Department of Electronics & Communication Engineering

School of Engineering & Technology

Mizoram University

(A Central University)

Aizawl- 796 004, Mizoram

Course Structure & Syllabus
for
Bachelor of Technology (B.Tech.)
Programme in

Electronics and Communication Engineering

(2016)

MIZORAM UNIVERSITY

School of Engineering and Technology

Department of Electronics and Communication Engineering

B. Tech. Course Structure

BRANCH: Common for ECE, IT, EE Courses Year : I Semester :I

Sl. No	Code No	Title	L	T	P	Credit	Marks
1	16AM101	Mathematics-1	3	1	0	4	100
2	16EE101	Basic Electrical Engineering	3	0	0	3	100
3	16AC101	Chemistry	3	0	0	3	100
4	16HU101	Communication Skills	3	0	0	3	100
5	16IT101	Introduction to Computer and Programming	3	0	0	3	100
6	16EE191	Basic Electrical Laboratory	0	0	3	2	100
7	16AC191	Chemistry Laboratory	0	0	3	2	100
8	16ME191	Engineering Graphics	0	0	3	2	100
9	16IT191	C Programming Laboratory	0	0	3	2	100
		Total	**15**	**1**	**12**	**24**	**900**

L = Lecture, T= Tutorial, P = Practical **Total Marks = 900**

Total contact hours = 15+1+12=28hrs per week Total Credits = 24

BRANCH: Common for ECE, IT, EE B. Tech. Courses Year : I Semester: II

Sl. No	Code No	Title	L	T	P	Credit	Marks
1	16AM201	Mathematics -11	3	1	0	4	100
2	16EC201	Basic Electronics Engineering	3	0	0	3	100
3	16AP201	Physics	3	1	0	4	100
4	16CV201	Environmental Science and Engineering	3	0	0	3	100
5	16ME201	Engineering Mechanics	3	1	0	4	100
6	16EC 291	Basic Electronics Laboratory	0	0	3	2	100
7	16AP291	Physics Laboratory	0	0	3	2	100
8	16WR291	Workshop Practice	0	0	3	2	100
		Total	**15**	**3**	**9**	**24**	**800**

L = Lecture, T= Tutorial, P = Practical **Total Marks = 800**

Total contact hours = 15+3+9=27 hrs per week Total Credits = 24
BRANCH : ECE Year : II Semester :III

Sl. No	Code No	Title	L	T	P	Credit	Marks
1	16AM302	Mathematics III	3	1	0	4	100
2	16EC301	Digital Electronics & Logic Design	3	1	0	4	100
3	16EC302	Electronics Devices & Circuits	3	0	0	3	100
4	16EC303	Network Analysis and Synthesis	3	1	0	4	100
5	16CE304	Data Structure &Object oriented Programming	3	0	0	3	100
6	16CE392	Data Structure &Object oriented Programming Laboratory	0	0	3	2	100
7	16EC391	Digital Design Laboratory	0	0	3	2	100
8	16EC392	Electronics Devices & Circuits Laboratory	0	0	3	2	100
		Total	**15**	**3**	**9**	**24**	**800**

L = Lecture, T= Tutorial, P = Practical **Total Marks = 800**
Total contact hours = 15+3+9=27 hrs per week Total Credits = 24

BRANCH : ECE Year : II Semester :IV

Sl. No.	Code No	Title	L	T	P	Credit	Marks
1	16AM402	Numerical Analysis	3	1	0	4	100
2	16EC401	Microprocessors& Microcontroller	3	1	0	4	100
3	16EC402	Analog Circuits & Systems	3	0	0	3	100
4	16EC403	Signals & Systems	3	0	0	3	100
5	16EC404	Analog Communication	3	0	0	3	100
6	16EC405	Electromagnetic Theory	3	0	0	3	100
7	16EC491	Microprocessor & Microcontroller Laboratory	0	0	3	2	100
8	16EC492	Analog Circuits Laboratory	0	0	3	2	100
		Total	**18**	**2**	**6**	**24**	**800**

L = Lecture, T= Tutorial, P = Practical **Total Marks = 600**
Total contact hours = 18+2+6= 26 hrs per week Total Credits = 24

BRANCH : ECE Year : III Semester :V

Sl. No	Code No	Title	L	T	P	Credit	Marks
1	16EC501	Linear Integrated Circuits	3	1	0	4	100
2	16EC502	Digital Signal Processing	3	0	0	3	100
3	16EC503	Digital Communication	3	1	0	4	100
4	16EC504	Antenna Engineering	3	0	0	3	100
5	16EE503	Control System	3	1	0	4	100
6	16EC591	Antenna Engineering Laboratory	0	0	3	2	100
7	16EC592	Communication Laboratory	0	0	3	2	100
8	16EC593	Digital Signal Processing Laboratory	0	0	3	2	100
9	16EC594	Industrial Training*	0	0	3	NC	100#
		Total	**15**	**3**	**12**	**24**	**800**

L = Lecture, T= Tutorial, P = Practical **Total Marks = 800**

Total contact hours = 15+3+12= 30 hrs per week Total Credits = 24

 # Marks will not be counted

***Industrial Training must be done during summer vacation (between 4th and 5th Semester) , training duration of minimum 30 days and maximum up to 45 days. Mark distribution (30- Presentation, 10- Viva Voce, 10- Report) same for both sessional (Internal) and examination**

BRANCH : ECE Year : III Semester :VI

Sl. No	Code No	Title	L	T	P	Credit	Marks
1	16EC601	Microwave Engineering	3	0	0	3	100
2	16EC602	VLSI Design	3	0	0	3	100
3	16EC603	Wireless and Mobile Communication	3	0	0	3	100
4	16EC604	Computer Networks	3	0	0	3	100
5	16EE605	Measurement & Instrumentation	3	0	0	3	100
6	16EC605	Computer Architecture & Organization	3	0	0	3	100
7	16EC691	Microwave Engineering Laboratory	0	0	3	2	100
8	16EC692	VLSI Laboratory	0	0	3	2	100
9	16EC693	Seminar##	0	0	3	2	100
		Total	**18**	**0**	**12**	**24**	**900**

L = Lecture, T= Tutorial, P = Practical **Total Marks = 900**

Total contact hours = 18+0+9= 27 hrs per week Total Credits = 24

 # # Seminar Topics will be given by corresponding Faculty member. Mark distribution (30- Presentation, 10- Viva Voce, 10- Report) same for both sessional (Internal) and examination.

BRANCH : ECE Year : IV Semester :VII

Sl. No	Code No	Title	L	T	P	Credit	Marks
1	16EC701	Optical Fiber Communication	3	1	0	4	100
2	16EC702	Microelectronics and IC Technology	3	1	0	4	100
3	16EC703	Digital Design using HDL	3	1	0	4	100
4	16EC7XX	Elective-I	3	1	0	4	100
5	16EC7XX	Elective-II	3	1	0	4	100
6	16EC791	**Minor Project +**	0	0	6	4	100
		Total	**15**	**5**	**6**	**24**	**600**

L = Lecture, T= Tutorial, P = Practical **Total Marks = 600**

Total contact hours = 15+5+6= 26 hrs per week Total Credits = 24

+ Mark distribution (35 – Presentation/Demonstration, 10- Viva Voce, 5-Report) same for both sessional (Internal) and examination

"XX => 04 to 12"

Electives (any two or more approved by the Department):

Code No.	Subjects
16EC04	Information and Coding Theory
16EC05	Multimedia Communication
16EC06	Nano Devices
16EC07	Artificial Intelligence
16EC08	Neural Networks
16EC09	Remote Sensing
16EC10	Radar Engineering
16EC11	Robotics
16EC12	Power Electronics

BRANCH : ECE Year : IV Semester :VIII

Sl. No	Code No	Title	L	T	P	Credit	Marks
1	16BM801	Principles & Practice of Management	3	0	0	3	100
2	16EC8XX	Elective- III	3	1	0	4	100
3	16EC8XX	Elective-IV	3	1	0	4	100
4	16EC81X	Open Elective	3	0	0	3	100
5	16EC891	Major Project*	0	0	15	10	300
		Total	**12**	**2**	**15**	**24**	**700**

L = Lecture, T= Tutorial, P = Practical **Total Marks = 700**
Total contact hours = 12 +2+15 = 29hrs per week Total Credits = 24
***Project Allotment, literature survey etc. start from 7th Semester and it will be submitted in 8th Semester, Mark distribution (105- Presentation/Demonstration, 30- Viva Voce, 15- Report) same for both sessional and examination**

"XX => 01 to 08"
Electives (any two or more approved by the Department):

Code No.	Subjects
16EC01	Satellite Communication
16EC02	Embedded System
16EC03	Advanced Digital Signal Processing.
16EC04	Design Using CAD Tools
16EC05	Opto-Electronics Devices
16EC06	Cryptography
16EC07	Digital Image Processing
16EC08	Advance Control System

"X => 1 to 5"
Open Electives (any two or more approved by the Department):

Code No.	Subjects
16EC1	Virtual Instrumentation
16EC2	Fundamental of MEMS
16EC3	Biomedical Instrumentation
16EC4	Material Science
16EC5	Solar Photovoltaic Technology

Total Credits (Course): 24+24+24+24+24+24+24+24 = 192

Total Marks (Course): 900+800+800+800+800+1000+600+700=6400

Mathematics- I: 16**AM101**

Credits:4 (3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I
Successive differentiation, Leibnitz's theorem, polar curves, angle between radius vector and tangent, angle of intersection of two curves, derivatives of arcs (Cartesian and polar), curvature, radius of curvature and evolute. 10L

UNIT II
Rolle's Theorem, mean value theorems, partial differentiation, Euler's theorem, total differential, differentiation of composite and implicit functions. 8L

UNIT III
Convergence, divergence, comparison test, ratio test, Cauchy's root test, Cauchy's integral test, alternating series, Leibnitz's theorem, absolute and conditional convergence, Expansion of functions into Taylor's and Maclaurin's series. 8L

UNIT IV
Binary operation, linear dependence and independence, basis, orthogonal basis, Vector Spaces and Subspaces, Simple examples, Matrices, elementary column and row operations, inverse, rank, system of linear equations, solution by Gauss elimination method. 11L

UNIT V
Reduction formulae for $\int \sin^n x\,dx, \int \cos^n x\,dx, \int \sin^m x \cos^n x\,dx.$. Evaluation of $\int_0^{\pi/2} \sin^n x\,dx, \int_0^{\pi/2} \cos^n x\,dx, \int_0^{\pi/2} \sin^m x \cos^n x dx$ where m and n are positive integers. Tracing of standard curves Folium of Descartes, Strophoid, Lemniscate of Bernoulli, Witch of Agnessi, Astroid, Cissoid of Diocles, Cardioid, Cycloid, Roses (three and four leaved), Length, area and volume of revolution involving simple curves. 11L

Text Books:
- B.S. Grewal, 'Higher Engineering Mathematics'43/e, Khana Publication, 2014.
- Shanti Narayan, 'Differential Calculus'. 5/e S Chand Publication, 2014.
- Shanti Narayan, 'Integral Calculus'5/e, S Chand Publication, 2014.
- Maity and Ghosh, 'Differential Calculus', New Central Book agency, 2010.

References Books:
- C.B. Thomas, 'Calculus and Analytical Geometry'9/e,Dorling Kindersley India, 2009
- N. Piskunov, 'Differential and Integral Calculus, 2/e Vol. I and Vol. II' G.K Publication, 2012.

Basic Electrical Engineering: 16**EE101**

Credits: 3 (3L)
Total hrs: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I

D.C. Circuit Analysis & Techniques: Definitions of Electric Circuits and Parameters, Active and Passive elements, Independent and Dependent sources, Current and Voltage division principles, KVL, KCL, Nodal, Loop and Mesh circuit analysis, Star-Delta transformation, Source equivalence and conversion, Network theorems: Superposition, Thevenin, Norton, Maximum Power Transfer and Reciprocity theorems and their applications. 10L

UNIT II

AC fundamentals and Circuits: A.C. generation, waveforms, average and RMS values, Peak factor, Form factor, Complex power, Power factor and Calculations of power in single phase ac circuits, R-L, R-C and R-L-C circuits.

Resonance: Series and Parallel resonance, Bandwidth Q-factor, and Sharpness of resonance.

Three phase circuit analysis: Star and Delta connected Systems, voltages, current and power in 3-phase circuits, Measurement of 3-phase power by two wattmeter method (Only balance load). 10L

UNIT III

Fundamentals of electrical machines: Construction, working principles and characteristics of DC generators and motors, Construction, working principle, EMF equation and equivalent circuit of a Single phase transformer, transformer losses, open and short circuit tests on transformer. 10L

UNIT IV

Electrical Wiring Systems: Introduction, Types of wiring systems, choice of wiring systems, concepts on earthing and its various methods. 6L

Text Books:

- Van Valkenburg, 'Network Analysis', Prentice Hall of lndia, 6th Edition, 1992.
- Kamaleshaiah and Naidu, 'Introduction to Electrical Engineering', Tata McGraw Hill Pub. Co 1995.
- W.H. Hayt, J. E. Kimmerly, 'Engineering Circuit Analysis', McGraw Hill, 9th Edition, 2007.
- Charles K. Aleximder& Matthew N. O. Sadiku, 'Fundamental of Electric Circuits',*5/e*Tata McGraw, Hill, 2003.
- Edward Hughes, 'Electrical Technology', English Language Book Society Publication with Longman, 10/e 2015.

References Books:

- Joseph A Edminister, 'Electric Circuits', 5/e McGraw Hill, 2011.
- Vincent Del Torro, 'Electrical Engineering Fundamental', 4thEdition, Prentice Hall of India Pvt. Ltd 2004.
- I. J. Nagrath, 'Basic Electrical Engineering', 6/e Tata McGraw Hill Pub. Co Feb 2014.

Chemistry: 16**AC101**

Credits: 3 (3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I
Phase rule, and their thermodynamic derivations, the distribution law and solvent extraction. Ionic, molecular and covalent network in solids, Crystal types: AX and AX_2, Point defects in crystals, Band theory of solids. 5L

UNIT II
Concept of rate, Rate constant, 1^{st}, 2^{nd}, and 3^{rd} order reactions, Determination of Rate law, Kinetics of catalytic, photochemical, and, fast reactions, Collision and absolute reaction rate theories, Adsorption of gases on solids, Langmuir and Freundlich isotherms, Homogeneous & heterogeneous catalysis, Industrial applications, Zeolites. 7L

UNIT III
Electrochemical systems, galvanic cells, classification and thermodynamic treatment, Concentration cell and liquid junction potential, Potentiometry, Membrane equilibria, ion,selective electrodes, and pH,metry, Corrosion types, mechanism, and methods of prevention. 6L

UNIT IV
Composition and properties of glass, refractoriness and cement, Molecular sieve, elementary ideas of electronic and photonic ceramics.Classification and properties of composite materials, Mechanism of reinforcement composites. Polymerization, classification, linking and engineering uses of polymers, thermoplastic and thermosetting resins, elastomers & synthetic fibers, ion,exchange resins, organic conducting and insulating materials. 9L

UNIT V
Elementary idea of absorption & emission spectrometry, flame, and spectrophotometer analysis of engineering materials, Infra,Red (IR) and Nuclear Magnetic Resonance (NMR) Spectroscopy and spectra of simple compounds, Mass Spectrometry, X,ray methods (X,Ray Diffraction, Electronic Spectroscopy for Chemical Analysis). 9L

Text Books:

- G. M. Barrow, 'Physical Chemistry', 5^{th} Ed., TMH, New Delhi, 2009.
- V. Walters, J. de Paulo, and Peter Atkins, 'Explorations in Physical Chemistry',2/e Oxford,2007
- Puri, Sharma, and Pathania, 'Principle of Physical Chemistry', 44^{th} Edition, Vishal Publishing House, New Delhi, 2008.
- Hameka, 'Chemistry:Fundamentals and Applications', Academic Press, 2001
- Davis, and Berner, 'Handbook of Industrial Chemistry 1/e (vol. 1 & 2)', John,Wiley, 2005.
- D. A. Skoog, 'Principles of Instrumental Analysis', 5^{th} Ed., Saunders College Publ, 2003.
- Parameshwara Murthy, 'Textbook of Engineering Chemistry', BS Publications, 2013.
- Walton, 'Polymers', 'Oxford University Press, 2005.

References Books:

- M. Bowker, 'The basis and Applications of Heterogeneous Catalysis', 3/e Oxford University Press (Oxford Chemistry Primers), 1998.
- S. Metcalfe, 'Chemical Reaction Engineering: First Course', Oxford (Oxford Chemistry Primers), 3/e 1997.
- West Anthony. R, 'Solid,state Chemistry and its applications', 4/e John,Wiley, 2007.
- Manfred Baerns, 'Basic Principles in Applied Catalysis', 2/e Springer,Verlag 2004.
- Jones, and S. Wimperis, 'NMR: the Tool kit', Oxford University Press (Oxford Chemistry primers) 3/e 2005.
- A. K. Brisdon, 'Inorganic Spectroscopic methods', Oxford University Press (Oxford Chemistry primers), 5/e 2005.
- W. Clegg, 'Crystal Structure Determination', Oxford University Press (Oxford Chemistry primers), 2/e 2001.
- Robinson, 'Undergraduate Instrumental Analysis'6/e, John,Wiley, 2004.
- James C Gerdeen, et. al., 'Engineering Design with polymers and Composites', CRC Press, 4/e 2005.
- James G. Speight, 'Handbook of Coal Analysis', John, Wiley. April-2005.

Communication Skills: 16HU101

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} =60.

UNIT I
Principles and Process of communication (coherent communication, barriers, removal of bottleneck; verbal &non,verbal network of communication). 7L

UNIT II
Grammar: Parts of Speech (Sentence and its structures, subject verd,object formation of speech & writing, assertive, negative, interrogative and idioms, active, passive voice etc). 7L

UNIT III
Tense form, agreement /concord 6L

UNIT IV
Phonetics, Stress pattern in English, Speech mechanism & Spoken exercises; Group discussion & Public speaking, presentation. 8L

UNIT V
Basics of Business letters, drafting: Addressing & concluding.
Report Writing: Types and specimens using hard & software. 8L

Text Books:

- LeenaSen, 'Communication Skills', 2/e PHI,2007.
- UrmilaRai, S.M. Rai, 'Managerial Communication',4/e Himalaya Publishing house, 2010.
- Wren and Martin,' English Grammar and Composition', regular edition S. Chand, 2016.
- Das, B.K. Samantray, K. et all. 'An Introduction to Professional English and Soft Skills', 1/e New Delhi: CUP, 2009
- Bansal, R.K.& Harrison, J. B., 'Spoken English [for India]',1/e Orient Longman, 2007.

References Books:

- O'Connor, J.D., 'Better English Pronunciation (Cambridge English Language Learning) 3/e 1981', CUP.
- Vikrant Schgal,'2/e An Introduction to Phonetics & Linguistics', Pointer Publisher, 2011.
- Patnaik, P., 'Group Discussion and Interview Skills'3/e, New Delhi: CUP, 2011.
- Seeley, John, 'Oxford Guide to Effective Writing and Speaking',2/e Delhi: OUP, 2000.
- E-Resources: Website, EnglishClub.com,for Business correspondence, Power Point Presentation-for professional Communication.
- Murphy, Raymond, 'English Grammar in Use [3rdedn] CUP', 2010.

Introduction to Computer and Programming: 16**IT101**

Credits: 3 (3L)
Total Hrs: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Computer Fundamentals: Generation, Classification, Functional Units. Software types, Concepts of algorithms, flowcharts 4L

UNIT II:
Introduction to C language – Tokens: constants, variables, keywords, data types, Type conversion. Operators: Arithmetic, Logic, Hierarchy of Operators. Control Structures: If, If-Else, While, For, Do-While, Break, Continue, Switch. 8L

UNIT III:
Functions: Concepts, return type, parameter passing, scope and life time of variable, recursion. Pointers: concepts, pointer and functions, call by value and call by reference. 9L

UNIT IV:
Array: declaration, initialization, array and function, array and pointer, more than one dimensional array.
String: concept, string manipulation functions, two dimensional array of character, pointer and string. 8L

UNIT V:
Structure: Declaration, accessing elements, storage, structure and pointer. Union. File: opening, read,write,close, file opening modes, binary file, command line argument. 9L

Text Books:

- Yashavant P. Kanetkar, 'Let Us C'13/e, BPB Publications, 2013.
- E.Balaguruswamy, 'Programming in ANSI C'6/e, TMC, 2012
- Byron S. Gottfried, 'Programming with C'2/e, (Schaum's Outlines Series)McGraw Hill, 1996.

References Books:

- Brian W. Kernighan and Dennis Ritchie, 'The C Programming Language', 2nd Edition, PHI, 2015.
- R. Sethi, 'Programming Language'2/e, Addison Wisely, 2002.
- V. Rajaraman, 'Computer Programming in C', 2/e PHI, 2008.

Basic Electrical Laboratory: 16EE191

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution: 30-practical, 10-viva-voce, 10-report/record book)

List of Experiments:

1. Characteristics of Tungsten and Carbon filament lamps
2. Characteristics of Fluorescent lamps
   (a) Verification of KVL
   (b) Verification of KCL
3. Verification of Thevenin's theorem.
4. Verification of Norton's theorems.
5. Verification of Maximum power theorem.
6. Verification of Superposition theorem
7. Study of R-L-C Series circuit
8. Study of R-L-C parallel circuit
9. SeriesandParallelResonance
10. MeasurementofS-phasePowerbytwoWattmeterMethodforbalancedloads
11. Layout of a typical household wiring scheme

Chemistry Laboratory: 16AC191

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution: 30-practical, 10-viva-voce, 10-report/record book)

List of Experiments:

1. Estimation of hardness of water using EDTA titration.
2. Critical micellar concentration of commercial detergents from surface tension measurements using stalagmometer.
3. Conductometric titration of strong acid with strong base.
4. Potentiometric titration of Fe^{2+} using potassium dichromate.
5. Evaluation of pKa of weak acid using pH meter.
6. Determination of surface tension and viscosity of liquid
7. Kinetics; Determination of rate constant for acid catalysed hydrolysis of Ester.
8. Determination of percentage composition of sugar solutions using viscometer.
9. Determination of partition coefficient of acetic acid between n,butanol and water.
10. Spectrophometric determination of copper.
11. Conductometric titration of weak acid with strong base.

Engineering Graphics: 16ME191

Credits: 2(3P)

Total Hrs: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution : 30-practical, 10-viva-voce, 10-report/record book/Chart)

UNIT-I

Scales:

Representative factor, plain scales, diagonal scales, scale of chords. Conic sections: Constructionofellipse,parabola,hyperbolabydifferentmethods;NormalandTangent.

UNIT-II

Projection:

Typesofprojection,orthographicprojection,firstandthirdangleprojection,Projection of pointsandlines,Lineinclinedto oneplane,inclinedwithboththeplane,TrueLength andTrueInclination,Tracesofstraightlines.

UNIT-III

Projectionofplanesandsolids:

Projectionof Planeslikecircleandpolygonsin differentpositions;Projectionof polyhedrons like prisms, pyramids and solids of revolutions like cylinder, cones in differentpositions.

UNIT-IV

SectionofSolids:

Sectionofrightsolidsbynormalandinclinedplanes;Intersectionofcylinders.DevelopmentofSurfaces:Parallellineandradial- linemethodforrightsolids.

UNIT-V

IsometricProjections:

Isometricscale,Isometricaxes,IsometricProjectionfromorthographicdrawing.

Nomography,basic concepts & uses, Computer Aided Drafting (CAD): Introduction, benefit, software's basic commands of drafting entities likeline,circle, polygon, polyhedron, cylinders; transformations and editingcommandslikemove,rotate,mirror,array;solutionofprojectionproblemson CAD.

Text Books:

1. K. L. Narayana& P Kannaiah, 'Engineering Graphics', Tata McGraw-Hill, 1988
2. V. Luxminarayana&Vaishwanar, 'A text Book of Engineering Graphics'16/e, Jain Brothers, 2009.

References Books:

1. N. D. Bhatt, 'Elementary Engineering Graphics', Charotar publishing house, Anand, 2004.
2. M. Chandra &Satish Chandra, 'Engineering Graphics', Narosa Publishing House, 1998.

Note:

Sketching anddrawing ofgeometries andprojections based onabove syllabus Term work

Tocoverabovesyllabus,InstitutemusthaveCADsoftwareandacomputerlab(6 to12hrs/month/student).

C Programming Laboratory: 16IT191

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution: 30-practical, 10-viva-voce, 10- report/record book)

Group A

1. Program to find whether the given number is prime or not.
2. Program to find the factorial of a given integer
3. Program to find the sum of individual digits of a positive integer.
4. Program to find the GCD (greatest common divisor) of two given integers.
5. Program to display first N terms of Fibonacci series.
6. Program to replace lowercase letters by uppercase letters and vice versa in a sentence
7. Program to check whether a string is palindrome or not
8. Program to sort 10 names in alphabetical order
9. Write a function(using a pointer parameter) that reverse the elements of a given array
10. Program to display contents of a file

Group B

1. Program to find output all the roots of a given quadratic equation, for non,zero
2. coefficients.
3. Program, which takes two integer operands and one operator from the user,
4. performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
5. Program to generate all the prime numbers between 1 and n, where n is a
6. value supplied by the user.
7. Program to find both the largest and smallest number in a list of integers.
8. Program to calculate the following Sum:
9. Sum=1,x^2/2! +x^4/4!,x^6/6!+x^8/8!,x^{10}/10!
10. Program to read matrix A (M X N) and find the following using function
    i) sum of elements of M rows
    ii) sum of elements of N columns
    iii) sum of all elements of the matrix
11. Program to multiply two matrices
12. Program which copies one file to another file.
13. Program to count the number of characters, tabs, spces, number of lines in a file
14. Create a structure to specify data on students given below:
    - Roll No. , Name, Class, marks obtained on three subjects
    - Enter N students information and display the percentage of each student (assume F.M is 100 each).
    - Print the data of a student whose roll number is given by the user

(During Practical examination students have to attempt one program from each group)

Mathematics-II: 16**AM201**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I
Order, degree, Solutions of equations, homogeneous and non homogeneous equations, exact equations, linear equations, Bernoulli's equations. 10L

UNIT II
Homogeneous equations, linear equations with constant coefficients, non homogeneous equations, method of variations of parameters and inverse differential operators, solution of Cauchy's homogeneous linear equations, Solution of simple simultaneous equations. 10L

UNIT III
Laplace Transforms of elementary functions, transforms of derivatives and derivatives of transforms, Inverse transforms, transforms of periodic, functions, unit step function, shifting theorems, and solutions of differential equations using Laplace transforms. 10L

UNIT IV
Direction cosines, planes, straight lines, spheres, right circular cone and right circular cylinder. 8L

UNIT V
Extreme values of a function of two variables, Lagranges's method of undetermined multipliers, simple problems, multiple integrals: evaluation by change of order of integration, changing of variables. Jacobians, Applications to areas and volumes, Beta and Gamma functions: elementary properties, simple problems. 10L

Text Books:

1. E.D. Rainvilleand P. E. Bedient, 'A short course in differential equation'. Pearson Higher Education, 1986.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics'. 9/eWiley India Pvt Ltd, 2010.
3. Shanti Narayan, 'Differential Calculus'. 30/e S.Chand Publishing, 2006
4. Shanti Narayan, 'Analytical solid Geometry' 19/eS.Chand Publishing, 2014

References Books:

1. C.B. Thomas, 'Calculus and Analytical Geometry'. 2/e Dorling Kindersley India, 2010.
2. N. Piskunov, 'Differential and Integral Calculus, 2/e Vol. I and Vol. II'. Cbs Publisher & Distributors, 2000.

Basic Electronics Engineering: 16EC201

Credits: 3 (3L)
Total hrs: 36

Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:

Crystalline materials, Fermi energy, Conductors, Semiconductors and Insulators: electrical properties, band diagrams, Intrinsic and extrinsic semiconductor, P-type and N-type, carrier conc. and mobility, drift and diffusion, continuity equation, The Hall Effect. 6L

UNIT II:

P-N junction, Forward and reverse bias, V-I Characteristics, Simple diode circuits, Zener and avalanche breakdown, load line, linear piecewise model, Capacitance of p-n junction diode, rectifiers: half wave, full wave, its PIV, DC voltage and current, ripple factor, efficiency Clipper and Clamper circuits, Zener diode application for voltage regulator, special types of diodes & their applications. 9L

UNIT III:

Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, Ebers-Moll model of transistor, transistor characteristics, Biasing. Different operating modes, Equivalent Circuit for h-parameters; Transistors as amplifier: Calculation of gain (Current and Voltage), input and output impedance, frequency response for CE amplifier with and without source impedance (qualitative). 9L

UNIT IV:

JFET's operation, static characteristics IGFET, MOSFET operation, Characteristics, types, enhancement, depletion mode, CS, CG, CD configuration. Introduction to CMOS and IC Technology, Properties of Op-amp, specification of IC-741, concept of virtual earth, Op-Amp transfer characteristics, Application of operational amplifier: inverting and non-inverting amplifier, summing, difference, constant gain multiplier, voltage follower, comparator, integrator, differentiator. 9L

UNIT V:

CRO Operation, Construction features of cathode ray tube, concept of dual beam CRO, application of CRO for different electrical measurements: amplitude frequency and phase of sine wave, Lissajous figure. 3 L

Text Books:

- Saha, Rakshit, Chattopadhaya, Foundation of Electronics, South Asia Book, 2nd Ed., 1988
- Malvino, Electronic Principle 7/e 2006.
- Mottershed, Electronics Devices & Circuits 2/e 2013
- B.G.Streetman& S. Banerjee, Electronics Devices & Circuits 6/e 2016
- Millman&Halkias, Integrated Electronics 2/e 2009

References:

- Millman&Grabal, Microelectronics 2/e 2001
- Schilling &Belove, Electronics Circuits 3/e 2002
- Salivahanan, Electronics Devices & Circuits 3/e 2012

Physics: 16**AP201**

Credits: 4 (3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Use of vectors in Physics, Different coordinate systems – Cartesian, cylindrical and spherical polar coordinates, Vector fields and their potentials, gradient, divergence, curl and their physical significance, continuity equations, Gauss and Stokes theorems and their physical significance.
Newton's laws of motion, motion in a uniform field, components of velocity and acceleration in Cartesian system, Plane polar coordinate system, centripetal acceleration, Centre of mass and its equation of motion, conservation of energy, linear and angular momenta, Conservative and non-conservative forces. 12L

UNIT II:
Harmonic oscillations, differential equation and its solution, kinetic and potential energy, spring and mass system, simple and compound pendulum, Superposition of waves of the same frequency, group and phase velocities, Standing waves, Free and forced vibration, resonance and condition of resonance, sharpness of resonance, Ultrasonics: production, detection and application of ultrasonic waves in engineering. 9L

UNIT III:
Wave optics: Huygen's principle, Young double slit experiment, Newton's rings, diffraction, single slit diffraction, diffraction grating. Polarization of light. 7L

UNIT IV:
Lattice, unit cell and translation vector, classification of crystals, Bravais lattice, classification of solids, different types of magnetic materials, hysteresis, various polarization mechanics in dielectrics and their frequency and temperature dependence, loss tangent, dielectric loss, dielectric breakdown, High resistivity alloys, superconductors-properties and applications. 10L

UNIT V:
Semiconductors– origin of band gap in solids, intrinsic and extrinsic semiconductors, elemental and compound semiconductors and their properties. Fermi-Dirac statistics, concept of hole, introduction to p-n junction.
Spontaneous and Stimulated emission of radiation, Population inversion, Einstein's co-efficients, Optical resonator and condition necessary for active Laser action, Ruby Laser, He-Ne Laser.
Optical Fibers–Core and cladding, total internal reflection, concept of numerical aperture and acceptance angle. 10L

Text Books:

- A Beiser, Concepts of Modern Physics, 6/e McGraw Hill 2009
- . R Feynman, R Leighton & M Sands, 2/e The Feynman Lectures in Physics, 2/e Vol. 1, 2 & 3, 2014
- M Speigel, Outline of Vector Analysis, Schaum Series 2/e 1969.
- C L Arora, Refresher Course in BSc Physics , 1/e S Chand and Co 2012.

- R Feynman, R Leighton and M Sands, The Feynman Lectures in Physics, 2/eVolumes 1,2& 3 2014
- R Murugeshan and KiruthigaSivaprasath, Modern Physics, S Chand and Co.

Reference Books:

- N C Rana and P S Joag, Introduction to Classical Mechanics, 1/e TMH 1978.
- D Halliday, R Resnick and J Walker, Fundamentals of Physics, J. Wiley & Sons 2/e 2015

Environment Science and Engineering: 16**CV201**

Credits: 3 (3L)
Total Hours: 36
FullMarks: 100(Internal: 40Marks,End SemesterExamination: 60Marks)

Internalmark:{28(Termtest)+ 8(Assignment/Presentation)+4(Attendance)} End semestermark distributionpattern:
Total8nos.ofquestions:{Q.1(a-f)6x 2(Mark)(Compulsory)+Anyfour(4)fromQ.2-8 x12(Marks)} = 60.

Objective: Making the students understand and appreciate the unity of life in all its forms, major causes of environmental degradation and methods of pollution prevention.

UNIT I Environment & Natural Resources 10 L

Definition, scope, importance, need for public, Natural Resources – forest resources – use, exploitation, deforestation, construction of multipurpose dams – effect on forests, Water resources – use of surface and subsurface water; effect of floods, drought, water conflicts, food resources – food problems, advantage and disadvantage of fertilizers & pesticides, effect on environment, Energy resources – need to develop renewable energy, land resources – Land degradation, soil erosion, desertification & case studies.

Unit II Environmental Pollution 8 L

Definition – Causes, pollution effects and control measures of Air, Water, Soil, Marine, NoiseThermal, Nuclear hazards. Unit operation and processes treatment of drinking water and domestic wastewater (Overview and Layout only).

Unit III Solid Waste Management 6 L

Types and sources of Solid wastes, properties of solid wastes, solid waste management: overview – Material flow in society – reduction in raw material – reduction in solid waste – reuse of solid wastes – materials recovery – energy recovery.

Unit IV Disaster Management 6 L

Classification of disaster, Natural disaster scene in the world, geophysical disaster, Tsunami, Earthquake, Meteorological disaster, Hydrological and Climatological disaster, Floods and Cyclone,Landslides. Disaster management, Disaster mitigation, Disaster preparedness, Response to disaster, Recovery from disaster.Disaster management in India.

Unit V Social Issues and the Environment 6 L

Concept of Environmental Impact Assessment (EIA), urban problems related to energy & sustainable development, water conservation, rain water harvesting, watershed management.Role of Information Technology, remote sensing and Geographical Information Systems (GIS) in natural resources management.

TextBooks:

1. Rajagopalan, R., (2014). Environmental Studies – from Crisis to Cure. 2nd edition. Oxford university press.
2. Masters. G.M.Introduction to Environmental Engineering and Sciences Prentice Hall of India.
3. Daniels and Krishnaswamy, (2010). Environmental studies. Wiley India Pvt Ltd.
4. Kurian Joseph & R. Nagendran (2004) "Essentials of Environmental Studies", 1st Edition, Pearson Education, 2004.

References:

1. Peavy, H.S., D.R. Rowe &T.George, "Environmental Engineering", New York: McGraw Hill, 1987.
2. Metcalf &Eddy,"Wastewater Engineering: Treatment and Reuse", New Delhi, Tata McGraw Hill, 2003.
3. Sharma, P. D. Ecologyand Environment. RastogiPublication, Meerut,India.

Engineering Mechanics: 16**ME201**

Credits: 4 (3L 1T) Total Hours: 48

Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks) Internal mark: {28 (Term test) + 8(Assignment/Presentation) + 4(Attendance)} End semester mark distribution pattern:

Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT-I:

Types of forces-concurrent, coplanar, distributed, spatial, resultant of a force about an axis, concept of equilibrium, Moment and couple, Principles of Transmissibility, Lamis and Varignon'stheorem,Simple applications to machines, mechanical efficiency.
10L

UNIT- II:

Concepts of stress and strains-Internal and external forces, Stress-normal, shearing and bearing, Deformations, Strain-Normal, shearing and bearing, Stress-strain diagram, Elastic and plastic behavior, elastic constants and their mutual relations, Thermal stresses. Shearing Force and Bending Moment. 10L

UNIT-III

Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.
10L

UNIT IV

Friction, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.
8L

UNIT V:

Rectilinear and curvilinear motion of particles, General plane motions, equations of motions in non-inertial frames of reference, D'Alembert'sprinciple,Basic Principle of work and energy, Mechanical vibrations, Principle of impulses and momentum, application to plane motion of particles and rigid bodies. 10L

Text Books:

1. Beer, F.P and Johnson Jr. E.R. “Vector Mechanics for Engineers”, Vol. 1 Statics and Vol. 2, Dynamics, McGraw-Hill International Edition, (1997).

2. Rajasekaran, S, Sankarasubramanian, G., “Fundamentals of Engineering Mechanics”, Vikas Publishing House Pvt. Ltd., (2000).

3. Hibbeller, R.C., “Engineering Mechanics”, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).

4. Palanichamy, M.S., Nagam, S., “Engineering Mechanics – Statics & Dynamics”, Tata McGraw-Hill, (2001).

5. Irving H. Shames, “Engineering Mechanics – Statics and Dynamics”, IV Edition – Pearson Education Asia Pvt. Ltd., (2003).

6. Ashok Gupta, “Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)”, Pearson Education Asia Pvt., Ltd., (2002).

Basic Electronics Laboratory: 16**EC291**

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution : 30- practical, 10- viva-voce, 10- report/record book)

List of Experiments:

1. Familiarization with components such as Resistors, Capacitors, Diodes, Transistors, FET's, Op-Amps.
2. Familiarization with DC Power supply, Multimeter, Function Generator etc.
3. Familiarization with CRO for different electrical measurements.
4. Familiarization with Bread Board and Soldering practice.
5. Study on V-I characteristics of Junction Diode.
6. Study on V-I characteristics of Zener Diode.
7. Study on Half Wave rectifiers.
8. Study on Full Wave rectifiers.
9. Study of CB, CE characteristics of BJT.
10. Study of Clipper and Clamper Circuit using Junction Diode.
11. Study of Voltage regulator Circuit using Zener Diode.

Physics Laboratory: 16**AP291**

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution: 30-practical, 10-viva-voce, 10-report/record book)

List of Experiments:

1. Errors and approximations ,with data from VernierCallipers and Screw Gauge
2. Determine the acceleration due to gravity by bar pendulum
3. Determination of Young's Modulus by cantilever bending method
4. Determination of Thermal Conductivity of bad conductor by Lee's Disc
5. Verify laws of vibrations of strings by using ac sonometer.
6. Determine the coefficient of linear expansion of a rod by optical lever method
7. Determination of velocity of ultrasonic sound in liquid using Ultrasonic wave interferometer
8. Determination of co-efficient of viscosity by Poiseulle's capillary flow method.
9. Determination of thickness of a wire by using air, wedge
10. Determine the refractive index of a liquid/solid by using a traveling microscope.
11. Determination of the dielectric permittivity of non, polar solids using LCR meter
12. Determination of the dielectric permittivity of liquids using a dipole meter
13. Determination of band gap of semiconductors
14. Determination of particle size by using He, Ne Laser
15. Determination of Laser parameters
16. Determination of fiber, optical properties ,acceptance angle, power,loss
17. Use CRO for the study of A.C. supply waveform and compare the frequencies.
18. Determination of wavelength of light by Newton's ring method.

Workshop Practice: 16**WR291**

Credits: 2(3P)
Total Hours: 45
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution: 30-practical, 10-viva-voce, 10-report/record book)

I. Theory (about various components involved in Workshop Practice)
(a) Carpentry: Timber, definition, Engineering applications, seasoning and preservation, plywood and ply,boards.
(b) Metal Joining Definitions of welding, brazing and soldering processes, and their applications. Oxy,acetylene glass welding process, equipment and techniques, types of flames and their applications. Manual metal arc welding technique and equipment, AC and DC welding, electrodes, constituents and functions of electrode coating.Weldingpositions.Types of weld joint. Common welding defects such as cracks, undercutting, slag inclusion, porosity.
(c) Metal Cutting: Introduction to machining and common machining operations. Cutting tool materials.Definition of machine tools, specification and block diagram of lathe, shaper, milling, drilling machine and grinder.Common lathe operations such as turning, parting, chamfering and facing.Quick return mechanism of shaper.Difference between drilling and boring.Files,material and classification.

II. Experiments : At least eight (8) experiments need to be conducted
List of Jobs to be made in the Workshop
(a) Carpentry:
1. T,Lap&L,joints
2. Bridle joint
(b) Metal Joining: Welding Practice.
1. Gas welding practice on mild steel flat
2. Lap joint by Gas welding
3. MMA welding practice by students
4. Square butt joint by MMA Welding
5. Lap joint by MMA Welding
6. Demonstration of brazing
7. Tin smithy for making mechanical joints and soldering of joints
(c) Metal Cutting:
1. Job on lathe with one step turning and chamfering operations
2. Job on shaper and milling machine for finishing two sides of a job
3. Drilling two holes of size 5 and 12 mm diameter on job used / to be used for shaping
4. Grinding a corner of above job on bench grinder
5. Finishing of two sides of a square piece by filing.

Text Books:

- Chapman & Arnold, 'Workshop Technology', 3/e, 2001.
- Begeman&Amstead, 'Manufacturing Process'8/e, John Wiley, 1987.

References Books:

- B S Raghubansi, 'Workshop Technology'9/e, Dhanpatrai& sons, 2002.
- Hajra, Chaudhuri, 'Elements of Workshop technology'Vol-I, Media Promoters & Publishers, 1/e, 2009.
- Khanna , O.P., 'Workshop Technology', 1/e DhanpatRai Publications, 2008.
- S. Crawford, 'Basic Engineering Processes', 1/e Hodder& Stoughton, 1985.

- S. Gowri and T. Jeyapoovan, “Engineering Practices Lab Manual’1/e, Vikas Publishing House Pvt Ltd., 2011.

Mathematics - III: 16AM302

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I
Finite sample space, conditional probability and independency, Baye's theorem, one dimensional random variable, mean, variance and expectation, Chebyschev's inequality, Two and higher dimensional random variables, covariance, correlation coefficients, least squares principle of curve fitting.
Distributions: Binomial, Poisson, Uniform, Normal, Gamma, Chi square and exponential, simple problems. 12L

UNIT II
Fourier series of odd and even functions and functions with arbitrary period, Half range extensions, Fourier sine and cosine transforms, and Fourier integrals. Parseval's identity, Convolution theorem, solution of boundary value problems by Fourier transforms, Z,transforms, solution of difference equations using Z,transforms. 10L

UNIT III
Introduction to complex numbers, functions, continuity, differentiability, analyticity ,Cauchy Riemann equations and properties of ana1ytic functions, Line integrals in complex plane and basic properties of Cauchy's integral theorem and Cauchy's integral formula ,derivatives of analytic functions. 10L

UNIT IV
Taylor, Maclaurin and Laurent's series, residue theorem, evaluation of standard real integrals using contour integrals. 8L

UNIT V
Gradient, divergence and curl, their physical meaning and identities, line, surface and volume integra1s, simple applications, Curvilinear coordinates. 8L

Text books:

- P. L. Mayer, 'Int. to Probability and Statistical Applications'2/e, American Publishing Co., 1986
- R. V. Churchill and J. W. Brown, 'Complex variables and applications', 2/e McGraw Hill, 2013.
- B.S. Grewal, 'Higher Engineering Mathematics'4/e, KhannaPublication , 2010.
- Murray R. Spigel, 'Vector Analysis', Schaum Outline Series,2/e Tata McGraw Hill, 2009.
- Erwin Kreyszig, 'Advanced Engineering Mathematics', 10/e wiley India Pvt. Ltd., 2003.

References Books:

- Murray R. Spigel, 'Complex variable'2/e, Schaum Outline Series, Tata McGraw Hill, 2009.
- Ross, 'Introduction to probability & statistics for engineers & scientists', 2/e Academic Press, 2012..
- K. S. Trivedi, 'Probability and Statistics', 2/e wiley India Pvt. Ltd., 2015.

Digital Electronics and Logic Design: 16**EC301**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction, Binary representation, Number Systems, Codes and their conversions, BCD, Octal, Hexadecimal, ASCII, Gray code, Excess-3 code, Binary arithmetic. 10L

UNIT II:
Boolean algebra, logic gates and circuits, Minimization of logic expressions by algebraic method, K-map method, VEM methods and Quine McClauskey method. 8L

UNIT III:
Adder, subtractor, encoder, decoder, comparator, multiplexer, de-multiplexer, parity generator, Priority Encoder, ALU, BCD to 7 segment code converter. Flip Flops, various types of Registers and counters and their design, Ring Counter, State table and state transition diagram, sequential circuits design methodology. 12L

UNIT IV:
Weighted resistor and R-2R ladder type D/A converter, Specification for D/A converters, Sample and Hold Circuit, Quantization and Encoding, Parallel-comparator type, Successive approximation type, Dual slope, Counting A/D converters, Specifications of A/D converter. 10L

UNIT V:
Bipolar Logic Families, Unipolar Logic Families, Characteristics of Digital ICs, DTL, TTL, ECL, MOS and CMOS, their operation, specifications, Advantages and Disadvantages, 8L

Text Books:
- Jain, Modern Digital Electronics, 4/e ,TMH 2009.
- Leach &Malvino, Digital Principles & Application, 8/e, TMH 2014
- Morris Mano, Digital Logic Design, 1/e PHI 2004.

References:
- H.Taub&D.Shilling, Digital Integrated Electronics,1/e McGraw Hill 2008.
- Givone, Digital Principles & Design, 1/e TMH 2002.
- Virendra Kumar, Digital Technology, New Age, 1/e 1996.

Electronic Devices & Circuits: 16EC302

Credits: 3(3L)

Total Hours: 36

Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)

Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}

End semester mark distribution pattern::

Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:

Introduction to Properties of metal semiconductor junctions, Hetero-junctions, photovoltaic effect-solar cells, Tunnel diode, Varactor diodes, Semi conductor sensors and detectors, High voltage and high power transistors. 5L

UNIT II:

Basics of BJT biasing & stability factor, JFET & MOSFET biasing, MOSFET as an amplifier and as a switch, LF and HF model, small signal operation of MOS amplifiers. 7 L

UNIT III:

MOS: MOS fundamentals, MOS capacitor, surface space charge region, accumulation, depletion and inversion, Flatband and threshold voltages, MOS capacitor on n-sub, electrostatic characteristic of MOS, Device physics of MOS, drain current and channel charge, gradual channel approximation, strong and moderate Inversion, Body bias effects. 10L

UNIT IV:

Concept, properties, positive and negative feed back, loop gain, open loop gain, feed back factors, topologies of feed back amplifier, effect of feed back on gain, output impedance, input impedance, sensitivities (qualitative), BW, Stability, effect of positive feed back: instability and condition for oscillation, Barkhausen criteria, general form of oscillator, configuration, loop gain, Wien- bridge oscillators, introduction to phase shift oscillators and crystal oscillators. 8L

UNIT V:

Silicon Controlled Rectifier (SCR): constructional features, physical operation, characteristics, applications, Uni-Junction Transistors (UJT): Physical operation, Characteristics and simple applications, Concept of TRIAC, DIAC, Insulated Gate Bipolar Transistor (IGBT) and GTO. 6L

Text Books:

- Millman&Halkias, Integrated Electronics, TMH 2/e. 2009.
- Millman&Grabel, MGH Micro-Electronics
- Neamen, Semiconductor Physics &devices TMH 4/e 2012
- Chattopadhyay, Rakshit, Saha&Purkait, 2/e -Foundation of Electronics 2015.

References:

- Prof. Manis Mukherjee, Foundation Of Electronics Devices And Circuits, EPH 1/e, 2010.
- Kasap, Principles of Electronic Materials &devices TMH 3/e 2007
- Malvino, Principle of Electronics, TMH 7/e, 2006.

Network Analysis and synthesis: 16EE303

Credits: 4 (3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I
Two port parameters: Z, Y, ABCD and h parameters, their interrelationships, series, parallel and cascade connection of two ports.
Graph of Network: Network Graph concept, oriented graph, incidence matrix, incidence matrix, loop, tie-set, tree and its properties, co-tree, tie-set matrix, cut-set, cut-set matrix, duality. 10L

UNIT II
Transient Response: Initial conditions in zero-input response of RC, RL and RLC networks. Definitions of unit step and ramp functions. Zero State Response with impulse and step inputs.
Complete response of circuits with initial conditions and forcing functions such as step, exponential and Sinusoidal functions. 10L

UNIT III
Laplace Transform: Impulse, step and sinusoidal response of RL, RC, LC and RLC circuits, waveform synthesis, Transient analysis of different electrical circuits with and without initial conditions, Application of Laplace Transform for circuit analysis. 10L

UNIT IV
Fourier series: Fourier series representation of periodic functions using both trigonometric and exponential functions. Symmetry conditions, Fourier transform representation of aperiodic signals, System function and its application in determining steady, state response. 10L

UNIT V
Network Synthesis: Hurwitz polynomials and their properties, Positive Real functions and their properties, Synthesis of reactive network (one port) by Foster method, pole, zero interpretations of elements of Foster form, Cauer form of reactive networks, RL network synthesis by Foster and Cauer form of representation, RC network systems by Foster and Cauer method. 8L

Text Books:

- M.R. Van Valkenburg, 'Network Analysis', Prentice Hall of India, 3rd Edition, 2014.
- W.H.Hayt, J.E.Kimmerly, 'Engineering Circuit Analysis', McGrawHill,6th Edition, 2000
- N.C. Jagan& C. Lakshminarayana, 'Network Analysis and Synthesis', 2/e B.S. Publications 2003.

References Books:

- M.R. Van Valkenburg, 'Introduction to Modern Network Synthesis',1/e Wiley, New York, 1984.
- Charles K. Aleximder&MatthewN.O.Sadiku, 'Fundamental of Electric Circuits',1/e, Tata MCGraw, Hill, 2009.

- Gopal G Bhise, Prem R Chadha&Durgesh, C. Kulshreshtha, 'Engineering Network Analysis & Filter Design', Umesh Publications, 2009.

Data Structure & Object oriented Programming: 16**CE304**

Credits: 3(2L, 1T)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Abstract Data Types (ADT); List – array-based implementation, linked list implementation, doubly-linked lists; applications of lists – Stack, Queue, circular queue implementation; Applications of stacks and queues. Tree – tree traversal techniques – Pre-Order, In-Order and Post-Order; Representation of trees – Array, Linked-list, leftmost child, right sibling representations; Binary Tree – Prefix, Infix and Postfix notations; binary search tree; 7L

UNIT II:
Definitions – Directed and Undirected Graphs; Graph search – Depth First Search, Breadth First Dearch; Shortest Path Algorithms; Minimum Spanning Tree; Applications of graphs. Internal sorting methods; Simple Sorting Schemes – Bubble, Insertion, Selection; Quicksort; Heapsort; Binsort; Running time of a program – Big Oh, Omega, theta notation; Analysis of sorting algorithms – Best case, worst case, average case; 8L

UNIT III:
Introduction of object oriented programming (OOP), applications of OOP, Characteristics of OOP, Features of OOP, Advantage of OOP; Classes & Objects, member functions, Inline functions, arrays within a class, memory allocation for objects, arrays of objects, Constructor, destructor, copy constructor. Polymorphism – Compile type, Runtime Polymorphism, static and Dynamic binding, Function overloading, operator overloading; Abstract class and Interface. Inheritance and its types with examples. 8L

UNIT IV:
Virtual Functions, pointers to objects, pure virtual functions and its implementation in program, Managing I/O operations, I/O streams, File handling with OOP, Error handling in file operations, random file access, Exception handling methods, throwing mechanism, catching mechanism, strings characteristics and uses. 8L

UNIT V:
Java Programming: Packages, Interfaces, String Handling, Multithreaded programming, Applet Programming, Managing Input/output 5L

Text Book:

- Aho, J.E. Hopcroft, and J.D.Ullman, 'Data Structures and Algorithm', 1/e Pearson Education, 1982
- YashavantKanetkar, 'Data Structures through C', 2nd Edition, BPB Publications, 2008.
- Ken Arnold, James Gosling, David Holmes "The Java Programming Language",3/e Pearson, 2008.

- Herbert Schildt, T"he complete Reference C++", 4th edition, McGraw Hill Education (India) edition, 2003

References Books:

- R. F. Gilberg, B. A. Forouzan, 'Data Structures: A Pseudocode approach with C', 2nd Edition, Thomson India Edition, 2005.
- Sara Baase and A. Van Gelder, 'Computer Algorithms', 3rd Edition, Pearson Education, 2000.
- E. Balagurusamy, "Programming with Java – A primer", 4th Edition, TMG, 2010.
- Y. Kanetkar, "Let us C++", 2nd Edition, BPB Publications, 2002

Data Structure & Object oriented Programming Laboratory: 16**CE392**

Credits: 2 (3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution :30- practical, 10- viva-voce, 10- report/record book)

List of Practicals:

1. Finding sum, average, maximum and maximum in an integer array.
2. Searching and insertion of element in integer array.
3. Implementation of different sorting techniques in integer array.
4. Program to implement constructor, copy constructor and function overloading
5. Program to implement inheritance and polymorphism
6. Construction of Graph using 2-D array for directed and undirected, weighted and unweighted graphs.
7. Construction of binary tree using linked list ADT.
8. Implementation of Depth First Search in binary tree.
9. Implementation of Breadth First Search in binary tree.
10. Preorder, Inorder and Postorder Tree Traversal technique.
11. Conversion of infix to postfix expression and evaluation of postfix expression.
12. Program to implement Java Applet Program and Multithreaded program in Java

Digital Design Laboratory: 16**EC391**

Credits: 2(3P)
Total Hours: 36
Full Marks: 50 (Sessional: 25 Marks, End Semester Examination: 25 Marks)
(Mark distribution : 15- practical, 5- viva-voce, 5- report/record book)

List of Experiments:

1. Design & Realization of basic gates using Universal logic gates
2. Design & Realization a circuit from 4-bit BCD code to Excess-3 code & vice-versa
3. Design & Realization of a simple Decoder Circuit
4. Design & Realization Multiplexer and De-Multiplexer circuits
5. Design & Realization of BCD to 7- Segment Decoder
6. Design & Realization of Half Adder & Full Adder circuits using Universal logic gates
7. Design & Realization of Half Subtractor& Full Subtractor circuits using Universal logic gates
8. Design & Realization of 4-bit parity generator & comparator circuits
9. Design & Realization of RS & JK flip-flops using Universal logic gates
10. Design & Realization of D & T flip-flops using Universal logic gates
11. Design & Realization of Asynchronous & Synchronous Up/Down counter
12. Design & Realization of Ring counter & Johnson's counter
13. Design & Realization of a Shift Register circuit
14. Design & Realization of a Digital to Analog Converter
15. Design & Realization of an Analog to Digital Converter.

Electronics Devices and Circuits Laboratory: 16**EC392**

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution: 30- practical, 10- viva-voce, 10- report/record book)

List of Experiments:

1. Study of fixed base bias BJT circuit and determination of operating point.
2. Study of collector to base bias BJT circuit and determination of operating point.
3. Study of Emitter resistance bias BJT circuit and determination of operating point.
4. Study of self-bias circuit bias BJT circuit and determination of operating point.
5. Study of V-I characteristics of Field Effect Transistors.
6. Study of voltage divider bias circuit bias FET circuit and determination of operating point.
7. Study of feedback circuit.
8. Study of Wien bridge oscillator.
9. Study of RC phase shift Oscillator Circuit.
10. Study of LC oscillator circuit.
11. Study the operation of special devices (SCR, UJT, TRIAC, DIAC and IGBT).

Numerical Analysis: 16AM402

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I
Solution of algebraic and transcendental equations using method of ordinary iteration, RegulaFalsi and Newton Rapson's method, Simple examples, Interpolation and applications, finite difference, Divided differences, Newton ,Gregory and Lagrange's interpolation formulae, Numerical differentiation. 8L

UNIT II
Trapezoidal rule, Simpson's one third and three eighth rule, numerical evaluation of Fourier coefficient, diff. equations with constant coefficient & their solution. 10L

UNIT III
Numerical solution of initial value problems in ordinary differential equations by Taylor series method, Picard's method, Euler's method, Modified Euler's method, RungeKutta second and fourth order method, Millne's Predictor and Corrector method. 10L

UNIT IV
Jacobi, Gauss,Seidal and relaxation methods, Solution of tridiagonal systems, Eigen values and eigenvectors of matrices and elementary properties, computation of largest Eigen value by power method. 10L

UNIT V
Finite difference methods, Derivation from Taylor's polynomial, Accuracy and order, Parabolic, Elliptic and Hyperbolic equations.Dirichlet, Neumann and Mixed problems. Heat equation: Explicit method, Implicit method, Crank,Nicolson schemes, Stability and convergence analysis, Introduction to FEM. 10L

Text Books:

1. S. S. Sastry, 'Introductory Methods of Numerical Analysis', Ed. 2, PHI, 2009.
2. B.S. Grewal, 'Higher Engineering Mathematics', KhannaPublication , 2010..
3. Joe D. Hoffman, 'Numerical methods for Engineers and Scientists', McGraw Hill, 1993.
4. G. D. Smith, 'Numerical solutions to Partial Differential Equations', Brunel University, Clarendon Press, Oxford, 1985.

References:

1. Erwin Kreyszig, 'Advanced Engineering Mathematics',Wiley India Pvt Ltd, 2010.
2. K.W. Morton and D.F. Mayers, 'Numerical Solution of Partial Differential Equations-An Introduction', Cambridge University Press, 2005.

Microprocessors & Microcontrollers: 16EC401

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Evolution of microprocessors & microcontrollers, Important features &Applications.RISC& CISC CPU Architectures, Harvard & Von-Neumann CPU architecture

Intel 8085 μP Block Diagram, Pin Description, Generation of Control Signals, De-multiplexing of Address / Data Bus, Bus Buffering. Introduction to Instruction sets & Programming technique. 10L

UNIT II:
Intel 8085 Instruction sets: Data Transfer, Arithmetic and Logic-operation, Branching, Stack and subroutines, Input and Output. Programming.

Addressing modes and Timing process.

The Address Map, Address Decoding Techniques, Memory Interfacing. IO Interfacing: Design of I/O Ports using MSI and PPI, Keyboard and Display Interfacing, DAC and ADC Interfacing Technique. 10L

UNIT III:
Intel 8085 Serial communication using 8251: Synchronous & Asynchronous transfer, Serial communication. Interrupt Driven data transfer, DMA Transfer & DMA controller.
8085 interrupts: Classification, Hardware & Software Interrupts, Enabling& Masking Interrupts. Device Polling. 8L

UNIT IV:
Intel 8086 architecture, Memory Segmentation, Read/Write cycle in Min/Max mode. Different states & operations, Pipelining and Co-processing, Addressing modes and Introduction to Instruction sets & Programming technique, Basic of Bus Interface: Peripheral component interconnect (PCI), Bus and Parallel printer interface (LPT). 10L

UNIT V:
Intel 8051 microcontroller: Important features & Architectural block. Memory organization and External memory interfacing.Instruction syntax and Introduction to Programming, Basic of I/O concepts & Interfacings.Introduction to PIC microcontroller. 10L

Text Books:

- Ramesh S. Gaonkar, Microprocessor architecture, programming and applications with 8085/8085A, Wiley eastern Ltd. 2/e 1989
- B.Ram, Fundamental of Microprocessor and Microcomputers, DhanpatRai&Sons 4/e 2010
- The 8051 Microcontroller and Embedded Systems – using assembly and C - Muhammad Ali Mazidi and Janice Gillespie Mazidi, Pearson 2/e 2007
- Microcomputer systems-The 8086 / 8088 Family – Y.C. Liu andG. A. Gibson, 2E PHI -2003
- The Intel Microprocessor, Architecture, Programming and Interfacing-Barry B. Brey,

6/e PHI, 2003

References:

- Intel Corp: The 8085 / 8085A. Microprocessor Book - Intel marketing communication, Wiley inter science publications. 1987
- Adam Osborne and J. Kane, An introduction to micro computers Vol. 2 - some real Microprocessor, Galgotia Book Source, New Delhi 1976
- Ray and Bhurchandi, Advanced Microprocessors, TMH 2/e
- Intel Corp. Micro Controller Handbook - Intel Publications. 1984
- Douglas V. Hall, Microprocessors and Interfacing, MGH International Ed. 2/e 1990
- Alan R. Miller, Assembly Language Programming the IBM PC, Subex Inc. 1987
- The 8051 Microcontroller Architecture, Programming & Applications", Kenneth J. Ayala ;, Penram International,2/e 1996

Analog Circuits & Systems: 16**EC402**

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Small Signal analysis of JFET, E-MOSFET and BJT, Hybrid Model of BJT, Single Stage and Cascade amplifiers, Difference amplifier, R-C and transformer-coupled amplifier, Darlington pair, Direct coupled amplifiers, LF & HF models of BJT and MOSFET. 8L

UNIT II:
Classification of amplifier: class A, class B, class C and class AB operations, Genaral consideration of Power and Efficiency, Operation of basic push-pull stage, Emitter follower as power amplifier, Amplifier distortion and heat sink. IC power amplifiers.Brief discussion of Noise in electronic Devices. 6L

UNIT III:
Differential Amplifiers: Advantages of differential amplifiers; MOS and BJT differential pair; Small signal and large signal operation of differential pairs; Parameters and non-ideal characteristics of differential amplifiers; differential amplifier with active load frequency response, constant current bias, current mirror, cascaded differential amplifier stages, level translator. Op-amp and its applications. 8L

UNIT IV:
Multivibrators: Astable, monostable and bistable circuits, detailed analysis and design with discrete components. Uses of multivibrators, Designs with ICs (NE-555 timer, op-amp) and logic gates. 6L

UNIT V:
Regulated power supply: Working principles of regulated power supply, simple zener shunt regulator, transistor series regulators, simple and fold back current limiting, line and load regulation, three terminal regulator ICs, LM78XX, LM79XX, IC-723, LM317, LM337 adjustable power supply design, basic principles of buck and boost switching regulators. 8L

Text Books:

• Millman&Halkias, Integrated Electronics, Tata McGraw Hill. 2001
• Franco, Design with Operational Amplifiers & Analog Integrated Circuits, 3/e,TMH
• Gayakwad R.A, OpAmps and Linear IC's, PHI 4/e 2004
• Coughlin and Drisscol, Operational Amplifier and Linear IC – Pearson Education. 6/e 2000
• Sudhakar, Circuits &Networks:Analysis& Synthesis, TMGH 4/e 2010

References:

• Malvino, Electronic Principles , 6/e ,TMH
• Millman&Taub, Pulse, Digital & switching waveforms- TMH 2/e 2007
• Horowitz & Hill, The Art of Electronics; Cambridge University Press. 3/e 2015
• Hayes & Horowitz, Student Manual for The Analog Elect.; Cambridge Univ. Press. 3/e
• Boyle'stead&Nashelsky, Electronic Devices & Circuit theory, PHI. 6/e 2000
• Millman&Halkias, Basic Electronic Principles; TMH. 1984
• Tobey &Grame, Operational Amplifier: Design and Applications, MGH 1971
• TusharJadhav, Linear Integrated Circuits, Everest Publishing House 2006

Signals and Systems: 16**EC403**

Credits: 3 (3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark: {28 (Term test) + 8 (Assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:

Introduction to signals, Example of different standard signals, Signal types: continuous and discrete time signals, analog and digital signals, Periodic & non-periodic signals, even & odd signals, energy and power signals, causal & non causal signals, deterministic and random signals. Mathematical operations on signals. 6 L

UNIT II:

Introduction to systems, classification of systems: static and dynamic system, linear and non linear system, causal and non causal system, time variant and time invariant system, stable and unstable system, IIR and FIR system, recursive and non recursive system. Continuous time and discrete time linear time-invariant (LTI) systems, impulse and step response of LTI system, response to arbitrary inputs, Linear convolution, interconnections, response of LTI systems in time domain. 8L

UNIT III:

Laplace Transform, properties and theorems of Laplace Transform, Region of convergence and its properties, Poles and zeros, Inverse Laplace transform, analysis of LTI continuous system using Laplace transform, Convolution and deconvolution using Laplace transform, Stability in s-domain. 8L

UNIT IV:

Fourier Transformation of continuous and discrete time signals and their properties, analysis of LTI continuous and discrete time system using Fourier transform, relation between Fourier and Laplace transform, Power spectral density function, autocorrelation and cross correlation function, relationship between PSD function and the auto correlation function. 8L

UNIT V:

Z-transform and Inverse z-transforms, relation between s–plane and z–plane, properties of Z-transform, Region of convergence and its properties, poles and zeros in z-plane, relation between Z-transform and Fourier transform, analysis of LTI system using Z-transform. 6L

Text Books:

- A.V.Opponheim, A.S.Willsky and Nawab, Signals and Systems,PHI. 2/e 1996
- J.G.Proakis&D.G.Manolakis- Digital Signal Processing Principles, Algorithms and Applications, PHI. 4/e 2006
- Robert A. Grabel and Richard A.Roberts, Signals and Linear System, John Willey and Sons.2/e 2009
- A Nagoorkani, Signals and Systems, McGraw Hill 2010

Reference Books:

- B.P. Lathi, Principles of Linear Systems and Signals (2nd Edition),Oxford University Press
- P.RameshBabu - Signals and Systems 4/e- Scitech
- Salivahanan, Digital Signal Processing 2Ed, TMH
- AnandKumar,Signal and Systems, PHI 2011
- S Ghosh- Signals and Systems- Pearson 2002
- I. J.Nagrath, S.N. Saran, R.Ranjan and S. Kumar, Signals and Systems, TMH 2006

Analog Communication: 16**EC404**

Credits: 3 (3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Analog communication system, chronology of developments, prospects and trends, modulation: types and reasons, elements of analog communication system: transmitters, transmission channels and receivers, merits and demerits. 6L

UNIT II:
AM: introduction, time domain expression and modulation index, frequency domain (spectral) representations, transmission bandwidth for AM, AM for a single tone message, phasor diagram of an AM signal, illustration of the carrier and side band components, transmission requirements for AM, normalized power and side band power, DSB modulation: time and frequency domain expressions, transmission requirements for DSB , bandwidth and transmission power for DSB, methods of generating AM and DSB: square law modulators, balanced modulators, ring modulators, SSB: generation of SSB using a side band filter, indirect generation of SSB, representation of SSB signals, transmission requirements for SSB, transmission bandwidth and power, side band filter examples, VSB, demodulation of AM signals: square law and envelope detectors, the superheterodyne receiver for standard AM radio. 12L

UNIT III:
Instantaneous frequency, instantaneous phase, time domain representation for FM and PM, phasor diagram, FM and PM signals for a single tone message, the modulation index, spectral representation of FM and PM for a single tone message, Bessel's functions, generation of FM using Armstrong method and VCO, commercial FM requirements, the limiter discriminator, and demodulation of FM using PLL, commercial FM radio and stereo FM radio. 7L

UNIT IV:
Pulse Analog Modulation, Practical Sampling, Introduction to different type of multiplexing, Frequency Division & Time Division Multiplexing. 7L

UNIT V:
Noise in Continuous wave Modulation: Noise in AM System, Noise in FM System 4L

Text Books:
- Taub& Schilling, Principle of Communication System, Tata McGraw Hill.4/e 2013
- B.P.Lathi, Modern Digital &Analog Comm. System,Oxford University press.3/e 1998
- Taub& Schilling, Principles of Communication Systems, 2nd ed., MGH.
- P. Chakrabarti, Analog Communication Systems, DhanpatRai& Co. 2005

References:
- Dungan, Electronics Communication System, Vikas. 1987
- Zeimer&Tarnter, Principles of Communication, Jaico. 5/e 2001
- RP Singh, Communication Systems: Analog& Digital, TMH.2/e 2009

Electromagnetic Theory: 16EC405

Credits: 3 (3L)
Total hrs: 36

Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:

Review of EM waves, Vector relation in rectangular, cylindrical, spherical coordinate system. Concept and physical interpretations of gradient, divergence and curl, Gauss divergence theorem and Stroke theorems. 4L

UNIT II:

Electric field intensity and flux density, Gauss's Law, Electric field due to various charge configurations (using Gauss law), Vector potential and retarded vector potential, Posisson's and Laplace's equation and their solution.

4L

UNIT III:

Faraday's law & Lenz's law. Displacement Current, J_c - J_D Relation, Maxwell's equations, Time-harmonic fields, Wave Equation, Boundary Conditions between media interface; Uniform Plane wave; Plane Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Good Conductor, Free space; Poynting Theorem, Power flow, Poynting vector, Skin Depth, Surface Resistance; Reflection and Transmission for normal and oblique incidence.

11L

UNIT IV:

Transmission Lines; Concept of Lumped parameters and Distributed parameters. Line Parameters, Transmission line equations and solutions, Physical significance of the solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart -Applications; Load Matching Techniques / Quarter wave Matching, Bandwidth problem; Low loss RF transmission lines, line as circuit elements.

11L

UNIT V:

Types of transmission line (open 2-wire, coaxial line, parallel plate waveguide,micro strip coplanar waveguide), applications and limitations: Design principle, Power handling capacity. Power Dissipation, Breakdown, Concept of TE and TM wave in parallel plate waveguide (qualitative). 6L

Text Books:

• W H Hayt, J A Buck, Engineering Electromagnetics 7th Edition –Tata McGraw Hill
• M.N.O. Sadiku, Elements of Electromagnetics 4th Edition –, Oxford.
• E. Jordan and K. Balmin , Electromagnetic waves and radiating systems, 2th edition, , Prentice Hall of India, New Delhi, 2001.

References:

• C.A. Balanis, Advanced Engineering Electromagnetics, John Willy and Sons, New York.
• J.D.Kraus, Electromagnetics, 4th edition, Tata McGraw Hill, New Delhi.
• N.N. Rao, Elements of Engineering Electromagnetics, 6th Edition- PHI

Microprocessors & Microcontrollers Laboratory: 16EC491

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks) (Mark distribution :30- practical, 10- viva-voce, 10- report/record book)

List of Experiments:

Intel 8085 Microprocessor

1. Familiarization with Intel 8085 register level architecture and trainer kit. Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical).
2. Programming using Intel 8085 kit: Block of memory transfer, Strings, Addition/Subtraction of 16-bit nos. (Consider Carry) multiplication & division [8-bit & 16-bit], Comparison, etc.
3. Programming using Intel 8085 kit: Packing and unpacking of BCD numbers, generation of Fibonacci series, Binary to ASCII conversion, Flashing a character, Decimal count,etc.
4. Programming using Intel 8085 kit for String Matching and Multiplication using Booth's Algorithm.
5. Interfacing Intel 8085 with ADC and DAC
6. Interfacing Intel 8085 with Speed & Direction control of DC motor
7. Interfacing Intel 8085 with Stepper motor
8. Interfacing Intel 8085 with LED matrix card.
9. Interfacing Intel 8085 with Hex Keyboard
10. Interfacing Intel 8085 with Study card using Latch
11. Interfacing Intel 8085 with Traffic light controller

Intel 8051 Microcontroller

1. Familiarization with Intel 8051Microcontroller kit,
2. Execution of programs: Data Transfer - Block move, Exchange, sorting. Arithmetic/ Logical : Addition/ Subtraction, Bit manipulations

Analog Circuits Laboratory: 16**EC492**

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks) (Mark distribution :30- practical, 10- viva-voce, 10- report/record book

List of Experiments:

1. Design a BJT Amplifier.

2. Design of a 2-stage R-C coupled amplifier and measure its Gain and Bandwidth

3. Design the BistableMultivibrator using NE 555.

4. Design of Timer Circuits (Monostable and AstableMultivibrator Configuration) using NE 555.

5. Design of Power Amplifiers (Class A , class B & Push Pull Power amplifier).

6. Study of Op-Amp and its application (Non inverting, inverting, adder, substractor, differentiator and integrator etc.)

7. Construction of V-I & I-V Converter using Op-Amps.

8. Study of Shunt Zener Voltage regulator

9. Study of transistor series voltage regulators.

10. Study of Voltage Regulator using regulator IC's.

11. Design and analysis of Oscillators(Hartly, Clopitts& Wien bridge Oscillators)

12. Study of R-2R ladder network and 8-bit Digital to Analog Converter

Linear Integrated Circuits: 16EC501

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
The basic operational amplifier and its schematic symbol, block diagram representation of op-amp, power supply requirements of an op-amp, evolution of op-amp, Specification of a typical op-amp (μA-741C). 6 L

UNIT II:
Input offset voltage, input bias current, input offset current, total output offset voltage, thermal drift, error voltage, supply voltage rejection ration (SVRR), CMRR-Measurement of OP-AMP parameters, null offset methods, slew rate. 10 L

UNIT III:
Open loop gain of OP-AMP, the negative feedback configurations: inverting and non-inverting amplifiers, voltage followers, differential amplifiers, summing, scaling and averaging amplifiers, voltage to current and current to voltage converters, integrators and differentiators, logarithmic and antilogarithmic amplifiers. 10 L

UNIT IV:
Advantages of active filters, classification of filters, response characteristics of butter worth, first order and second order butter worth filters- low pass and high pass types, Band pass and band reject filters. 10L

UNIT V:
Basic comparator and its characteristics, zero crossing detector, Schmitt trigger , voltage limiters, clippers and clampers, small signal half wave and full wave rectifiers, sample and hold circuit. square wave, triangular wave and saw tooth wave generators, voltage controlled oscillator. 12L

Text Books:

- Millman&Halkias, Integrated Electronics, Tata McGraw Hill. 2001
- Franco, Design with Operational Amplifiers &Analog Integrated Circuits , 3/e,TMH
- Gayakwad R.A, OpAmps and Linear IC's, PHI 4/e 2004
- Coughlin and Drisscol, Operational Amplifier and Linear IC – Pearson Education. 6/e 2000
- Millman and Halkias, Integrated Electronics: Analog and Digital circuits and system Tata McGraw Hill 2/e 2011

References:

- Malvino, Electronic Principles , 6/e ,TMH
- Millman&Taub, Pulse, Digital & switching waveforms- TMH 2/e 2007
- Horowitz & Hill, The Art of Electronics; Cambridge University Press. 3/e 2015

- Hayes & Horowitz, Student Manual for TheAnalogElectronics; Cambridge Univ. Press. 3/e
- Boylestad&Nashelsky, Electronic Devices & Circuit theory, PHI. 11/e 2012
- Millman&Halkias, Basic Electronic Principles; TMH. 1984
- TusharJadhav, Linear Integrated Circuits, Everest Publishing House 2006

Digital Signal Processing: 16**EC502**

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:

Review of signals and systems, basic concept of discrete time signals, basic idea of sampling and reconstruction of signal, limitations of analog signal processing, advantages and applications of digital signal processing, decimation and interpolation. 5L

UNIT-II

Discrete Fourier Transform: Introduction, Definition of DFT, Properties of DFT, Circular convolution, Linear Convolution using DFT. relation between DFT and Z-transform. Efficient computation of DFT: FFT algorithms, Decimation in time and Decimation in frequency. 7L

UNIT III:

Digital Filter Design-I: FIR filter, Linear phase FIR filter, Gibbs phenomenon, FIR filter design using Fourier series method, FIR filter design using window methods: Rectangular, Hamming, Hanning, Barlett, Blackman and Kaiser windows. 12L

UNIT IV:

Digital Filter Design-II: IIR Filter, frequency response of analog and digital IIR filter, design of IIR filters from analog filters, Impulse invariance transformation, bilinear transformations, design of Butterworth and Chebyshev filters. 8L

UNIT V:

Realization of FIR system: direct form, cascade form, linear phase. Realization of IIR system: direct form-I, direct form-II, cascade form and parallel form. 4L

Text Books:

- John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing, 3/e, PHI.
- S K Mitra, Digital Signal Processing, 3/e, TMH.
- P. Ramesh Babu, Digital Signal Processing, 2/e, Scitech, 13th Reprint, 2004.
- A NagoorKani, Digial Signal Processing, 2e, TMH

Reference Books:

- A V Oppenheim and R.W Schafer, Discrete-Time Signal Processing, 3/e, Pearson.
- L R Rabinar and Gold, Theory and applications of Digital Signal Processing, PHI. 1975
- S. Salivahanan, A. Vallavaraj and C. Gnanapriya, Digital Signal Processing, TMH, 19th reprint.
- TarunKumarRawat," Digital Signal Processing", OUP 2010

Digital Communication: 16EC503

Credits: 4 (3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Digital Communication System, Chronology of developments, Prospects and trends, Elements of Digital communication system Transmitters, transmission channels and receivers, Merits and demerits. 8L

UNIT II:
Analog-to-Digital Conversation: Sampling, Quantizing, Quantization error, Encoding, Non-uniform quantization, A-Law Compandor, PCM, DPCM, DM, ADM. 10L

UNIT III:
Transmission Line Codes, Differential encoding, PSD of digital signals (viz. UP, P, BP, SP, HDB3, DB), Inter Symbol Interference: Nyquist's Laws, Spectrum shaping, Optimum pulse shape, Full cosine roll-off, Duo binary. 10L

UNIT IV:
BPSK, DPSK, BFSK, MARY-PSK & -FSK, QPSK, Error calculation, synchronous, envelope/non-coherent schemes and performance evaluation (BER, SNR, BW) for various schemes. 10L

UNIT V:
Bit error probability, Decoding errors, Error threshold, Regenerative Repeaters, Error performance, Parity check, Hamming distance, ARQ and FEC systems, Cyclic codes & Convolutional codes, Viterbi Algorithm. . 10L

Text Books:

- Taub& Schilling, Principle of Communication System, Tata McGraw Hill. 4/e 2013
- B.P.Lathi, Modern Digital &Analog Comm. System, Oxford University press. 3/e
- Simon Haykin, Communication System, John Wiley & Sons, 4/e 2013
- L.W. Couch II, Modern Communication System, Prentice Hall India. 8/e 2013
- Taub& Schilling, Principles of Communication Systems, 2nd ed., MGH.
- Carlson, Communication System, 4/e ,TMH

References:

- J.G. Proakis, Digital Communications, McGraw Hill. 5/e 2007
- J.Das, S.K.Mullick, P.K.Chatterjee, Principle of Digital Comm., Wiley Eastern Ltd 1986.
- Roden, Analog& Digital Communication Systems, 5/e, SPD
- Dungan,Electronics Communication System, Vikas 1987
- Zeimer&Tarnter, Principles of Communication, Jaico. 5/e 2001
- Rekha, Digital Communications, Scitech 2009
- RP Singh, Communication Systems: Analog& Digital, TMH 2/e 2009

Antenna Engineering: 16**EC504**

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Antenna fundamentals, Basic antenna parameters, radiation patterns, beamwidth, Beam effeiency, gain, directivity, aperture concepts, field zones, wave polarization. 6L

UNIT II:
Point sources, Source with Hemispheric, Unidirectional Cosine, Bidirectional Cosine, sine (Doughnut), sine square, unidirectional Cosine Power patterns, array of two isotropic point sources, Non-isotropic similar and dissimilar point sources. Principle of pattern multiplications, Linear Array of n isotropic point sources, Null Directions for n isotropic point sources. 9L

UNIT III :
Short Electric Dipole, Radiation resistance and fields of Short Electric Dipole, and thin linear antennas, Radiation resistance and fields of thin linear antennas, Concepts of loop antenna, short magnetic dipole equivalence to a loop, different types of loop Small, circular, square loops. 8L

UNIT IV:
Introduction to Helical, Slot, Horn Antennas, spiral and log periodic and Microstrip antennas. 9 L

UNIT V:
Antenna Measurements: Pattern, Phase, Directivity, gain, Terminal Impedance measurements and Ploarization measurements etc. 4L

Text Books:
- J.D Kraus, R. J. Marhefka and A. Khan, Antennas and Wave Propagation, McGraw Hill, 4th edition,2010
- Jordan E.C. &Balmain K.G, Electromagnetic Waves & Radiating systems, PHI. 2/e 1995
- C.A Balanis, Antenna theory: Analysis and design, , John Wiley and Sons, New York,1982

References:
- Kennedy G, Electronic Comm. Systems, 4th ed., MGH Book Co.
- J.D Kraus, Electromagnetic with Applications, McGraw Hill, 5th Ed
- R.S Elliot, Antenna Theory and Design, , John Wiley and Sons.2002

- R.Garg, P.Bhartia,I.Bhal,A.Ittipiboon., Micrstrip antenna Design Handbook, Artech House, London 2001.

Control Systems: 16EE503

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I

Fundamentals of Control system: Basic Definitions-Linear, Nonlinear, Time Invariant and Time Variant, Continuous and discrete control systems, Classification of control systems, open loop and close loop control systems, Effects of feedback.

Mathematical Model of Physical Systems: Introduction, Differential equation representation of physical systems, Transfer function concepts, Block diagram algebra and Signal flow graphs. 9L

UNIT II

Control System Components: Potentiometer, AC & DC techo-generators, AC & DC servomotors, amplidyne, synchro transmitter, synchro control transformer, synchro as a error detector and remote position control. 8L

UNIT III

Time Response Analysis: Introduction, Standard test signals, Performance indices, Time response of first and second order systems, steady state error and their minimization, error coefficients, P, PI and P,I,D type controllers.

Stability Analysis in Time Domain: The concept of stability, Assessment of stability from pole positions, Necessary conditions for stability, Routh Stability Criterion, Relative stability analysis. 12L

UNIT IV

Root Locus Technique: Introduction, The root locus concept, Root locus construction rules, Root contours, Case studies.

Frequency Response Analysis: Introduction, Performance indices, Frequency response of second order systems, Polar plots, Bode plots, All pass systems, Minimum-phase and Non-minimum, phase systems, Illustrative examples. 12L

UNIT V

Stability Analysis in Frequency Domain: Introduction, A brief review of Principle of Argument, Nyquist stability criterion, Assessment of relative stability Gain Margin and Phase Margin, Closed loop frequency response, Illustrative examples. 7L

Text Books:

1. I.J. Nagrath, M. Gopal, 'Control System Engineering', new Age International (P) Limited publishers, 2010.
2. J. F. Franklin and J.D. Powell, 'Digital Control of Dynamic Systems', Addison Wesley, 1980.

References books:

1. M. Gopal, 'Control System Principles and Design', Tata McGraw Hill, 2nd edition, 2008.
2. K. Ogata, 'Modern Control Systems', 3rd Edition, PHI, 2002.

Digital Signal Processing Laboratory: 16EC591

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution: 25- practical, 10- viva-voce, 5- report/record book)

List of Experiments (Simulation Laboratory with standard simulator)

1. Generation, sampling, different arithmetic operation of signals.
2. Convolution of two signals or sequences.
3. Laplace Transform and Inverse Laplace Transform of different signals.
4. Fourier Transform and Inverse Fourier Transform of different signals.
5. Z-Transform and Inverse Z-Transform of different signals.
6. Pole & zero plot in Z-domain.
7. DFT and IDFT of any sequence.
8. Circular Convolution using DFT.
9. Design of digital FIR filter using Fourier Series method.
10. Design of digital FIR filters using Rectangular window method.
11. Design of digital FIR filters using Blackman window method.
12. Design of digital FIR filters using Hamming window method.
13. Design of digital FIR filters using Hanning window method.
14. Design of different digital Butterworth filters.
15. Design of different digital Chebyshev filters.
16. Mapping of DSP algorithm onto FPGA.

Communication Laboratory: 16EC592

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution : 30- practical, 10- viva-voce, 10- report/record book)

List of Experiments:

1. Realization of Amplitude Modulation (AM) & Demodulation techniques.
2. Realization of DSB-SC Modulation & Demodulation technique.
3. Realization of SSB-SC Modulation & Demodulation technique.
4. Realization of Frequency Modulation (FM) & Demodulation techniques.
5. Realization of Phase Modulation (PM) & Demodulation techniques.
6. Realization of PAM and Demodulation techniques.
7. Realization of PCM transmitter and receiver Circuit.
8. Realization of Delta Modulator & Demodulator Circuit.
9. Realization of Time Division Multiplexing (TDM) & De-multiplexing.
10. Realization of ASK modulator and demodulator technique, connected by either physical or simulated channel.
11. Realization of PSK modulator and demodulator technique, connected by either physical or simulated channel
12. Realization of FSK modulator and demodulator technique, connected by either physical or simulated channel

Antenna Engineering Laboratory: 16**EC593**

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution :30- practical, 10- viva-voce, 10- report/record book)

List of Experiments:

1. Study of Radiation pattern and Measurement of Gain & Bandwidth of a simple dipole antenna.
2. Study of Radiation pattern and Measurement of Gain & Bandwidth of a folded dipole antenna.(Single elements)
3. Study of Radiation pattern and Measurement of Gain & Bandwidth of a helical antenna.
4. Study of Radiation pattern and Measurement of Gain & Bandwidth of a YagiUda antenna.
5. Study of Radiation pattern and Measurement of Gain & Bandwidth of a log periodic antenna.
6. Study of Radiation pattern and Measurement of Gain & Bandwidth of a Horn antenna.
7. Study of reciprocity theorem.
8. Measurement of currents at different parts of antenna by current censor.
9. Study of Radiation pattern and Measurement of Gain & Bandwidth of a folded dipole antenna (3- elements)
10. Study of Radiation pattern and Measurement of Gain & Bandwidth of a folded dipole antenna (5- elements).
11. Study of Radiation pattern and Measurement of Gain & Bandwidth of a simple dipole antenna (3- elements)
12. Study of Radiation pattern and Measurement of Gain & Bandwidth of a simple dipole antenna (5- elements)

Microwave Engineering: 16**EC601**

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction: Microwave frequencies, systems and measurements. Electron motionin EM field. Microwave Transmission lines(Brief discussion)-Transmission line Equations and Solutions, Reflection and transmission Co-efficient, Standing waves and SWR,Line impedance and Admittance, Impedance matching using Smith chart. 9L

UNIT II:
Microwave wave guides-Detailed study of Rectangular and Circular Wave guides.TE,TM propagation, Microwave components-rectangular, Circular and Semi Circular cavity resonators., S parameters. Wave guide Tees, E-plane, H-Plane, E-H Plane, Directional Couplers, Circulators and Isolators, Hybrid couplers. 9L

UNIT III:
Microwave Sources-Klystrons, Reflex klystrons, Slow wave structures, TWTs, BWO, Magnetrons, Gyrotron. ` 6L

UNIT IV:
Microwave solid state devices-Transistors, Tunnel Diodes, FETs, Gunn LSA diodes.Avalanche transit time devices- IMPATT, TRAPATT, and BARITT Diodes.Parametricdevices.Introduction to MMIC. 9L

UNIT V:
Microwave measurements VSWR, power, frequency. Industrial Applications of microwave. 3L

Textbooks:
- David M Pozar, Microwave Engineering, John Willy & Sons, Inc. 4/e 2012
- Peter A. Rizzi, Microwave Engineering – Passive Circuits, Prentice Hall of India 1988

References:
- M L Sisodia, Microwave Active Devices:Vacuum and SolidState, New Age Int. Pub. 2006
- S Y. Liao, Microwave Devices and Circuits, Pearson Education/PHI. 3/e 2003
- M.N.O Sadiku, Elements of Electromagnetism, Oxford 3/e 2005
- K. C. Gupta, Microwaves, New Age Int. Publication 1979

VLSI Design: 16EC602

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction, Review of MOSFET characteristics (C-V and I-V), Body effect, Channel Length Modulation, Scaling and Small-geometry effects, MOSFET capacitances, MOS current source, current mirror circuits, MOS voltage source. 6 L

UNIT II:
MOS inverters, CMOS inverter, state characteristics, switching characteristics, power dissipation issues. CMOS logic gates: NAND, NOR, XOR, CMOS logic design of Half and Full adders, Comparator, Dynamic Logic Circuits, Pass transistor logic, CMOS transmission gates, pseudo-nMOS, domino logic gates, Sequential MOS Logic Circuits: The SR latch circuit, clocked latch and flip-flop, CMOS D-latch, Schmitt trigger circuit. 9L

UNIT III:
Switches: Ideal Voltage Controlled Switches, Bipolar Transistor as a Switch, MOS Transistor as a Switch, Common Source Amplifier, Differential Amplifier, Two stage CMOS operational amplifier (OPAMP) design, Cascade OPAMP. 8L

UNIT IV:
Design Methodologies, Full Custom, Standard Cells and Gate Arrays, basics of PAL and PLA, Programmable Logic Devices (PLD), CPLD and FPGA. 6L

UNIT V:
SPICE: Element lines, Control lines, Command lines, Types of analysis, Models and model parameters, Programming Examples (NAND, NOR, XOR, Half Adders). Layout: Layout design rules, Layout of inverters, NAND, NOR gates.
VHDL: VHDL Syntax, Basic concepts in VHDL, Structural specification, VHDL description of Inverter, NAND gate, NOR gate, Half adder, Full adder, Multiplexer, Decoder. 9L

Text Books:
- J.M. Rabaey, Digital Integrated Circuits, PHI 1995
- K. Eshraghian, D. A. Pucknell and S. Eshraghian, "Essential of VLSI Circuits and Systems", PHI Publication 2005
- Geiger, Allen &Strader, VLSI Design Tech. for Analog& Digital Circuits, MGH. 1990
- J. Bhaskar, VHDL Primer. Prentice Hall 3/e 2010

References:
- P. P. Sahu, "VLSI Design", McGraw Hill Publication. 2013
- Ken Martin, Digital Integrated Circuit Design, OUP 1999
- S.M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits, TMH 4/e 2014
- Baker, Li and Boyce, CMOS Circuit Design, Layout and Simulation, PHI 3/e 2010

Wireless and Mobile Communication: 16**EC603**

Credits: 3 (3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT-I
Wireless local area network (LAN), applications, requirements, technology – Infrared (IR) wireless LAN, diffuse, quasi-diffuse and point-to-point IR wireless LAN, Narrowband Microwave LAN, Bluetooth: architecture and application, Wireless local loop (WLL): configuration, advantages and its propagation characteristics. 7L

UNIT-II
Limitations of conventional mobile system, mobile cellular communication: introduction, concept of frequency reuse, cluster size, cellular system architecture: mobile station, base station, mobile switching centre, description of mobile radio environment: introduction to radio wave propagation, concepts of free space propagation model, comparison of first generation(1G) second generation (2G) and third generation (3G) wireless cellular mobile radio networks. 8L

UNIT-III
Global System for Mobile (GSM): services and features, system architecture, GSM radio interface, protocols, GSM channel types, location updating and call setup, handover, General packet radio service (GPRS). 9L

UNIT-IV
Spread Spectrum Communication: definition, types, pseudo-random sequences, direct sequence spread spectrum (DS-SS), frequency hopping spread spectrum (FH-SS), Introduction to Code Division Multiple Access (CDMA), digital cellular standard, comparison between GSM and CDMA. 7L

UNIT-V
Satellite mobile communication**:** GEO, MEO, LEO system, routing, localization and handover, Global positioning system: basic principles of position fixing with GPS, GPS application. 5L

Text Book:

- JochenSchiller,MobileCommnications,Pearson Education. 2/e 2003
- William C.Y.Lee, Mobile cellular telecommunications: analog& digital systems, MGH 1995
- KamiloFeher,Wireless Digital Communications,PHI. 1995
- Stallings,Wireless Communication & Networks, Pearson Education.8/e 2006
- Pratt,Bostian,Allnutt,SatelliteCommuniation,Wiley. 2/e 2003

Reference Book:

- Theodore S. Rappaport, Wireless communications: principles and practice, Pearson. 2009
- Aggarwal, Introduction to Wireless & Mobile Systems,Vikas 3/e 2011
- D. C. Agarwal, Satellite communication, Khanna publishers 2010
- Santamaria et al, Wireless LAN systems, Artech House
- Talukder&RoopaYavagal, Mobile Computing. TMH 2/e 2010
- Black U D, Data Communication and Distributed Networks, PHI9/e 2010
- Comer, Computer Networks and Internets, PH Int.6/e 2003
- Tanenbaum, Computer Networks, PHI.5/e 2010

Computer Networks: 16**EC604**

Credits: 3(3L)
Total Hours: 36

Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:

Introduction to computer network, connection types (point-to-point, multipoint), direction of data flow (simplex, half-duplex, full-duplex), categories of network (LAN, MAN, WAN), topology (mesh, star, bus, ring, tree), reference models (OSI, TCP/IP), comparison of OSI and TCP reference model. 5L

UNIT II:

Physical Layer: Overview of data (analog& digital), signal (analog& digital), digital data transmission, transmission media (guided & unguided), basic of MODEM, circuit switching, packet switching, message switching, internetworking devices(repeater, bridge, hub, switch, router).

Data Link Layer: services provided to the data link layer: framing, error detection & correction method, flow control (stop-and –wait ARQ, go-n-back ARQ, selective-repeat ARQ, sliding window protocol), Access control(ALOHA, CSMA, CSMA/CD, CSMA/CA). 10L

UNIT III:

Network Layer: Design issue, IPv4 addressing, subnetting, routing algorithms (flooding, Distance Vector Routing, Link State Routing, Broadcast Routing, Multicast Routing), ARP, ICMP, internetworking devices (repeater, bridge, hub, switch, router). 9L

UNIT IV:

Transport layer: Transport layer services, elements of transport protocols, UDP, TCP service model, protocol, segment header, connection management, transmission policy, congestion control, timer management. 6L

UNIT V:

Application Layer: Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW. ISDN, ATM. 6L

Text Books:

- B. A. Forouzan – "Data Communications and Networking" – TMH 5/e 2012
- S. Tanenbaum – "Computer Networks " – Pearson Education/PHI 5/e 2010
- W. Stallings – "Data and Computer Communications" – PHI/ Pearson Education 8/e 2006
- Black- Data & Computer Communication, PHI 9/e 2010
- Comer – "Internetworking with TCP/IP" – Pearson Education/PHI 6/e 2003

References:

- Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education 6/e 2012
- Leon, Garica, Widjaja – "Communication Networks" – TMH 2003
- Walrand – "Communication Networks" – TMH. 2010
- Zheng&Akhtar, Network for Computer Scientists & Engineers, OUP 2001
- Miller, data Communication & Network, Vikas 2004
- Miller, Digital & Data Communication, Jaico 2005
- Shay, Understanding Data Communication & Network, Vikas 3/e 2003

Measurements and Instrumentation: 16EE605

Credits: 3 (3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x12(Marks)} = 60.

UNIT I
Principles of Measurement and Instrumentation: Objectives of measurements, analog versus digital measurements, accuracy, precision and uncertainty, sources of measurement error. Standard cell and standard resistance. Basic characteristics of measuring instruments with a moving element.
Instruments: Ammeter, Voltmeter. Expression for torque of moving coil, moving iron, dynamometer, induction and electrostatic instruments. Extension of range of instruments wattmeter, torque expression for dynamometer instruments. Reactive power measurement. 8L

UNIT II
Energy meters, single phase and poly phase, Driving torque and braking torque equations. Errors and testing compensation, maximum demand indicator, power factor meters, frequency meters, electrical resonance and Weston type of synchoroscope. 6L

UNIT III
Bridge methods: measurement of inductance, capacitance and resistance using Bridge. Maxwell's Anderson, Wein, HeavesideCambell'sDesauty's, Schering's bridges, Kelvin's doublebridge, price guard wire bridge, loss of charge method, megger, wagnersEarthing device. 8L

UNIT IV
Magnetic measurements: Ballistic Galvanometer, calibration by Hibbert's magnetic standard flux meter, Lloyd,fischer square for measuring iron loss, testing of ring and bar specimens. Determination of B,H curve and hysteresis loop using CRO, Determination of leakage factor. 6L

UNIT V
Potentiometers and Instrument Transformers: Crompton's DC and AC polar and coordinate type. Applications, Measurement of impedance. Calibration of ammeter, voltmeter and wattmeter. Use of Oscilloscope in frequency, phase and amplitude measurements. Instrument transformers. Ratio and phase angle errors and their reduction. 8L

Text books:

1. A.K. Sawhney, 'A course in Electrical and Electronics Measurements and Instruments', DhanpatRai and Sons, Delhi, 2005.
2. UmeshSinha, 'Electrical and Electronics Measurements and Instruments', SatyaPrakashan', 2011.

References books:

1. F.W. Golding and Widdis, 'Electrical and Electronics Measurements and Instruments', Edition, 2011.
2. John D. Turner, Martyn Hill,' Instrumentation for Engineers and Scientists', Oxford,2009

Computer Architecture & Organization: 16EC605

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction, Functional Units, Introduction to Logic Gates, Boolean algebra, Map Simplification, Combinational Circuits, Half-adder, Full-adder. Integrated Circuits, Decoders, Multiplexers, Registers. Memory Unit-RAM, ROM, Types of ROMs. Basic Computer Organization and design: Instruction Codes, Computer Registers, Computer Instructions, Timing & Control, Instruction Cycle, Memory-Reference Instructions, Concept of Interrupt. 10L

UNIT II:
Machine Language, Assembly Language, Assembler, Program Loops, Subroutines. Control Unit: Micro-operations, Microinstruction Format , Control of the processor, Hardwired Implementation. 8L

UNIT III:
Introduction, Number Systems, Complements, Fixed Point Representation, Floating Point Number Representation, Addition, Subtraction, Multiplication and Division of Numbers in different types of Representation. 6L

UNIT IV:
General Register Organization, Stack Organization, Instruction Formats. Addressing Modes, RISC. Input/ Output: Peripheral Devices. Necessity of Interfacing.Asynchronours function of I/0 and I/O bus, Modes of I/O Transfer. 6L

UNIT V:
Introduction, Memory Hierarchy, Main Memory, Auxiliary Memory, Cache Memory, Virtual, Memory,Memory Management Hardware.M.J.Flynn's Classification of Computer Systems, Parallel Processing, Pipelining, Arithmetic Pipelining. 6L

Text Books:

- Mano, M.M., Computer System Architecture, Prentice Hall of India, 1983.
- Hayes, Computer Architecture and Organization, McGraw Hill International Edition. 3/e 1998
- William Stallings, Computer Organization & Architecture, PHI 10/e 2015

References:

- Langholz, G., Grancioni, J., and Kandel, A.L., Elements of Computer Organization, Prentice Hall International, 1988.
- Assembler, Manual for the Chosen Machine.
- Gear, C. W., Computer Organization and Programming, McGraw Hill, 1975.
- Tanenbaum, A.S., Structured Computer Organization, Prentice Hall of India. 6/e 2012
- Dr.Madhulika Jain, VineetaPillai&Satish Jain, Computer Organization and Architecrure. BPB 2003

Microwave Engineering Laboratory: 16EC691

Credits: 2(3P)
Total Hours: 36

Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution : 30- practical, 10- viva-voce, 10- report/record book)

List of Experiments:

1. Familiarization of Microwave Test Bench and microwave components.
2. Study of VI characteristics of Gunn Diode.
3. Study of Klystron characteristics
4. Measurement of unknown frequency by direct frequency meter.
5. Measurement of unknown frequency by indirect frequency meter
6. Study of E plane Tee.
7. Study of H-plane Tee.
8. Study of Magic (E-H) Plane Tee.
9. Study of Circulator
10. Study of Directional Coupler
11. Study of Phase shifter
12. Measurement of reflection coefficient and SWR using slotted line.
13. Measurement of radiation pattern of Horn antenna.
14. Measurement of dielectric constant using Waveguide Test Bench (WTB).

VLSI Laboratory: 16EC692

Credits: 2(3P)
Total Hours: 36
Full Marks: 100 (Sessional: 50 Marks, End Semester Examination: 50 Marks)
(Mark distribution : 30- practical, 10- viva-voce, 10- report/record book)

List of Experiments:

1. Design basic Logic Gates Using VHDL / Verilog HDL.
2. Design Universal Logic Gates Using VHDL / Verilog HDL.
3. Design XOR and XNOR gates Using VHDL / Verilog HDL.
4. Design the Half Adder and Full Adder circuit Using VHDL / Verilog HDL.
5. Design the Half Subtractor and Full Subtractor circuit Using VHDL / Verilog HDL.
6. Design 16:1 Multiplexer using VHDL / Verilog HDL.
7. Design :1:16 De-Multiplexer using VHDL / Verilog HDL.
8. Design 2 bit Comparator using VHDL / Verilog HDL.
9. Design 8:3 Encoder using VHDL / Verilog HDL.
10. Design 3:8 Decoder using VHDL / Verilog HDL.
11. Design the D Flip-Flop and T Flip-Flop circuit Using VHDL / Verilog HDL.
12. Design a 4-bit counter using VHDL / Verilog HDL.
13. Design and Simulate CMOS NAND gate using SPICE
14. Design and Simulate CMOS NOR gate using SPICE
15. Design and Simulate CMOS XOR gate using SPICE
16. Design and Simulate CMOS XNOR gate using SPICE

Optical Fiber Communication: 16EC701

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction to optical fiber communication and systems: principles and operation, advantages and disadvantages of fiber communication, chronology of developments, prospects and trends, elements of optical communication system: transmitters, transmission channels and receivers, merits and demerits. 10L

UNIT II:
Optical Fibers–Core and cladding, total internal reflection, calculation of numerical aperture and acceptance angle, meridional and skew rays, step index-fiber, graded index fiber, V-number, single mode fiber operation, transmission requirements of optical fibers: attenuation , material absorption, linear and Rayleigh scattering. 10L

UNIT III:
Optical sources: light emitting diodes LEDs: structure, band structure requirement, typical construction, characteristics and parameters, circuits, homojunction and heterojunction LED: edge-emitting and surface emitting, output and modulation characteristics, quantum efficiencies Semiconductor Lasers: principle of operation, the Einstein relations, population inversion, optical feedback and laser oscillation, the rate equations, efficiency, it's characteristics and structures, heterojunction laser, strip geometry, injection laser characteristics and coupling to fibers. 10L

UNIT IV:
Optical detectors: photodiode, performance and compatibility requirements, device types, optical detection principles, quantum efficiency, the p-i-n photodiode, speed of response, noises in a photodiode, avalanche photodiode: structure, benefits and drawbacks, multiplication factor. 10L

UNIT V:
Multiplexing strategies: wavelength division multiplexing WDM: Principle of operation, devices, Schemes, examples, other high data rate handling schemes, elements of solitons. 8L

Text Books:

- John. Senior, Optical fiber communications: principles and practice, PHI. 3/e 2008
- Walker, Optical Engineering Fundamentals, PHI. 2/e 2009
- Gerd Keiser, Optical fiber communications, McGraw Hill, 3rd edition

References:

- Mynbaev&Scheiner, Fiber optic communication technology, Pearson. 1/e 2000
- R. P. Khare, Fiber optic and optoelectronics, Oxford University press. 2004

- John Gowar, Optical Communication Systems, PHI. 1993
- Selverajan, Kar&Srinivas, Optical fiber comm.: principle & system, TMH.2003

Microelectronics and IC Technology: 16**EC702**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Basic Considerations in Microelectronics, Discrete circuits vis-à-vis Microelectronics, Classification of different types of Integrated Circuits, General outline of hybrid integrated circuits based on thin and thick film technology, Semiconductor monolithic circuits based on bipolar, MOS and CMOS technology, Advantages and disadvantages of different types of IC's, Structure-based classification of IC's -SSI, MSI, LSI, VLSI and ULSI. Introduction to BJT & MOSFET fabrication steps. 8L

UNIT II:
Crystal Growth, Wafer preparation, Methods of PN junction formation (melt growth junctions, alloying, solid state diffusion, ion implantation). Introduction to epitaxial growth: LPE, VPE, MBE; Growth and deposition of dielectric layers: Thermal oxidation, CVD, plasma CVD, sputtering. 12L

UNIT III:
Planar technology, masking, lithography and etching, pattern definition, metal deposition technique. Design considerations in respect of the isolation between components; Polarity dependence, high temperature dependence, poor tolerance of the components, Poor dissipation capability, cost, Yield and Reliability: Failure mechanisms and yield loss. 10L

UNIT IV:
Basic considerations and design approach using bipolar and MOS technology, Realization of passive components, restrictive components and building blocks, Realization of different active structures. MOS integration; Different steps, MOS gates, CMOS inverter process, Silicon on Sapphire device, non volatile memory devices. 12L

UNIT V:
Introduction to Bi-CMOS inverter, VLSI interconnects. 6L

Text Books:

- S.M.Sze, VLSI Technology, TMH 1983
- W. Wolf, "Modern VLSI Design", (3/e), Pearson,2002.
- Plummer, "Silicon VLSI Technology-Fundamentals Practice and Modeling",Pearson.1/e 2000
- Campbell, Microelectronics Science &Engg. Fabrication, Oxford University Press. 2/e 2001

References:

- DeMicheli, Synthesis & Optimization of Digital Circuits, TMH 1994
- E. S. Young, Microelectronics Devices, McGraw Hill International, New York 1998
- S.K. Ghandhi, VLSI Fabrication Principles, John Wiley & Sons 2/e 1994

Digital Design using HDL: 16EC703

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction, Design Methodologies: Top-Down, Bottom-Up, Basic of HDL, Conbinational Circuit Design Approaches, Sequential Circuit Design Approaches. 8L

UNIT II:
Hardware Modeling Issues, Brief overview of VHDL, VHDL Capabilities, Basic Terminology, Entity, Architecture body: BehavioralModeling, Data Flow Modeling, Structural Modeling, Mixed Modeling, Configuration, package body and package declaration, Subprograms and overloading, Functions, Procedures and Declarations, Operator Overloading. 12L

UNIT III:
Identifiers, Data Objects, Data Types: Subtypes, Scalar Types, Composite Types, Acess Types, Incomplete Types, File Types, Operators: Logical Operators, Relational Operators, Adding Operators, Multiplying Operators, Miscellaneous Operators. 8L

UNIT IV:
Brief overview of Verilog HDL, Register Transfer Level, Control/Data Partitioning, Elements of Verilog, Hardware Modules, Primitive Instantiations, Assign Statements, Conditional Expressions, Procedural Blocks, Module Instantiations, Component Description in Verilog, Basic of Module, Wires and Variables, Verilog Operators, Verilog Data Types, Verilog Simulation Model and Basic Examples. 12L

UNIT V:
Programmable aspects of Gate Arrays, CAD for Gate Arrays-Circuit and Logic Simulation, Testing, Test Generation, Placement and Routing, Silicon on Insulator (SOI), GaAs on Si, Information about XLINIX and ACTEL Gate Arrays. 8L

Text Books:

- J. Bhaskar, A VHDL Primer, AT & T ,1999
- Z. Navabi, Verilog Digitral System Design, TMH. 2/e 2005

References:

- M. Sarrafzadeh and C.K. Wong, An Introduction to VLSI Physical Design, MGH. 1996
- Sait&Youssef, VLSI Physical Design Automation: Theory and Practice, World Scientific Publication Company 1995.
- A. B. Kahng and G. Robins, Kluwer, On Optimal Interconnections for VLSI, Academic Publishers, Boston, MA, 1995.

Elective-I & Elective-II

Information Theory and Coding: 16**EC704**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT-I
Information Theory: Concept of information, uncertainty, average information, entropy and its properties, Conditional entropy, Joint Entropy, Information rate, Discrete Memory less Channel (DMC), Lossless channel, Binary Symmetric channel, Noiseless channel, Mutual information. 8L

UNIT-II
Channel coding theorem: source coding theorem, channel capacity theorem, Shannon Hartley theorem, Kraft's inequality, Shannon-Fano coding, Huffman coding. 9L

UNIT-III
Introduction to error control coding, **Linear Block Code**: matrix description of linear block codes, generator matrix, parity check matrix, Hamming code, syndrome decoding, error correction using syndrome decoding. **Cyclic Code:** Definition, polynomials, binary cyclic code properties, generator and parity check matrix of cyclic codes, systematic form of generator matrix, encoders for cyclic codes, decoders for cyclic codes. 14L

UNIT-IV
Linear algebra, Galois Field (GF), primitive field elements, minimal polynomials, solution of equation in Galois Field. **BCH codes:** Description, Decoding BCH codes, Implementation of error correction, Error detection of Binary BCH codes. 9L

UNIT-V
Convolution codes: Convolution encoder representation (connection representation, state diagram, tree diagram, trellis diagram), Encoding, Distance properties, Maximum likelihood decoding of convolution codes, Viterbi algorithm, Viterbi decoding of convolution codes. 8L

Text Books:

- S. Haykin , Communication System, Wiley India. 5/e 2005
- H. Taub and D.L.Schilling, Principles of Communication Systems, TMH .1971
- Gravano: An Introduction to Error control codes, OUP 1/e 2001

- Shu Lin & Costello, Jr. D.J., Error Control Coding: Fundamentals and Applications, PHI. 2/e 2007
- Digital Communications B. Sklar and P.K.Ray, Digital Communication Fundamentals and Applications, Pearson 2009
- Ranjan Bose, Information theory Coding and Cryptography, TMH.2008

References:

- Jorge Castiñeira Moreira & Patrick Guy Farrell, Essentials of Error-Control Coding, Wiley 2006.
- Jones, Information & Coding Theory, Springer 2000
- Wells, Applied Coding and Information Theory –Pearson 1/e 1998

Multimedia Communication: 16**EC705**

Credits: 4(3L, 1T)
Total Hours: 48

Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction of Multimedia, multimedia tools, Audio & Video Response of Human Organs, Fundamentals of multimedia, Digital Audio: Audio synthesis, FM synthesis, Digital signal processing. 8L

UNIT II:
Digital video: Fundamentals of picture frame and interlacing, RGB Color representation, VGA and SVGA standards, display devices-CRT, LCD, Plasma Panel display, Comparison, Mixing video and graphics, Digital Video Camera, Zooming. 10L

UNIT III:
Digital Video Compression: Compression Models, Lossy Compression, Lossless Compression, JPEG and Motion JPEG, MPEG 1, MPEG 2, MPEG 4, Compression Standards. 10L

UNIT IV:
CD Technology: CD production, CD formats, Recording and playback techniques, Comparison, CD standards, DVD technology, DVD writing technology, Difference with CD. 10L

UNIT V:
Multimedia transmission: Issues, Properties of Multimedia data, Transmission time, quality maintenance, Noise reduction, transmission techniques: ISDN, ISDB, OFDM, COFDM. 10L

Text Books:
- Banerji, Multimedia Technologies, Tata Mc.Graw Hill, 2014.
- Gonzalez& Woods, Digital Image Processing, Pearson Education. 3/e 2007

References:
- Rogers & Adams, The mathematical element of Computer Graphics, MGH. 2/e 1998
- Parekh, Principle of Multimedia, Tata Mc.Graw Hill, 2014.

Nano Devices: 16**EC706**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Nanotechnology and nanomaterials; Brief history, Comparison of dimensions of small scale materials, Applications in Electronics, Chemical, mechanical and other branches of science and engineering. 8L

UNIT II:
Basic FET structure, Operation, Drain current-drain voltage characteristics, Effect of gate voltage and drain voltage on mobility, Short channel effect, Hot electron effect, Gate tunneling, DIBL and GIDL, Sub-threshold; Scaling, Quantum effects, Power dissipation issues, Simulation tools. 8L

UNIT III:
Quantized motion of electrons in narrow potential wells: basic concepts and length scales, Quantum Wells, Wires and Dots, E-k diagrams and density-of-states function, Modulation doping, Transport in low dimensional systems: mobility enhancement, conductance quantization, resonant tunneling; Quantum Hall effect. 12L

UNIT IV:
High electron mobility transistors, resonant tunneling diodes and transistors, Applications in high frequency electronics, Single Electron Transistors: operation and applications. SOI devices. 10L

UNIT V:
Absorption and recombination in Wells, Wires and Dots, Excitons, Effect of electric field, Intersubb, absorption and emission. Introduction toCarbon Nanotubes. Basic structure, chirality, Metallic and Semiconducting Nanotubes, Transport and mobility, CNT FETs, Other applications. 10L

Text Books:
- Klimov Victor, Semiconductor & Metal Nano crystal. CRC Press 1/e 2003
- Lonescu& Banerjee, Emerging Nano Electronics: Life with after CMOS. Springer 2005
- Waser Rainer, Nanoelectronics and IT.Wiley 3/e 2012

References:
- Polushkin V, Nuclear Electronics. Wiley 1/e 2004

Artificial Intelligence: 16EC707

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Artificial Intelligence (AI) Basics, AI Techniques, AI Problems, Problem space, production systems, Heuristics Search techniques-Hill climbing, BFS, DFS, Problem Reduction, Water-Jug Problem, Hill Climbing Problem, AND-OR Graph, Heuristic Function, Estimate of Heuristic Function, A*, AO* algorithm. 10L

UNIT II:
Statements, Connectives, Well-formed formulas, Conjunctive Normal form, disjunctive normal form, Inference rules: simplification, modus ponens, modus tollens, Predicate logic, prepositional logic, universal and existential quantifiers, conceptual dependency graph. 10L

UNIT III:
Monotonic reasoning, Non-monotonic reasoning, examples, properties, uses, Common-sense reasoning and its properties, Bayesian Networks, Dempster-Shafer Theory. 8L

UNIT IV:
Representing and Using Domain Knowledge, Expert systems shells, Explanation, Knowledge acquisition, Example-MYCIN, Properties of MYCIN. 10L

UNIT V:
Game Playing, techniques, Mini-max search procedure, Natural Language and its links with AI, Speech Synthesis and its recognition, Syntactic and semantic analysis with AI, Bio-medical application of AI in context of Fuzzy Sets, Image Processing with AI (only relational study). 10L

Text Books:
- Rich&Knight, Artificial Intelligence, TMH. 2/e 1990
- Peterson, Artificial Intelligence. PHI 1999

References:
- Vidyasagar, Intelligent Robotics Systems, TMH. 1998
- Simon, The sciences of the Artificial Systems, MIT Press. 3/e 1996

Neural Networks: 16EC708

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Fundamentals of Artificial Neural Network (ANN), Biological prototype, Neural Network Concepts, Definitions – Activation, Functions single layer and multiplayer networks, Training ANN's, perceptrons, Exclusive OR problem, Linear seperability, storage efficiency, perceptron learning - perceptron training algorithms, Hebbian learning rule - Delta rule, Kohonen learning law problem with the perceptron training algorithm.
10L

UNIT II:
The back propagation Neural network, Architecture of the back propagation, Network Training algorithm, network configurations, Back propagation error surfaces, Back propagation learning laws, Network paralysis _ Local minima, temporal instability. 8L

UNIT III:
Counter propagation, Networks Architecture of the counter propagation network, Kohonen layer, Training the Kohonen layer preprocessing the input vectors initializing, the weight vectors Statistical properties, Training the Grossberg layer- Feed forward counter propagation, Neural Networks Applications. 10L

UNIT IV:
Statistical methods simulated annealing, Bloltzman Training, Cauchy training –artificial specific heat methods, Application to general non-linear optimization problems, back propagation and Cauchy training. 10L

UNIT V:
Hopfield net stability, Associative memory, statistical Hopfield networks, Applications ART NETWORKS GENETIC ALGORITHMS, Bidirectional Associative memories-retrieving stored information, Encoding the association, continuous BAMS. 10L

Text Books:
- Li Min Fu, Neural Network in Computer Intelligence , McGrawHill 1994
- Philip D.Wasserman, Neural Computing(Theory and Practice)Coriolis Group1/e 1998

References:
- Robert Hecht-Nilson, Neuro Computing.Meta Publications; Limited 1/e 1998
- James A.Anderson, An Introduction to Neural Networks.A Bradford Book 1995
- Jacek M. Zurada, Introduction to Artificial Neural Systems. West Group 1/e 1992

Remote Sensing: 16**EC709**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Transmission of Solar Radiation through Atmosphere: Solar radiation spectrum, Radio infrared & optical windows of earth's atmosphere, Spectrum of solar radiation, Emissions from disturbed sun. Reflection, Absorption and Emission from Earth and Atmosphere: Variation of earth's reflectivity, wavelength and geographical location, Seasonal variation of reflectivity, Solar radiation reflected from earth. Thermal radiation from the earth, Thermal radiation from the atmospheric constituents, Thermal emission from cloud, rain, snow and fog, Radio noise and interference at satellite heights. 10L

UNIT II:
Sensors and Cameras: Optical and infrared detectors and filters, Optical and infrared cameras, Microwave and Millimetre wave radiometers, Scanning systems, Mechanical and Electronic Systems; Scatter meter, Altimeter. 8L

UNIT III:
Remote Sensing Satellites: Orbits of remote sensing satellites, Remote sensing satellites – LANDSAT, Indian Remote Sensing (IRS) Satellites, INSAT, NOAA Series, NASA's Upper Atmosphere Research Satellites (UARS), TRMM satellite. 10L

UNIT IV:
Remote Sensing of Atmosphere and Sea State: Passive and active remote sensing, Side Looking Airborne Radar (SLAR)), Synthetic Aperture Radar (SAR), Along Track Scanning Radiometer (ATSR), Laboratory measurements of remote sensing parameters, Tropical rainfall measurements, Microwave sensing of sea surface. 10L

UNIT V:
Interpretation of Sensing Data: Photo-interpretation, image processing and pattern recognition, Spectral interpretation of remote sensing imagery, Interpretation of thermal maps, Colour coding and enhancement, Image interpretation. Brief overview of GIS. 10L

Text Books:

- Forsyth, Computer Vision- A modern Approach, Prentice Hall. 2/e 2011
- Mann, Scott, Wireless Application protocol. Wiley 1/e 2007

References:

- Singhal, Wireless Application protocol: Writing application for Mobile Internet.Addison Wesley Longman 1/e 2011
- Gonzalez, Digital Image Processing. Pearson 3/e 2007

Radar Engineering: 16**EC710**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Rader fundamentals, Range equation, Different types of radar and its working principle. 4L

UNIT II:
Radar transmitters - High power transmitting devices, Receivers - Special design considerations, low noise receivers, Antennas, mechanical and electronic scanning of beam, Indicators and Display, Solid-State Radar - present trend. 8L

UNIT III:
Detection probability for a pulse Doppler radar, Factors affecting angular resolution, Effect of Propagational Factors on the Performance of Radar Systems: Atmospheric attenuation and refraction of radar waves, Attenuation, Back scatter and Doppler effects, Confusion of radar systems by Chaff. 12L

UNIT IV:
Wavelength and polarization dependence of complex targets, Control of radar cross section (RCS), RCS reduction, Body shaping, Radar absorbing materials (RAM), Resonant and broad band RAM, Impedance loading, Enhancement of RCS by multiple scattered, dielectric lenses, Retrodirective arrays and impedance loading. 10L

UNIT V:
General considerations, Requirements in angle tracking, Angle tracking system organization, Rate and position errors of tracking loop, Tracking loop mechanization, Range and velocity tracking, Signal Processing and Waveform Design: Matched filter processing, Radar ambiguity function for sophisticated waveforms, Choice of waveforms in different environmental conditions, Optimum waveform for detection in clutter, Desirability of range-Doppler ambiguity, Special techniques for optical signal processing, digital signal processing, Radar measurement accuracy. Applications of radar. 14L

Text Books:

- Peyton Z.PeeblesJr.,Radar principles , John Wiley 2004.
- Babu R, Digital Signal Processing , Scitech. 6/e 2014

References:

- Tri T. Ha, Digital Satellite Communication, McGraw Hill. 2/e 1990
- William Lee, Mobile Cellular Telecommunication, MGH 3/e 2005

Robotics: 16**EC711**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction to cognitive science and perception, problem representation through heuristics, problem reduction, basic heuristic search procedures; Knowledge representation and knowledge engineering. 10L

UNIT II:
Dimensions of Object, Color differentiation, Gray level images, color Images, Length estimations, Automated visual inspection, Object recognition & matching. 10L

UNIT III:
Stereo geometry & correspondence, Motion analysis, Optical flow, Robot arm, Robot sensing, Speech Recognition. 10L

UNIT IV:
Imaging, recognition captured imagery, stereoscopy of images, Application of computer vision**,** Bio-medical imaging**,** Document processing, OCR. 10L

UNIT V:
Inference engines and expert systems; Programming languages for AI; Feedback control and robot manipulation, robot learning. 8L

Text Books:
- Rich & Knight, Artificial Intelligence.McGraw-Hill 2/e 1990
- Gonzalez, Digital Image Processing. Pearson 3/e 2007

References:
- Jain, Machine Vision, MGH.1/e 1995
- Forsyth, Computer Vision- A modern Approach, Prentice Hall. 2/e 2011

Power Electronics: 16**EC712**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction, Power Diodes: Rectifiers, Single phase and three phase; Effect of Inductive elements; Controlled rectifiers (SCR, Triac); Triggering Devices (UJT, Diac); Three phase converters; Effect of ac side inductance; Power FETs; VMOS; High power devices on SiC and other materials. Thyristers. 14L

UNIT II:
Thyristor Gating circuits; Gate pulse amplifier; dv/dt triggering; snubber circuit; Commutation circuit; Jones chopper. 7L

UNIT III:
DC-DC switch mode converters; Buck Boost, Buck-boost converter; Continuous and discontinuous mode operations; Full-bridge DC-DC converter; PWM bipolar and unipolar switching; Switch-mode DC-DC inverter; Three phase inverter using thyristors; Resonant converters; Switch-mode power supplies and their control; UPS; Flyback converter; Forward converter; Half-bridge converter; Full-bridge converter. 14L

UNIT IV:
Speed control of DC motor; Two quadrant and four quadrant and chopper; Dual converter; Control of induction motor; Regenerative braking. 7L

UNIT V:
Cycloconverter: Cycloconverter variable frequency speed control system; Cycloconverter circuits. 6L

Text Books:

- Krein, Elements of Power Electronics, OUP 2/e 2014
- Mohan, Undeland& Robbins, Power Electronics(Converters, App. & Design), JW 3/e 2002
- Jacob, Power Electronics, Vikas 2001
- M H Rashid, Power Electronics (Circuits, Devices & Applications), Pearson. 4/e 2014

References:

- M D Singh & K B Khanchandani, Power Electronics, TMH 1998
- B.K. Bose, Modern Power Electronics, Jaico 2001
- P C Sen, Modern Power Electronics, Wheeler Publishing1999
- Dr. P.C. Sen, Power Electronics, S.Chand 2005
- S N Biswas, Industrial Electronics, DhanpatRai& Co. 4/e 2003
- S K Bhattacharya &S Chatterjee, Industrial Electronics & Control, TMH 2006

Principles and Practice of Management: 16BM801

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I

Management: Concept, Nature, Importance; Management Vs. Administration, Management Skills, Levels of Management, Characteristics of Quality Managers. History of management Thoughts, Theories & Approaches to Management. Business Ethics and Social Responsibility: Concept, Shift to Ethics, Tools of Ethics. 6L

UNIT II

Planning: Nature, Scope, Objectives and Significance of Planning, Types of Planning, Process of Planning, Barriers to Effective Planning, Planning Premises and Forecasting, Decision Making.
Organizing: Concept, Organization Theories, forms of Organizational Structure.
Combining Jobs: Departmentation, Span of Control, Delegation of Authority, Authority & Responsibility, Organizational Design. 9L

UNIT III

Staffing: Concept, System Approach, manpower Planning, Job Design, Recruitment & Selection, Training & Development, Performance Appraisal
Directing: Concept, Direction and Supervision
Motivation: Concept, Motivation and performance, Theories of Motivation, Approaches for improving Motivation, Pay and Job Performance, Quality of Work Life, Morale Building. 9L

UNIT IV

Leadership: The Core of Leadership: Influence, Functions of Leaders, Leadership Style
Communication: Communication Process, Importance of Communication, Communication Channels, Barriers to Communication. 6L

UNIT V

Controlling; Concept, Types of Control, Pre requisite of Control. The Quality Concept Factors affecting Quality, Developing a Quality Control System, Total Quality Control.
Change and Development: Model for managing Change, Forces for Change, Need for Change, Alternative Change Techniques. 6L

Text Book:

1. Prasad, L.M., 'Principles & Practices of Management'6/e, Sultan Chand Publication, New Delhi, 2001.
2. Gupta, C.B. 'Modern Business Organization'. Mayer Paper Books, New Delhi, 2002.

Reference Books:

1. Stoner, Freeman & Gilbert Jr, 'Management'6/e, Prentice Hall of India,1995.
2. Koontz, 'Principles of Management '1/e, Tata McGraw Hill, 2008.
3. Robbins & Coulter, 'Management'8/e, Prentice Hall of India, 2010.
4. Robbins S.P. and Decenzo David A., 'Fundamentals of Management: Essential Concept and Application'5/e, Pearson Education,2010.
5. Hillier Frederick S. and Hiller Mark S., 'Introduction to Management Science: A Modeling and Case Studies Approach with Spreadsheets'2/e, Tata McGraw Hill ,2008.
6. Weihirch Heinz and Koontz Harold, 'Management: A Global and Entrepreneurial Perspective'12/e, McGraw Hill, 2008.

ELECTIVE 3 & ELECTIVE 4

Satellite Communication: 16EC801

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

1. **Introduction:** Original satellite communication, History, Current State, Overview of Satellite System Engineering; Communications Satellites, Orbiting satellites, Frequencies and bands, satellite multiple access formats. 10L

2. **Satellite Channel:** Power flow, polarization, Atmospheric losses, Receiver noise, CNR, satellite link analysis for uplinks and downlinks.6L

3. **Satellite Transponder:** Transponder model, Satellite signal processing RF-RF translation, IF demodulation. 6L

4. **Multiple Access Techniques:** Frequency division multiple access, amplification with multiple FDMA carriers, AM/FM Conversion with FDMA, switched FDMA, synchronization, SS-time division multiple access, code division multiple access, DS CDMA, frequency-hopped, CDMA. 10L
5. **Satellite link design:** Performance requirements and standards. Design of satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite- based personal communication. 8L
6. Earth station design. Configuration. Antenna and tracking systems. Satellite broadcasting. 6L

7. **Carrier recovery & bit timing.** 2L

Text Books:

- D.Roddy, Satellite Communication (3/e), McGraw- Hill, 2001.
- Satellite Communications by T. Pratt and W. Boston,John Wiley & Sons, 2004.
- B.N.Agrawal, Design of Geosynchrons Spacecraft, Prentice- Hall,1986

Reference Books

- Satellite Communications by Gagliardi 2/e 1991
- Satellite Communications system using design principles by M. Richharia 2/e 1999
- Digital Satellite Communications by T. T. Ha,McGraw Hill, U. S. A., 2004
- Principles of Communication Satellite by G. D. Gordon, W. L. Morgan,John Wiley & Sons, U. S. A., 2005

Embedded System Design: 16**EC802**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction to Real Time Embedded Systems: Embedded Systems Components, Memory, Digital Signal Processors, General Purpose Processors, Embedded Processors and Memory-Interfacing. 8L

UNIT II:
Embedded Systems I/O: Interfacing bus, Protocols, Timers, Interrupts, DMA,USB and IrDA, AD and DA Converters, Analog Interfacing. 8L

UNIT III:
Design of Embedded Processors: Field Programmable Gate Arrays and Applications, Introduction to Hardware Description Languages. 8L

UNIT IV:
Embedded Communications: Serial, Parallel, Network, Wireless Communication. 8L

UNIT V:
Embedded System Software and Software Engineering issues: Introduction to Real-Time Systems, Real-Time Task Scheduling, Concepts in Real-Time Operating Systems, Commercial Real-Time Operating Systems, Introduction to Software Engineering, Requirements Analysis and Specification, Modeling Timing Constraints, Software Design. 16L

Text Books:

- Real Time Systems, Rajib Mall, PHI, New Delhi 2006
- Embedded SystemsArchitecture- A Comprehensive Guide for Engineers and Programmers, Tammy Noergaard, Newnes, Elsevier. 2010
- Embedded Systems-Architecture, Programming and Design, Raj Kamal , TMH 2/e 2008

References:

- Prasad, Embedded Systems/Real time Systems. 2003
- An Embedded System Primer, Simon, PHI 2/2 2013
- Vahid Frank, Givargis, Tony, Embedded System Design. 1/e 2002
- Heath Steve, Embedded System Design 1997

Advanced Digital Signal Processing: 16EC803

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I :
Review: Discrete-Time Signals and Systems, Sampling, Z-transform, DFT, Filter design techniques-FIR, IIR. 4L

UNIT II:
Discrete Hilbert transforms: Real and Imaginary Part, sufficiency of the FT for causal Sequences, Sufficiency Theorems for Finite length Sequences, Relationship between Magnitude and Phase, HT Relation for complex sequences. 8 L

UNIT III:
Cepstrum analysis and HomomorphicDeconvolution : Definition of complex cepstrumHomomorphicDeconvolution, Properties of complex Logarithm, Alternative expression for complex cepstrum, The complex cepstrum of exponential sequences, Realization of the Characteristic system, Examples of Homomorphic Filtering, Application to speech processing. 12 L

UNIT IV:
Multirate DSP: The basic sample rate Alteration device Filters in sampler rate Alteration System, Multistage Design of Decimator and interpolator.Thepolyphase Decomposition, Arbitrary rate sampler rate converter, Digital filter banks, Nyquist filters, two channel quadrature mirror filter bank, L channel QMF banks, Cosine modulated L- channel filter banks, Multilevel filter bank, STFT, Wavelet transform, DCT. 10L

UNIT V:
Adaptive filters: Introduction, Examples of Adaptive filtering, The minimum mean Square Error Criterion, The windrow LMS algorithm, Recursive Least Square Algorithm, Forward and Backward Lattice method, Gradient adaptive Lattice method.Application Oriented introduction to DSP: DTMF Detection, Subband coding , Digital audio sampling rate conversion, Speech and Image Processing. 14L

Text Books:
- Emmanual C. Ifeachor et. Al., Digital Signal Processing : A Practical approach, Pearson Education, 2nd edition
- Digital Signal Processing, Algorithms and Applications 3rd edition, Proakis and Manolakis,Prentice Hall of India, New Delhi, 1999.
- Simon Haykin, Adaptive Filters,PHI. 4/e 2001

References:
- Digital Signal Processing, A Computer based Approach, 2nd edition, S.K.Mitra, Tata McGraw Hill, New Delhi, 2001.
- L.R. Rabiner and B.Gold, Theory and Application of Digital Signal Processing., PHI, 2011

Design using CAD Tools: 16EC04

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Overview of VLSI structured design approach - from circuit topology to wafer fabrication through stages of layout pattern using various CAD tools; Full and semi custom design approaches; Data and control flow in systematic structures. 8L

UNIT II:
Device Simulation - Modeling of Bipolar and MOS Transistor; Information about BIPOL: Description, Features, MINIMOS CAD tools: Description, Basic Features of MINIMOS-NT, MINIMOS 6.1 Description and Features, MINIMOS 6.1 Win. 8L

UNIT III:
ATLAS Overview, Features and Capabilities of ATLAS, ATLAS Inputs and Outputs, The ATLAS Syntax: Statements and Parameters, Defining a Structure, Specifying Mesh, Specifying Regions of Materials, Electrodes, Doping, Defining Material Parameters, Specifying Interface Properties, Solutions: DC, AC, Transient, Information about ATHENA, TSUPREM: Simulation Features, Advantages and Disadvantages.
12 L

UNIT IV:
Circuit Simulation - Linearization methods, Frequency domain analyses, Non-linear DC circuit analyses, Transient analyses of dynamic networks, Optimization and Sensitivity analyses, Automatic Design. 8L

UNIT V:
Brief overview of SPICE, SPICE Element, SPICE Unit, Model and Models Parameters, Different Analysis (DC, AC, Transient, Sensitivity, Noise), Circuit Elements, Sub Circuit, Basic Programming Examples.
10L

Text Books:
- Eshraghian, Pucknell& S. Eshraghian, Essential of VLSI Circuits and Systems, PHI. 2005
- ATLAS User's Manual, Silvaco Inc.

References:
- M. Sarrafzadeh and C.K. Wong, An Introduction to VLSI Physical Design, MGH. 1996
- Sait&Youssef, VLSI Physical Design Automation: Theory and Practice, World Scientific Publication Company. 1999

- A. B. Kahng and G. Robins, Kluwer, On Optimal Interconnections for VLSI, Academic Publishers, Boston, MA, 1995.

Opto-Electronic Devices: 16EC805

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction, radiative and non-radiative recombination processes, Einstein's relations for spontaneous and stimulated emissions and absorption, direct and indirect band-gap semiconductors, ternary and quaternary materials, heterojunctions, coherence properties of light, light as an electromagnetic radiation. 10 L

UNIT II:
Electroluminescent process, Injection efficiency, recombination efficiency, LED materials, LED construction, device configuration and efficiency, LED structures: planar, dome shaped, hetero junction, surface emitting, edge emitting LED; device performance, drive circuitry, spectral response. 10L

UNIT III:
Photoconductors, Photodiodes: p-n, p-i-n, hetero junction photodiodes, avalanche photodiodes, comparison of different photodiodes, photo transistor, liquid crystal displays, solar cells. 8 L

UNIT IV:
Operation, population inversion, gain, lasing threshold condition, semiconductor laser structures: Buried hetero structure laser, distributed feedback laser, quantum well laser; gas lasers, mode locking, Q switching, tunable semi-conductor lasers. 10L

UNIT V:
Optical fiber as waveguide, principle of ray propagation (ray theory), material and structure, meridional and skew rays, numerical aperture, step index and graded index fibers, electromagnetic wave propagation in step and graded index fibers, single mode and multimode fibers, normalized frequency, mode volume, mode field diameter, cut-off wavelength. Introduction to optical integrated devices 10 L

Text books:

- Keiser, Optical fiber communication, Tata McGraw Hill. 2013
- J. Wilson & J.F.B Hawkes, Optoelectronics – an introduction, Prentice Hall of India. 1993
- Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India 2/e 1996

References:

- Jasprit Singh, Optoelectronics – an introduction to materials and devices, MGH. 1996
- John M. Senior, Optical fiber communication, Prentice Hall of India 2/e 2014

- Prince S, Optical & Optoelectronic Devices, Scitech 2011

Cryptography: 16**EC806**

Credits: 4(3L, 1T)

Total Hours: 48

Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:

Introduction to attack, and security, principles of network security, types of attack, different security mechanisms, modular arithmetic for cryptography, Kerckhoff's Principle, traditional symmetric key cipher: substitution cipher (monoalphabetic and polyalphabetic), transposition cipher, modern symmetric key cipher: modern block cipher and modern stream cipher, use of modern block cipher (ECB, CBC, CFB, OFB, CTR). 12L

UNIT II:

The DES algorithm, Characteristics of the DES, Analysis of the DES, The modes of the DES, Future of the DES, IDEA (International Data Encryption Algorithm). 8L

UNIT III:
Asymmetric key cipher,RSAalgorithm,The Knapsack system, Message integrity with the aid of Hash functions, digital signatures, message digest, Entity authentication with symmetrical algorithm, Message authentication with a message authentication code (MAC), Message authentication with digital signatures, Fixed password, one time pass word, Zero – knowledge techniques. 12L

UNIT IV:

Key Management, General aspects of key management, Needham-Schroder protocol, Diffie-Hellman key exchange, Key distribution for asymmetrical systems, Key distribution for symmetrical algorithms, X.509. 9L

UNIT V:
Security at transport layer (Secure Socket Layer), Security at network layer (IPSec), Security at application layer (PGP, MIME), Firewalls. 7L

Text Books:

- B. A. Forouzan - Cryptography and Network Security, TMH. 2007

- William Stallings, Cryptography and Network Security Principles and practice, Pearson 6/e 2013
- AtulKahate-Cryptography and Network Security, TMH 2/e 2009

References:

- Michael. E. Whitman and Herbert J. Mattord Principles of Information Security. 4/e 2011

Digital Image Processing: 16**EC807**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Enhancement, restoration, Image analysis and reconstruction, image data compression, two dimensional systems, linear systems and shift invariance, Fourier transform, Z-transform, Block matrices and Kronecker products, Random signals. 8L

UNIT II:
Introduction, light, luminance, brightness and contrast, MTF of the visual system, visibility, function, monochrome vision models, color matching and reproduction, color vision Model, Image sampling and quantization, two dimensional sampling theory, reconstruction of images from its samples, Nyquist rate, aliasing, sampling theorem, Practical limits in sampling reconstruction, Image & visual quantization. 12L

UNIT III:
Two dimensional orthogonal and unitary transforms, properties of unitary transforms, one dimensional DFT, cosine, sine Harmrd and Haar transforms. 10L

UNIT IV:
Point operations, contrast stretching, clipping and thresholding, digital negative intensity level slicing, bit extraction, Histogram modeling, histogram equalization, modification, spatial operations, smoothing techniques, Magnificent and interpolation, Transform Operations, Color image enhancement. 12L

UNIT V:
Spatial feature extraction, transform features, Edge detection, gradient operators, compass operators, stochastic gradients, line and spot detection. 6L

Text Books:

- Jain Anil K, Fundamentals of Digital Image Processing , Prentice Hall 1998
- Gonzalez Rafel C &Wintz Paul, Digital Image Processing , Addison Wesley 1978
- Pratt William K, Digital Image Processing, John Wiley and Sons 2007

References:

- RosenfieldAzriel& K. Avinash, Digital Image Processing , Academic Press. 2/e 1982

Advanced control System: 16EC808

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I
LINEAR SYSTEM: Introduction to Optimal Control Systems, Calculus of Variations, General optimal control problem using Lagrange multiplier technique, Optimal Control Systems and Performance Indices. Problems of Optimal Control Systems.
Robust Control Systems and sensitivity. Analysis of robustness of Control Systems. Stability of systems with uncertain parameters. Design of Robust Control Systems. 10L

UNIT II
DISCRETE DATA SYSTEM: Introduction to Digital Control System, Sampling, Finite Pulse width Sampler, Sampling Spectra and Aliasing. Sampling theorem, Choice of sampling rate. Specifications and Design of Discrete data of Control System. Z,transform, Pulse transfer function. Transfer function from difference equation. Inverse Z, transform. 10L

UNIT III
Mapping of s-plane into z-plane, Transient response, characteristics of z-plane pole, locations. Damping ratio and natural frequency. Stability of z-plane pole locations. Damping ratio and natural frequency. Stability on z, Digital Compensator design in frequency domain. Lead, lag and lag-lead compensation, Single loop digital controllers. Two term (PI, PD) and three term (PID) Control Algorithm design. Implementation of Digital Controllers. 10L

UNIT IV
Solution of State Difference Equations of linear discrete control systems, Evolution of State Transition Matrix using Similarity transformation. Controllability and Observability of discrete data control system. 8L

UNIT V
Non-linear control system: the state space approach, phase plane method, Describing function analysis: Dead zone non linearity, saturation non linearity, On-Off Non linearity with dead zone, On-Off Non-linearity, Dead zone and saturation, On-Off Non-linearity with hysteresis, Relay with dead zone and hysteresis, Backlash, Stability: Liapunov's 1^{st} and 2^{nd} method. 10L

Text Books:

1. Kuo B.C. 'Automatic Control System', PHI, 2009.
2. Nagrath I J &Gopal M., 'Control Systems Engineering', New Age International Pub. 2010.
3. Ogata K., 'Modern Control Engg.' 3e, PHI, 2002.

References books:

1. Dorf R C & Bishop R.H., 'Modern Control System', Addison Wisley Publications.1999.
2. Gopal, 'Modern Control System Theory', New Age International Publications, 2000.
3. Gopal, 'Digital Control Engineering', New Age International Publications, 1988.

Open Electives:

Virtual Instrumentation: 16EC811

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Historical perspective and traditional bench-top instruments - General functional description of a digital instrument, Block diagram of a Virtual Instrument, Physical quantities and analog interfaces- Hardware and Software – User Interfaces, Advantages of Virtual Instruments over conventional instruments, Architecture of a Virtual Instruments and its relation to the operating system. 12L

UNIT II:
Definition, Pattern recognition, Criteria of success, Production Systems, Control Strategies, Heuristic Search, Problem Characteristics, Production System Characteristics, Forward and backward reasoning, Matching Indexing, Heuristic Functions, Search algorithms. 8L

UNIT III:
LabVIEW – graphical user interfaces, Controls and Indicators, 'G' programming, data types, data flow programming, Editing Debugging and Running a Virtual Instrument, Graphical programming palettes and tools, Front panel objects, Function and Libraries. 10L

UNIT IV:
FOR Loops, WHILE loops, Shift Registers, CASE structure, formula nodes, Sequence structures, Arrays and Clusters, Array operations, Bundle, Unbundle, Bundle/Unbundle by name, graphs and charts, string and file I/O, High level and Low level file I/Os – attribute nodes local and global variables. 8L

UNIT V:
Basics of DAQ Hardware and Software, Concepts of Data Acquisition and terminology – Installing Hardware, Installing drivers, Configuring the Hardware, addressing the hardware in LabVIEW, Digital and Analog I/O function, Buffered I/O, Real time Data Acquisition. Computer based instruments, Image acquisition, Motion Control. 10L

Text Books:
- Garry M. Johnson, LabVIEW Graphical Programming, Tata McGraw-Hill, Edition, 1996.
- Lisa.K.Wills, LabVIEW for Everyone, Prentice Hall of India, 1996.

References:
- Labview Basics I and II Manual, National Instruments, 2003
- Barry Paton, Sensor, Transducers and Lab VIEW, Prentice Hall, 2000.

Fundamental of MEMS: 16**EC812**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction To Fabrication Techniques: Basic fabrication techniques (lithography, thin film deposition and doping) MEMS fabrication techniques-Nano fabrication techniques (E-Beam nano-imprint fabrication, Epitaxy and strain engineering. Scanning probe techniques).
9L

UNIT II:
Machining and Transport Property: Introduction to Micromachining and MEMS – Essential technical background for lithography-based micromachining - Photolithography, vacuum systems, etching methods, deposition methods. 9L

UNIT III:
MEMS Device Physics and Design: Critical understanding of various transduction principles -Design, production, and characterization of MEMS devices - Sensing (piezoelectric, capacitive, magnetic, etc.) - Actuation (electrostatic, electromagnetic, thermal, piezoelectric, SMA, etc.) 12L

UNIT IV:
Layout and design rules Experimental Mechanics for Microelectromechanical Systems (MEMS) - Methods, techniques. 8L

UNIT V:
Applications: Sensors, Actuators, and Signal Processing - Principles and performance of micro transducers - Design of experiments - Sensor and actuator spatial/temporal resolution, error analysis, uncertainty - propagation, and data acquisition - Applications of micro transducers for distributed real-time control of systems. Introduction to RF MEMS. 10L

Text Books:
- J. A. Pelesko and D. H. Bernstein, Modeling MEMS and NEMS, CRC, 2002,.
- N. Cleland, Foundations of Nanomechanics: From Solid-State Theory to Device 2011
- Applications. Advanced Texts in Physics. Berlin: Springer, 2003.

References:
- V. Kaajakari, Practical MEMS, Las Vegas, Nevada: Small Gear, 2009.
- Liu, Foundations of MEMS. Illinois ECE Series, Upper Saddle River, New Jersey: Pearson/Prentice Hall, 2006.

Biomedical Instrumentation: 16**EC813**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction to bio potential origin, Electric activity of excitable cells, resting potential, action potential, Nerst equation, propagation of action potential, Surface map of bio- potential concept.
5L

UNIT II:
Electrode theory, Working principle & application of different bio-potential electrodes & biochemical transducers (Microelectrodes, surface electrodes, needle electrodes, Reference electrode, pH electrode, blood gas electrode, Ion electrode).
8L

UNIT III:
Sources of action potentials, Methodology & principle of measurement, Electroencephalograms & Electromyograms & their inferences. Brief description of cardiovascular system, Electrocardiography-Sources of cardiac bio-potentials, Methodology & principle of measurement, Electrocardiograms & their inferences, Vector cardiography-concept, Principles of direct & indirect measurement of blood pressure, Principles of measurement of blood flow/cardiac rate, PH & blood gas analyzer. 15L

UNIT IV:
Working principles of medical X-ray, CT scan, CAT scan, Ultrasound scanning, MRI, Medical application of LASER including safety aspects, Fiber optic application in imaging internal organs, Effect of mm wave and microwave on human body, Electrical safety.
10L

UNIT V:
Respiratory mechanism, parameters of respiratory system, Principle of measurement of various parameters, impedance pneumograph, spirometer. Pacemakers, Defibrillators, ventilators, respirators, heamodialysis machine, cobalt therapy (Radio therapy).
10L

Text books:

- Carr & Brown, Intro. to Biomedical Equipment Tech., Pearson Education. 1998
- Cromwell, Weibwell& Pfeiffer, Biomedical Instr. & Measurements, PHI. 2/e 1979
- Khandpur, Hand book of Biomedical Instrumentation, TMH 3/e 2014

References:

- John Webster, Medical Instrumentation, Application & Design, John Willey 3/e 2007
- Venkata Ram, Biomedical Electronics & Instrumentation, Galgotia Pub. Ltd. 2000
- Marvin D & Weirs Chilton, Biomedical Instrumentation, Book Co, London. 1998

Material Science: 16**EC814**

Credits: 4(3L, 1T)
Total Hours: 48
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern:
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Introduction, Crystal structures and crystal planes, Crystal binding, Crystal defects, Polycrystalline materials, Grain boundaries, Defects, Amorphous materials, Solutions and Phase Diagrams. 8L

UNIT II:
Dielectric Constant, Clausius-Mossotti relation, Dielectric behavior at high frequency, Non-linear Susceptibility, Piezoelectricity: Origin, Piezoelectric materials, Surface Acoustic Waves, Ferro electricity: Spontaneous polarization, Different ferroelectric materials, Dielectric Resonator Materials, Diamond like Carbon, Photorefractive Materials, Materials for Optical Storage, Various Electronic and Optoelectronic applications. 12L

UNIT III:
Theory of Para, Ferro, ferri and anti-ferromagnetism, Magnetic domains, Ferrites, Magnetic materials in Electronics, Communication and Computers. Classification - Elemental, Compound, Alloy, Amorphous, Oxide and Organic Semiconductors, Applications.12L

UNIT IV:
Different types, Applications, Ferroelectric Liquid Crystals and their use. Phenomena; Principles; Tunneling in junctions; Application in microwaves, power transmission and in computers; Mag Lev, High-Tc Superconductors(HTS). 8L

UNIT V:
Bridgman, Zone melting and other techniques; Epi-taxial growth: VPE, LPE, MBE, MOCVD. Various electrical and optical methods of characterization. 8L

Text Books:

- Irene Eugene, Electronic Material Science. 1/e, 2005
- C. Kittel, Introduction to SolidState Physics 8/e, 2004
- Ali Omar, Introduction to SolidState Physics, 1993
- Rajendran and Marikanni, Semi conductor physics and opto electronics. 1999

References:

- Streetman and Banerjee, Electronic Devices and Circuits. 6/e, 2009

Solar Photovoltaic Technology and Applications: 16**EC815**

Credits: 3(3L)
Total Hours: 36
Full Marks: 100 (Internal: 40 Marks, End Semester Examination: 60 Marks)
Internal mark {28 (Term test) + 8 (assignment/Presentation) + 4 (Attendance)}
End semester mark distribution pattern::
Total 8 nos. of questions: {Q. 1 (a-f) 6 x 2(Mark) (Compulsory) + Any four (4) from Q.2-8 x 12(Marks)} = 60.

UNIT I:
Energy scenario of the world, current energy resources and reserves, total worlds consumption, potential of solar PV. Measurement and estimation of solar radiation, earth-sun geometry and various angles that affect the amount of solar radiation falling on a collector surface, the Sun-Earth movement. Angle of Sun rays on solar collector, Local apparent time, day length calculations, sun tracking systems. 5L

UNIT II:
Introduction to solar PV cells: difference between solar thermal and solar PV energy conversion, semiconductor and potential generation, elemental and compound semiconductors used in solar cell application. Review of semiconductor properties: Charge Carriers and charge carrier concentration, drift and diffusion, Carrier lifetime, generation and recombination- thermal generation and optical generation, absorption coefficient and absorption length for different materials, radiation intensity, excess charge carrier density, recombination at surface and in bulk. 6L

UNIT III:
Biasing of P-N junction and I-V relationship, Illumination of P-N junction diode, generation of photovoltage (photovoltaic effect), Solar cell as power source, carrier concentration profile in solar cells, current-voltage relationship of solar cells, I_{sc}, V_{oc}, FF and η of solar cells, power rating of solar cells, input power, peak output/rated power. 8L

UNIT IV:
Design of solar cells: (1) Design for high open circuit voltage, surface recombination velocity (SRV), effect of base and emitter recombination on voltage, Back Surface Field (BSF), (2) Design for high FF, metal-semiconductor ohmic contacts, resistive losses, metal contact design, series resistance and FF, shunt resistance and FF. 8L

UNIT V:
Basics of Fabrication of Solar-cells: Fabrication steps used in industrial cell process, saw-damage removal, surface texturing, diffusion and its parameters, edge isolation, ARC deposition, metal printing, contact firing.Solar-PV systems: Battery Charging. DC micro grid – A reality! Solar-PV system for DC micro grid. 9L

Text Books:

- "Solar Photovoltaics: Fundamentals, Technologies and Applications" by Chetan S. Solanki, Prentice Hall of India, 2009.

References:

- Solar Cells: Operating Principles, Technology and System Applications, M. Green, UNSW bookshop, 1982
- Silicon Solar Cells: Advanced Principles and Practice, M.A. Green, UNSW bookshop, 1995
- "Physics of Solar Cells" J. Nelson, Imperial College Press, UK, 2003.
- "Solid State Electronic Devices" by Ben Streetman, Pearson Education, 2000.