic guide way profiles, designing guide way for stiffness a wear resistance, hydrostatic and antifriction grand ways. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings for machine tools.

UNIT V

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process,closed loop system, chatter in machine tools.

Control Systems: Functions, requirements & types of machine tool controls, controls for speed &feed change. Automatic and manual Controls.Basics of numerical controls.Machine tool testing.

Text Books:

1. N.K. Mehta, "Machine Tool Design and Numerical Control" Second Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1984.
2. S.K. Basu and D.K. Pal, "Design of Machine Tools", Fourth Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
3. G.C. Sen and A. Bhattacharya, "Principles of Machine Tools", Second Edition, New Central Book Agency (P) Ltd., Kolkata, 1988.

Reference Books:

1. F. Koenigsberger, "Design Principles of Metal Cutting and Machine Tools", Edition 1964, Pergamon Press Ltd., London.
2. H.C.Town, "The Design and Construction of Machine Tools", Central Machine Tool Research Institute, Bangalore, Machine Tool Design Handbook.
3. PSG College of Engg. & Technology, PSG Design Data Book.
4. N.K. Acherkan, "Machine Tool Design (Vol.I to Vol.IV)", Mir Publishers.

OEC809	BLOCKCHAIN	4L-0T-0P	CREDIT -4

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore of blockchain and its architecture.
CO2: Understand the consensus, Consensus protocols for Permissioned Blockchains.
CO3: understand theHyperledger Fabric and its implementation.
CO4: Applies blockchain concept in Financial Software and Systems, trade/supply chain (use cases).
CO5: Applies blockchain concept for Government(use case).

Unit-I Introduction :

Introduction to Blockchain: Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms

Unit-II : Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains:Design goals, Consensus protocols for Permissioned Blockchains

Unit-III : Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chaincode Design and Implementation Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

Unit-IV:Use case 1 : Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Use case 2: Blockchain in trade/supply chain: (i) P Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc

Unit-V Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social

Text Books:

1. MsteringBitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

OEC 810	Computer Vision	4L-0T-0P	CREDIT -4

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore fundamental image processing techniques required for computer vision
CO2: Understand Image formation process and Generate 3D model from images.

CO3: Perform feature extraction and motion estimation on the images.

CO4: To perform shape analysis and perform segmentation.

CO5: Perform Object Analysis and do processing.

Unit-I Introduction :

Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level , Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.

Unit-II : Image Formation Models : Monocular imaging system , Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc, Orthographic & Perspective Projection,• Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading , Photometric Stereo, Depth from Defocus , Construction of 3D model from images.

Unit-III :

Image Processing , Feature Extraction and Motion Estimation : Image preprocessing, Image representations (continuous and discrete) , Edge detection, Regularization theory , Optical computation , Stereo Vision , Motion estimation , Structure from motion

Unit-IV :

Shape Representation and Segmentation : Contour based representation, Region based representation, Deformable curves and surfaces , Snakes and active contours, Level set representations , Fourier and wavelet descriptors , Medial representations , Multiresolution analysis.

Unit-V

Object recognition and Image understanding: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis , Shape priors for recognition, Pattern recognition methods, HMM, GMM and EM.

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill
2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
3. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992
4. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

OEEE-811	Metro Systems and Engineering	L-T-P-C: 4-0-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the basic plan of metro systems	
CO2	Aware of the construction methods, quality and safety systems	
CO3	Comprehend the SCADA based signalling system	
CO4	Understand vehicle dynamics, ventilation, fire safety	
CO5	Relate with the Power Supply and Back-up systems	

UNIT I GENERAL

Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

UNIT II CIVILENGINEERING

Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems - Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

UNIT III ELECTRONICS AND COMMUNICATION ENGINEERING

Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors

UNIT IV MECHANICAL & TV + AC:

Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

UNIT V ELECTRICAL:

OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics**.**

Reference Books:

1. Railway Engineering, Rangwala, Charotat Publishing
2. Civil Engineering for Underground Rail Transport, J.T. Edwards, Science Direct
3. **http://www.railsystem.net/electric-traction-systems/**

OEC-812	Speech and Audio Processing	L-T-P-C: 4-0-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Mathematically model the speech signal	
CO2	Analyze the quality and properties of speech signal	
CO3	Modify and enhance the speech and audio signals	

UNIT I

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

UNIT II

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

UNIT III

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmicquantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

UNIT IV

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

UNIT V

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students" Edition), 2004.
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.