Indian Institute of Space Science and Technology

Department of Space, Govt. of India

Thiruvananthapuram

Curriculum and Syllabus for

B.TECH AVIONICS -R 2012

I SEMESTER

Code	Course Title	L	T	P	C
MA111	Calculus	2	1	0	3
PH111	Physics I	3	1	0	4
CH111	Chemistry	2	1	0	3
AE111	Basic Mechanical Engineering	2	1	0	3
AV111	Basic Electrical Engineering	2	1	0	3
HS111	Communication Skills I	1	0	0	1
PH131	Physics Lab I	0	0	3	1
CH131	Chemistry Lab	0	0	3	1
AE131	Basic Engineering Lab	0	0	3	1
HS131	Communication Skills Lab I	0	0	3	1
Total		12	5	12	21

II SEMESTER

Code	Course Title	L	T	P	C
MA121	Vector Calculus and Differential Equations	2	1	0	3
PH121	Physics II	3	1	0	4
CH121	Materials Science	2	1	0	3
AE121	Engineering Mechanics	2	1	0	3
AV121	Basic Electronics Engineering	2	1	0	3
HS121	Communication Skills II	1	0	0	1
PC141	Physics II and Materials Science Lab	0	0	3	1
AE141	Engineering Graphics	1	0	3	2
AV141	Basic Electrical and Electronics Engineering Lab	0	0	3	1
HS141	Communication Skills Lab II	0	0	3	1
Total		13	5	12	22

III SEMESTER

Code	Course Title	L	T	P	C
MA211	Linear Algebra, Numerical Analysis and Transforms	3	0	0	3
AV211	Analog Electronic Circuit	3	0	0	3
AV212	Semi Conductor Devices	3	0	0	3
AV213	Signal and Systems	3	1	0	4
AV214	Electromagnetic and Wave Propagation	3	0	0	3
HS212	Introduction to Social Science and Ethics	2	0	0	2
MA231	C Programming Lab	0	0	3	1
AV231	Analog Electronic Circuit Lab	0	0	3	1
AV232	E-CAD Lab	0	0	3	1
Total		17	1	9	21

IV SEMESTER

Code	Course Title	L	T	P	C
MA221	Partial Differential Equations, Calculus of Variation and Complex Analysis	3	0	0	3
AV221	Digital Electronics and VLSI Design	4	0	0	4
AV222	Microprocessor and Microcontrollers	3	0	0	3
AV223	RF and Microwave Communication	3	0	0	3
AV224	Computer Organization and OS	3	1	0	4
HS222	Introduction to Economics	2	0	0	2
AV241	Digital Electronics Lab	0	0	3	1
AV242	VLSI Design Lab	0	0	3	1
AV243	Microprocessor and Microcontroller Lab	0	0	3	1
AV244	RF and Microwave Communication Lab	0	0	3	1
Total		18	1	12	23

V SEMESTER

Code	Course Title	L	T	P	C
MA311	Probability and Statistics	3	0	0	3
AV311	Digital Signal Processing	3	0	0	3
AV312	Digital Communication	3	0	0	3
AV313	Control and Guidance Systems	3	1	0	4
AV314	Instrumentation and Measurement	3	0	0	3
CH311	Environmental Science and Engineering	2	0	0	2
AV331	Digital Signal Processing Lab	0	0	3	1
AV332	Digital Communication Lab	0	0	3	1
AV333	Control and Guidance Lab	0	0	3	1
AV334	Instrumentation and Measurement Lab	0	0	3	1
Total		17	1	12	22

VI SEMESTER

Code	Course Title	L	T	P	C
AV321	Computer Networks	3	0	0	3
AV322	Power Electronics	3	0	0	3
AV323	Radar Systems	3	0	0	3
E01	Elective I	3	0	0	3
ES321	Introduction to Space Science and Applications	2	0	0	2
HS321	Principles of Management Systems	3	0	0	3
AV341	Computer Networks Lab	0	0	3	1
AV342	Power Electronics Lab	0	0	3	1
Total		17	0	6	19

VII SEMESTER

Code	Course Title	L	T	P	C
AV411	Navigation Systems and Sensors	3	1	0	4
E02	Elective II	3	0	0	3
E03	Elective III	3	0	0	3
E04	Elective IV	3	0	0	3
I01	Institute Elective	3	0	0	3
AV431	Navigation Systems and Sensors Lab	0	0	3	1
AV451	Summer Internship and Training	0	0	0	3
AV452	Comprehensive Viva-Voce I	0	0	0	2
Total		15	1	3	22

VIII SEMESTER

Code	Course Title	L	T	P	C
AV453	Comprehensive Viva-Voce II	0	0	0	3
AV454	Project Work	0	0	0	12
Total		0	0	0	15

ABBREVIATIONS

MA – Mathematics; PH – Physics; CH – Chemistry; HS – Humanities; AE – Aerospace Engineering; AV – Avionics; PC–Physics and Chemistry; ES-Earth and Space Sciences; L – Lecture; T – Tutorial; P – Practical; C – Credits.

DEPARTMENT ELECTIVE COURSES

Sl No.	Course Code	Course name
1	AV461	Advanced Control Theory
2	AV462	Embedded Systems and Real Time OS
3	AV463	Soft Computing
4	AV464	Advanced DSP and Adaptive Filter
5	AV465	Robust and Optimal Control
6	AV466	Estimation and Stochastic Theory
7	AV467	Introduction to Optimization and OR
8	AV468	Digital Control System
9	AV469	EMI/EMC
10	AV470	Digital Image Processing
11	AV471	VLSI Design
12	AV472	Opto-Electronics and Fiber Optics Communication
13	AV473	Information Theory and Coding
14	AV474	Cryptography
15	AV475	Mobile Communication
16	AV476	Microwave Integrated Circuits
17	AV477	Antenna Engineering
18	AV478	Satellite Communication
19	AV479	Computer Graphics
20	AV480	Graph Theory and OR
21	AV481	Modern Algebra and Tensors
22	AV482	Data Structure and DBMS
23	AV483	Software Engineering
24	AV484	Wireless Mesh Network
25	AV485	Microelectronics and Microsystem Technologies
26	AV486	Antenna Active and Passive
27	AV487	Virtual Reality

SEMESTER I

MA111	CALCULUS	(2 – 1 – 0) 3 credits

Sequence and Series of Real Numbers: sequence – convergence – limit of sequence – non-decreasing sequence theorem – sandwich theorem (applications) – L'Hopital's rule – infinite series – convergence – geometric series – tests of convergence (nth term test, integral test, comparison test, ratio and root test) – alternating series and conditional convergence – power series.

Differential Calculus: functions of one variable – limits, continuity and derivatives – Taylor's theorem – applications of derivatives – curvature and asymptotes – functions of two variables – limits and continuity – partial derivatives – differentiability, linearization and differentials – extremum of functions – Lagrange multipliers.

Integral Calculus: lower and upper integral – Riemann integral and its properties – the fundamental theorem of integral calculus – mean value theorems – differentiation under integral sign – numerical Integration- double and triple integrals – change of variable in double integrals – polar and spherical transforms – Jacobian of transformations.

Textbooks:

1. Stewart, J., Calculus: Early Transcendentals, 5th ed., Brooks/Cole (2007).
2. Jain, R. K. and Iyengar, S. R. K., Advanced Engineering Mathematics, Narosa (2005).

References:

1. Greenberg, M. D., Advanced Engineering Mathematics, Pearson Education (2007).
2. James, G., Advanced Modern Engineering Mathematics, Pearson Education (2004).
3. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., John Wiley (2005).
4. Thomas, G. B. and Finney, R. L., Calculus and Analytic Geometry, 9th ed., Pearson Education (2003).

PH111	PHYSICS I	(3 – 1 – 0) 4 credits

Vectors and Kinematics: vectors, linear independence, completeness, basis, dimensionality, inner products, orthogonality – displacement, derivatives of a vector, velocity, acceleration – kinematic equations – motion in plane polar coordinates.

Newtonian Mechanics: momentum, force, Newton's laws, applications – dynamics of a system of particles, conservation of momentum, impulse, center of mass.

Work and Energy: integration of the equation of motion – work energy theorem, applications – gradient operator – potential energy and force, interpretation – energy diagrams – non-conservative forces – law of conservation of energy – power – particle collisions.

Rotations: angular momentum – torque on a single particle – moment of inertia – angular momentum of a system of particles – pure rotation about an axis – the physical pendulum.
Central Force Motion: central force motion of two bodies – relative coordinates – reduction to one dimensional problem – spherical symmetry and conservation of angular momentum, consequences – planetary motion and Kepler's laws.

Harmonic Oscillator: 1-D harmonic oscillator – damped and forced harmonic oscillators – solutions.

Thermodynamics: Zeroth law of thermodynamics – temperature – measurement and scales – thermal expansion – heat and work – First law of thermodynamics – heat transfer mechanisms – irreversible processes and entropy, change in entropy – Second law of thermodynamics – heat engines.

Textbooks:

1. Kleppner, D. and Kolenkow, R. J., An Introduction to Mechanics, Cambridge Univ. Press (2010).
2. Zemansky, M. W., Heat and Thermodynamics, McGraw-Hill (1997).

References:

1. Serway, R. A. and Jewett, J. W., Principles of Physics: A Calculus Based Text, 4th ed., Thomson Brooks/Cole (2006).
2. Halliday, D., Resnick, R., and Walker, J., Fundamentals of Physics, 6th ed., John Wiley (2001).
3. Young, H. D., Freedman, R. A., Sundin, T. R., and Ford, A. L., Sears and Zemansky's University Physics, 11th ed., Pearson Education (2004).

CH111	CHEMISTRY	(2 – 1 – 0) 3 credits

Chemical Kinetics: basic concepts of chemical kinetics – reaction rate, rate law, reaction stoichiometry, empirical rate equations, elementary reactions, order and molecularity – complex reactions, reversible reactions, chain reactions, reaction mechanisms – effect of temperature on reaction rates, Arrhenius equation – catalysis, different types of catalysts, enzyme catalysis, inhibition.

Electrochemical Systems: introduction to electrochemistry, different types of electrodes – standard hydrogen electrode (SHE) – half cell potential and its significance – electromotive force – Gibb's free energy and cell potential – Nernst equation – electrochemical series, classification of electrochemical cells.

Corrosion Science: definitions – causes and consequences – significance of corrosion control – classification of corrosion – theories of corrosion – chemical corrosion – fundamental components of corrosion cell – electrochemical corrosion – galvanic cell corrosion – factors influencing corrosion – different forms of corrosion – corrosion control.

Spectroscopy: fundamentals of spectroscopy – interaction of matter with light – electronic spectroscopy – vibrational spectroscopy – other spectroscopic techniques.

Propellants: classification of propellants – performance of propellants and thermochemistry – liquid propellants – oxidizers and fuels – solid propellants – burning rate – composite solid propellants, oxidizers, polymer fuel binders and other ingredients – propellant processing.

Textbook:

- Gopalan, R., Vengappya, D., and Nagarajan, S., Textbook of Engineering Chemistry, Vikas Publishing House (2010).

References:

1. Atkins, P. and de Paula, J., Atkins' Physical Chemistry, 8th ed., Oxford Univ. Press (2007).
2. Laidler, K. J., Chemical Kinetics, 3rd ed., Pearson Education (2005).
3. Kemp, W., Organic Spectroscopy, Palgrave Foundations (1991).
4. Revie, R. W. and Uhlig, H. H., Corrosion and Corrosion Control – An Introduction to Corrosion Science and Engineering, 4th ed., Wiley (2008).
5. Bockris, J. O'M. and Reddy, A. K. N., Modern Electrochemistry 1: Ionics, Springer (1998).

AE111	BASIC MECHANICAL ENGINEERING	(2 – 1 – 0) 3 credits

Introduction to mechanical engineering – role of mechanical engineers – engineering thermodynamics; basic laws and thermal engineering applications – introduction to engineering materials and manufacturing processes – introduction to mechanisms – introduction to measurement systems and data analysis.

Textbooks:

1. Agrawal, B. and Agrawal, C. M., Basic Mechanical Engineering, Wiley India (2008).
2. Lecture Notes.

References:

1. Shanmugham, G., Introduction to Mechanical Engineering, Tata McGraw-Hill (2007).
2. Çengel, Y. A. and Boles, M. A., Thermodynamics - An Engineering Approach, 5th ed., Tata McGraw-Hill (2006).
3. Kalpakjian, S. and Schmidt, S. R., Manufacturing Engineering and Technology, 4th ed., Prentice Hall (2001).
4. Holman, J. P., Experimental Methods for Engineers, 7th ed., Tata McGraw-Hill (2004).
5. Sawhney, G. S. and Schmidt, S. R., Fundamentals of Mechanical Engineering: Thermodynamics, Mechanics and Strength of Materials, Prentice Hall of India (2001).

AV111	BASIC ELECTRICAL ENGINEERING	(2 – 1 – 0) 3 credits

Circuit analysis, Kirchoff's law, mesh and nodal methods – transient analysis for RLC circuit – alternating current theory – resonance, Q factor and power measurement by two wattmeter circuits – network theorems – magnetic circuit, principles of magnetic circuits – DC and AC excitation – hysteresis loop, BH curve – losses, energy, and force production – Introduction to electrical machines: classification – operating principle – applications.

Textbooks:

1. Hughes, E., Electrical and Electronic Technology, Pearson Education (2002).
2. Deltoro, V., Principles of Electrical Engineering, 2nd ed., Prentice Hall (1986).

References:

1. Mittle, V. N. and Mittal, A., Basic Electrical Engineering, 2nd ed., Tata Mcgraw-Hill (2006).
2. Cotton, H., Principles of Electrical Engineering, Sir Isaac Pitman & Sons (1967).
3. Hayt, W. H. and Kemmerley, J. E., Engineering Circuit Analysis, 4th ed., McGraw-Hill (1986).
4. Murthy, K. V. V. and Kamath, M. S., Basic Circuit Analysis, Jaico Publishing (1998).
5. Kothari, D. P. and Nagrath, I. J., Theory and Problems of Basic Electrical Engineering, Prentice Hall (2000).
6. Pal, M. A., Introduction to Electrical Circuits and Machines, Affiliated East–West Press (1975).

HS111	COMMUNICATION SKILLS	(1 – 0 – 0) 1 credit

Functional English: conversation skills – asking questions, requests, doubts, engage in conversation – different types of communication-verbal and non-verbal, body language.

Teaching Grammar: grammar games, exercise.

Teaching Vocabulary: Language games, exercise.

References:

1. Garner, A., Conversationally Speaking: Tested New Ways to Increase Your Personal and Social Effectiveness, McGraw-Hill (1997).
2. Bechtle, M., Confident Conversation: How to Communicate Successfully in Any Situation, Revell (2008).
3. Brown, S. and Smith, D., Active Listening with Speaking, Cambridge Univ. Press (2007).

PH131	PHYSICS LAB I	(0 – 0 – 3) 1 credit

- Mechanics, Thermodynamics, and Oscillations

    - Ratio of specific heats
    - Mechanical equivalent of heat
    - Moment of inertia and angular acceleration with Cobra3
    - Damped driven harmonic oscillator
    - Waves
    - Modulus of elasticity
    - Torsional vibrations and torsion modulus
    - Characteristics of a solar cell
    - Surface tension: the ring method
    - Projectile motion
    - Estimation of Celsius equivalent of absolute zero
    - Measurement of *g* using free fall

CH131	CHEMISTRY LAB	(0 – 0 – 3) 1 credit

- Determination of total hardness of water
- The Nernst equation
- Estimation of the amount of phosphoric acid in a soft drinks
- Potentiometry
- Conductometry
- Validation of Ostwald's dilution law and solubility product
- Determination of chloride content in a water sample
- Estimation of iron using spectrophotometer
- Spectrophotometric determination of two-components in a mixture
- Kinetics of acid hydrolysis of ester
- Kinetics of sucrose inversion
- Bomb calorimetry

AE131	BASIC ENGINEERING LAB	(0 – 0 – 3) 1 credit

- Study of general purpose hand tools in workshop
- Assembly and disassembly practices of the following models

    - Gear box assembly
    - Centrifugal pump assembly along with shaft alignment practice
    - Cam and follower mechanisms assembly
    - Transducer (sensor) trainer

- Experiments on different basic machines

    - Turning exercise – straight turning, taper turning, thread cutting practice
    - Milling exercise – spur gear cutting practice
    - Welding practice – arc welding
    - Fitting practice – models with marking and drilling exercises

HS131	COMMUNICATION SKILLS LAB I	(0 – 0 – 3) 1 credit

- Presentation skills
- Appreciation of videos – songs – short films
- Role plays – debates – extemporizes – group presentations
- Introduction to technical writing

SEMESTER II

MA121	VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS	(2 – 1 – 0) 3 credits

Vector Calculus: scalar and vector fields – level surfaces – directional derivatives, gradient, curl, divergence – Laplacian – line and surface integrals – theorems of Green, Gauss, and Stokes.

Sequences and Series of Functions: complex sequences – sequences of functions – uniform convergence of series – test for convergence – uniform convergence for series of functions.

Differential Equations: first order ordinary differential equations – classification of differential equations – existence and uniqueness of solutions of initial value problem – higher order linear differential equations with constant coefficients – method of variation of parameters and method of undetermined coefficients – power series solutions – regular singular point – Frobenius method to solve variable coefficient differential equations.

Special Functions: Legendre polynomials, Bessel's function, gamma function and their properties – Sturm-Liouville problems.

Textbooks:

1. Ross, S. L., Differential Equations, Blaisedell (1995).
2. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., John Wiley (2005).
3. Stewart, J., Calculus: Early Transcendentals, 5th ed., Brooks/Cole (2007).

References:

1. Greenberg, M. D., Advanced Engineering Mathematics, Pearson Education (2007).
2. Jain, R. K. and Iyengar, S. R. K., Advanced Engineering Mathematics, Narosa (2005).

PH121	PHYSICS II	(3 – 1 – 0) 4 credits

Electricity: curvilinear coordinates – conservative vector fields and their potential functions – Gauss' theorem, Stokes' theorem – physical applications in electrostatics – electrostatic potential and field due to discrete and continuous charge distributions – dipole and quadrupole moments – energy density in an electric field – dielectric polarization – conductors and capacitors – electric displacement vector – dielectric susceptibility.

Magnetism: Biot-Savart's law and Ampere's law in magnetostatics – magnetic induction due to configurations of current-carrying conductors – magnetization and surface currents – energy density in a magnetic field – magnetic permeability and susceptibility – force on a charged particle in electric and magnetic fields – electromotive force, Faraday's law of electromagnetic induction – self and mutual inductance, displacement current.

Optics: nature of light – ray approximation in geometrical optics – reflection – refraction, Fermat's principle – dispersion – mirrors and lenses – aberrations – interference – diffraction – polarization – lasers.

Textbooks:

1. Griffith, D. J., Introduction to Electrodynamics, 3rd ed., Prentice Hall (1999).
2. Hecht, E., Optics, 4th ed., Pearson Education (2008).

References:

1. Feynman, R. P., Leighton, R. B., and Sands, M., The Feynman Lectures on Physics, Narosa (2005).
2. Reitz, J. R., Milford, F. J., and Christy, R. W., Foundations of Electromagnetic Theory, 3rd ed., Narosa (1998).
3. Wangsness, R. K., Electromagnetic Fields, 2nd ed., Wiley (1986).
4. Sadiku, M. N. O., Elements of Electromagnetics, 8th ed., Oxford Univ. Press (2007).

CH121	MATERIALS SCIENCE	(2 – 1 – 0) 3 credits

Polymer Chemistry: basic concepts – molecular weights and distributions – thermal transitions – morphology – classification of polymers – methods of polymerization – molecular weight determination.

Selection of materials – structure of solids, crystal structure – defects in crystals properties of materials, mechanical, electrical, thermal, magnetic, and optical – semiconductor materials, composites, ceramics, smart materials, and nanomaterials – material characterization.

Textbooks:

1. Callister Jr., W. D., Materials Science and Engineering: An Introduction, 7th ed., John Wiley (2007).
2. Lecture Notes

References:

1. Billmeyer, F. W., Textbook of Polymer Science, 3rd ed., Wiley India (1984).
2. Fried, J. R., Polymer Science and Technology, 2nd ed., Prentice Hall India (2005).
3. Saxena, S., Antolovich, A., and Warner, S., The Science and Design of Engineering Materials, 2nd ed., McGraw-Hill (1999).
4. Askeland, D. R. and Phule, P. P., The Science and Engineering of Materials, 4th ed., Thompson-Engineering (2006).

AE121	ENGINEERING MECHANICS	(2 – 1 – 0) 3 credits

Statics: fundamental principles and concepts – equilibrium of a particle – force system resultants – equilibrium of a rigid body – analysis of structures – friction – moment of inertia.

Dynamics: review of kinematics of a particle – rectilinear and curvilinear motion – kinetics of a particle – planar kinematics of a rigid body – rotation – relative motion – planar kinetics of a rigid body.

Textbook:

- Hibbeler, R. C., Principles of Statics and Dynamics, 11th ed., Prentice Hall (2010).

References:

1. Meriam, J. L. and Kraige, L. G., Engineering Mechanics: Statics (Vol. 1), Dynamics (Vol. 2), 5th ed., Wiley (2002).
2. Beer, F. B. and Johnston, E. R., Vector Mechanics for Engineers: Statics (Vol. 1), Dynamics (Vol. 2), 8th ed., Tata McGraw-Hill (2007).
3. Shames, I. H., Engineering Mechanics: Statics and Dynamics, 4th ed., Prentice Hall (2006).

AV121	BASIC ELECTRONICS ENGINEERING	(2 – 1 – 0) 3 credits

Semiconductor diode characteristics – applications in rectifiers and power supplies – transistor characteristics.

Biasing circuit – bias stabilization and compensation techniques – small signal low frequency h-parameter model – low frequency transistors.

Amplifiers – FET biasing and low frequency amplifier circuits – RC-coupled amplifiers.

Introduction to operational amplifiers – inverting and non-inverting mode of its operation – digital circuits – Boolean logic – basic gates – truth tables – logic minimization using K maps – combinatorial and sequential circuits.

Textbooks:

1. Boylestad, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education (2003).
2. Mano, M. M., Digital Design, Prentice Hall (2002).

References:

1. Mottershed, A., Electronic Devices and Circuits: An Introduction, EEE Publication, 12th Indian ed. (1989).
2. Bapat, Y. N., Electronic Devices and Circuits, Tata McGraw-Hill, 9th ed. (1989).
3. Malvino, A. P., Electronic Principles, 12th ed., 3rd TMH ed., Tata McGraw-Hill (1989).
4. Jain, R. P., Modern Digital Electronics, McGraw-Hill (2004).
5. Floyd, T. L., Electronic Devices, Pearson Education, 8th ed. (2007).

HS121	COMMUNICATION SKILLS II	(1 – 0 – 0) 1 credit

Reading and appreciating stories, poems, essays – listening and appreciating video lectures – comprehensive questions and answers.

References:

1. Garner, A., Conversationally Speaking: Tested New Ways to Increase Your Personal and Social Effectiveness, McGraw-Hill (1997).
2. Bechtle, M., Confident Conversation: How to Communicate Successfully in Any Situation, Revell (2008).

PC141	PHYSICS AND MATERIALS SCIENCE LAB	(0 – 0 – 3) 1 credit

- Electricity, Magnetism, and Optics (five experiments out of the following)
    - Millikan's oil drop experiment
    - Magnetic moment in the magnetic field
    - Coulomb field and potential of metal spheres
    - Photo electric effect
    - Black body radiation
    - Brewster's angle
    - Malus law
    - Specific charge of electron
    - Dielectric constant of different materials
    - Earth's magnetic field
    - Faraday's law
    - Inductance of solenoids
    - Magnetic field of single coil (Biot-Savart's law)
- Materials Science
    - Preparation of polymers and condensation polymerization
    - Free radical polymerization of polymers by different techniques
    - Determination of molecular weight of polymers
    - Preparation and characterization of carbon foam
    - Synthesis and characterization of nano-particles/nano-composites

AE141	ENGINEERING GRAPHICS	(1 – 0 – 3) 2 credits

Introduction and importance of Engineering Graphics – sheet layout and free-hand sketching – lines, lettering and dimensioning – geometrical constructions – engineering curves – orthographic projection – first angle and third angle projections – projection of points, straight lines and planes – projection of simple solids – sections of solids – development of surfaces – isometric projection – introduction to AutoCAD – creation of simple 2D drawings.

Textbook:

- Bhatt, N. D., Engineering Drawing: Plane and Solid Geometry, 50th ed., Charotar Publishing House (2010).

References:

1. Jolhe, D. A., Engineering Drawing with an Introduction to AutoCAD, Tata McGraw-Hill (2008).
2. Venugopal, K. and Prabhu Raja, V., Engineering Drawing + AutoCAD, 5th ed., New Age International (2011).
3. Varghese, P. I., Engineering Graphics for Degree including AutoCAD, VIP Publishers (2012).
4. Luzadder, W. J. and Duff, J. M., Fundamentals of Engineering Drawing, 11th ed., Prentice Hall (1992).
5. Bethune, J. D., Engineering Graphics with AutoCAD, Prentice Hall (2007).

AV141	BASIC ELECTRICAL & ELECTRONICS ENGINEERING LAB	(0 – 0 – 3) 1 credit

- Electrical Engineering Lab
    - Magnetic measurements
    - Three phase power measurement
    - Verification of theorems
    - Characteristic of electrical machines (AC and DC)
- Electronics Engineering Lab
    - Implementation of digital circuits
    - Design of electronic system using operational amplifiers
    - Device characteristic
    - Power supply design
    - Wave shaping circuits: clippers and clampers
    - Biasing of transistor

HS141	COMMUNICATION SKILLS LAB II	(0 – 0 – 3) 1 credit

- Technical writing-how to write minutes, paper, report, poster, and project proposal
- Short plays, individual presentations, group discussions, debates

SEMESTER III

MA211	LINEAR ALGEBRA, NUMERICAL ANALYSIS AND TRANSFORMS	(3 - 0 - 0) 3 credits

Linear Algebra: matrices; solution space of system of equations Ax = b, eigenvalues and eigenvectors, Cayley-Hamilton theorem – Definition of Group, ring field – Vector spaces over real field, subspaces, linear dependence, independence, basis, dimension – inner product – Gram-Schmidt orthogonalization process – linear transformation; null space and nullity, range and rank of a linear transformation.

Numerical Methods: solution of algebraic and transcendental equations – solution of system of linear equations – numerical integration – interpolation – solution of ordinary differential equations.

Transforms: Fourier series expansion of periodic functions with period two – Fourier series of even and odd functions – half-range series – Fourier series of functions with arbitrary period – conditions of convergence of Fourier series.
Fourier integral – the Fourier transform pair – algebraic properties of Fourier transform – convolution, modulation, and translation – transforms of derivatives and derivatives of transform – inversion theory.
Laplace transforms of elementary functions – inverse Laplace transforms – linearity property – first and second shifting theorem – Laplace transforms of derivatives and integrals – Laplace transform of Dirac delta function – applications of Laplace transform in solving ordinary differential equations.

Textbooks:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., John Wiley (2005).
2. Jain, M. K., Iyangar, S. R. K., and Jain, R. K., Numerical Methods for Scientific and Engineering Computation, New Age International (2003).

References:

1. Greenberg, M. D., Advanced Engineering Mathematics, Pearson Education (2007).
2. Conte, S. D. and de Boor, C., Elementary Numerical Analysis, 3rd ed., Tata McGraw-Hill (2005).
3. Krishnamurthy, K. V., Numerical Algorithms, Affiliated East-West Press (1986).
4. Jain, R. K. and Iyengar, S. R. K., Advanced Engineering Mathematics, Narosa (2005).

AV211	ANALOG ELECTRONIC CIRCUIT	(3 - 0 - 0) 3 credits

Basic stability and device stabilization techniques (BJT). Small signal low & high frequency models for (BJT, FET, MOSFET), Large signal amplifiers, Differential Amplifier, Instrumental amplifiers, Integrated circuits, Tuned amplifiers, Feedback amplifiers, Oscillators, Multivibrators, Wave shaping circuits, Filter design.

Textbook:

- J. Millman and C.C. Halkias, Integrated Electronics - Analog and Digital circuit system, McGraw Hill, 1996.

References:

1. David A.Bell, Electronic Devices and Circuits, Prentice Hall of India, 2006.
2. Donal L. Schilling and Charles Beloue, Electronic Circuits , Third Edition, McGraw Hill, 2005.
3. David A. Bell, Solid State Pulse Circuits , Prentice Hall of India, 1992.
4. John D. Ryder, Electronic Fundamental and Applications - Integrated and Discrete system , Prentice Hall of India, 1999.
5. J. Millman and H. Taub, Pulse Digital and Switching waveform-Devices and circuits , McGraw Hill International, 1965.

AV212	SEMI CONDUCTOR DEVICES	(3 - 0 - 0) 3 credits

Semiconductor fundamentals, crystal structure, Fermi level, energy-band diagram, intrinsic and extrinsic semiconductor, carrier concentration, scattering and drift of electrons and holes, drift current , diffusion mechanism, generation and recombination and injection of carriers, transient response, basic governing equations in semiconductor, physical description of p-n junction, transport equations, current – voltage characteristics and temperature dependence, tunneling current, small signal ac analysis.

BJT equivalent circuits and modeling frequency response of transistors, pnpn diode, SCR, MOS structure, flat-band threshold voltages, MOS static characteristics, small signal parameters and equivalent circuit, charge – sheet model, strong, moderate and weak inversion, short channel effects, scaling laws of MOS transistors, LDD MOSFET, NMOS and CMOS IC technology, CMOS latch –up phenomenon, ideal Schottky barrier, current voltage characteristics, MIS diode heterojunctions devices, optical absorption in a semiconductor, photovoltaic effect, solar cell, photoconductors, PIN photodiode, avalanche photodiode, LED, semiconductor lasers; negative conductance in semiconductors, transit time devices, IMPATT, Gunn device, BiCMOS device

Textbook:

1. SZE, Semiconductor Physics and Devices, Wiley Student Edition, 2007.

References:

1. Ben G. Streetman and Sanjay Kumar Banerjee, Solid State Electronic Devices, Dorling Kindersley, 2007.
2. Sima Dimitrijev, Principles of Semiconductor Devices, Oxford University Press, 2006.
3. Robert.F. Pierret, Semiconductor Device Fundamentals, Prentice Hall of India, 2007.

AV213	SIGNAL AND SYSTEMS	(3 - 1 - 0) 4 credits

Classification of signals and systems, Types of signals, Types of systems, Analysis of Continuous Time Signals and LTI systems: Fourier series, Fourier Transform, Laplace Transform, Differential Equation, State Space Matrix, Anlaysis of Discrete Time Signals and LTI DT systems: Fourier

Transform, DFT, Z Transform, Wavelet transform, Difference Equations, State variable equation and matrix, some applications – communication, control systems etc.

Textbooks:

1. R.F. Ziemer, W.H. Tranter and D.R. Fannin, Signals and Systems - Continuous and Discrete, Prentice Hall, 2006.
2. B.P. Lathi, Linear Systems and signals, 2nd edition, Oxford University Press, 1998.
3. Simon Haykin, Barry Van Veen, Signals and Systems, John Wiley and Sons (Asia) Private Limited, 2005.
4. A.V. Oppenheim, A.S. Willsky and I.T. Young, Signals and Systems, Prentice Hall, 2006.

References:

1. Douglas K. Lindner, Introduction to Signals and Systems, Mc-Graw Hill International, 1999.
2. Robert A. Gabel, Richard A. Roberts, Signals and Linear Systems, John Wiley and Sons (SEA) Private Limited, 1995.
3. M. J. Roberts, Signals and Systems - Analysis using Transform methods and MATLAB, Tata McGraw Hill, 2003.
4. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, Signals and Systems, Tata McGraw Hill, New Delhi, 2001.
5. Ashok Ambardar, Analog and Digital Signal Processing, 2nd Ed., Brooks/ Cole Publishing Company, 2006.

A. Papoulis, Circuits and Systems: A Modern Approach, HRW, 1980.

6. B.P. Lathi, Signal Processing and Linear Systems, Oxford University Press, 1998.

AV214 ELECTROMAGNETIC AND WAVE PROPAGATION (3 - 0 - 0) 3 credits

Electromagnetic Theory: Electrostatics- Magnetostatics- Ampere's Law- Faraday's law- Electromagnetic Energy – Boundary Conditions – Maxwell's Equations – Pointing Vector. Electromagnetic Waves: Wave equation & Uniform Plane waves – Plane waves in lossy and lossless mediums – Normal and oblique incidences of plane waves.

Transmission line theory: LCR model for transmission lines – Analogy with wave equations – characteristics of lossless lines – VSWR, Impedance matching – Smith chart – Case study.

Waveguides: TEM, TE, TM Waves – wave propagation in Rectangular, Circular & Planar wave guides.

Fundamentals of Antenna: Radiation – Hertzian dipole antenna – Gain and Directivity.

Textbooks:

1. William H.Hayt, Engineering Electromagnetics, Tata McGraw Hill 7th edition.

References:

1. E.C. Jordan & K.G. Balmain, Electromagnetic Waves and Radiating Systems, Prentice Hall of India 2nd edition 2003. (Unit IV, V). McGraw-Hill, 9th reprint.

2. J.D.Ryder , Networks, Lines and Fields, Prentice Hall of India, New Delhi, 2003.
3. M.N.O.Sadiku, Elements of Engineering Electromagnetics, Oxford University Press, Third edition.
4. Ramo, Whinnery and Van Duzer, Fields and Waves in Communications Electronics, John Wiley & Sons (3rd edition 2003).
5. David M.Pozar, Microwave Engineering, 2nd Edition – John Wiley.
6. David K.Cheng, Field and Waves in Electromagnetism, Pearson Education, 1989.

HS212 INTRODUCTION TO SOCIAL SCIENCE AND ETHICS (2 - 0 - 0) 2 credits

Social Science: Introduction to sociology, anthropology – social science research design and sampling.
Ethics: Professional and personal ethics – values & norms and human rights.
Textbooks:

1. Lecture Notes.

References:

1. Perry, J. and Perry, Contemporary Society: An Introduction to Social Science, 11thed., Allyn & Bacon (2005).
2. Giddens, A., Sociology, 5th Edition. Wiley (2006).
3. Flyvberg, B, Making Social Science Matter, Cambridge Univ. Press (2001).
4. Singer, P., A Companion to Ethics, Wiley-Blackwell (1993).

MA231 C PROGRAMMING LAB (0 - 0 - 3) 1 credit

Introduction to C: algorithms and flowchart, C preliminaries – structure of a C program, character set, tokens, operators and expressions – variables and constants – data types and declarations – formatted and unformatted I/O – debugging techniques – control flow statements – conditional and unconditional, looping statements – storage Classes.

Functions, Arrays and Pointers: functions, call by value, call by reference – recursion, arrays – one-dimensional and multi-dimensional, strings – passing arrays to functions – pointers, pointer arithmetic, arrays and pointers, pointers to function, function pointer – structure, union, typedef, structure using pointer.

Pre-Processing and Files Handling: pre-processor directives, file I/O, file operations – text and binary files – command line arguments – sorting techniques – selection, bubble, insertion, quick, merge.
Textbooks:

1. Balaguruswamy, E., Programming in ANSI C, 4th ed., McGraw-Hill (2007).
2. Kamthane, A. N., Programming with ANSI and Turbo C, Pearson Education (2006).

References:

1. Kernighan, B. W. and Ritchie, D. M., C Programming Language, Prentice Hall (1988).

2. Brooks, D. R., C programming: The Essentials for Engineers and Scientists, Springer-Verlag (1999).
3. Kanetkar, Y. P., Let Us C, Infinity Science Press (2008).

AV231	ANALOG ELECTRONIC CIRCUIT LAB	(0 - 0 - 3) 1 credit

1. Feedback amplifier and multistage amplifiers.
2. LC and RC oscillators.
3. Tuned amplifier and stage tuned amplifiers.
4. Multivibrators.
5. Schmitt Trigger.
6. Wave shaping circuits.
7. Differential Amplifiers, CMRR measurements.

AV232	E-CAD LAB	(0 - 0 - 3) 1 credit

1. Simulation of analog electronics circuits using ORCAD (PSpice)
2. PCB layout using ORCAD
3. Application to electronic system design.

SEMESTER IV

MA221	PARTIAL DIFFERENTIAL EQUATIONS, CALCULUS OF VARIATION AND COMPLEX ANALYSIS	(3 - 0 - 0) 3 credits

Partial Differential Equations: introduction to PDEs – modeling Problems related and general second order PDE – classification of PDE: hyperbolic, elliptic and parabolic PDEs – canonical form – scalar first order PDEs – method of characteristics – Charpits method – quasi-linear first order equations – shocks and rarefactions – solution of heat, wave, and Laplace equations using separable variable techniques and Fourier series.

Calculus of Variations: optimization of functional – Euler-Lagranges equations – first variation – isoperimetric problems – Rayleigh-Ritz method.

Complex Variable: complex numbers and their geometrical representation – functions of complex variable – limit, continuity and derivative of functions of complex variable – analytical functions and applications – harmonic functions – transformations and conformal mappings – bilinear transformation – contour integration and Cauchy's theorem – convergent series of analytic functions – Laurent and Taylor series – zeroes and singularities – calculation of residues – residue theorem and applications.

Textbooks:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., John Wiley (2005).
2. Mathews, J. H. and Howell, R., Complex Analysis for Mathematics and Engineering, Narosa (2005).

References:

1. Churchill, R. V. and Brown, J. W., Complex Variables and Applications, 6th ed., McGraw-Hill (2004).
2. Wylie, C. R. and Barrett, L. C., Advanced Engineering Mathematics, McGraw-Hill (2002).
3. Greenberg, M. D., Advanced Engineering Mathematics, Pearson Education (2007).
4. James, G., Advanced Modern Engineering Mathematics, Pearson Education (2004).
5. Sneddon, I. N., Elements of Partial Differential Equations, McGraw-Hill (1986).
6. Renardy, M. and Rogers, R. C., An Introduction to Partial Differential Equations, 2nd ed., Springer-Verlag (2004).
7. McOwen, R. C., Partial Differential Equations - Methods and Applications, 2nd ed., Pearson Education (2003).

AV221	DIGITAL ELECTRONICS AND VLSI DESIGN	(4 - 0 - 0) 4 credits

Boolean Algebra, standard representation and Minimization Procedures. Logic families, combinational circuits, asynchronous and synchronous sequential circuits, Memories. Introduction to VLSI systems- CMOS logic - MOS transistor theory- Layout design rules- Circuit characterization and performance estimation- Circuit simulation- Combinational and sequential circuit design- Static and dynamic CMOS gates- Memory system design- Design methodology and tools-HDL. Design of FPRG, Complex CMOS design.

Textbook:

1. Morris Mano, Digital Design, 4th ed., Prentice-Hall of India, 2006.
2. John.F.Wakerly, Digital Design Principles and Practice, 3rd edition, Pearson Education, 1990.

References:

1. William I. Fletcher, An Engineering Approach to Digital Design, Prentice-Hall of India, 1980.
2. T.L. Floyd, Digital Fundamentals, Charles E. Merrill publishing Company, 1982.
3. R.L. Tokheim, Digital Electronics - Principles and Applications, Tata McGraw Hill, 1999.
4. R.P. Jain, Modern Digital Electronics, Tata McGraw Hill, 1999.
5. N. Weste and D. Harris, CMOS VLSI Design: Circuits and Systems Perspective, Addison Wesley, 2004.
6. Wayne Wolf, Modern VLSI Design, Prentice Hall,1998.
7. Peter J. Ashenden, The Designer's Guide to VHDL, Harcourt Asia private Limited & Morgan Kauffman, 1996.
8. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design Systems and Circuits, Prentice Hall of India, 1993.

AV222 MICROPROCESSOR AND MICROCONTROLLERS (3 - 0 - 0) 3 credits

Microprocessor family - internal architecture, addressing modes, interrupts, assembly Language programming, Instruction types, Interrupts & its application for 8086 – 8254, 8259, 8255-interfacing devices, coprocessors. DMA, DRAM, Cache memories, Coprocessor & EDA tools - Applications.

Micro controllers - Types of micro controller, Processor Architecture, Atmel and PIC Microcontroller features, Addressing Modes, Instruction set. Timers, Serial I/O, Parallel I/O Enhanced features & programming. Application Design emulators, real time operating systems. Case study of a sample Microprocessor / Microcontroller based system.

Textbook:

1. R. Gaonkar, , Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publisher India Ltd, 5th Ed, 2007.
2. Kenneth J. Ayala, The 8051 Microcontroller- Architecture, Programming and Applications, Penram International, 1996.

References:

1. Barry B. Brey , The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, and Pentium Pro Processor Architecture, Programming and Interfacing, Prentice Hall, 2005.
2. Douglas V. Hall, Microprocessors and Interfacing: Programming and Hardware, Glencoe McGraw-Hill; 2 Sub edition, 1991.

AV223	RF AND MICROWAVE COMMUNICATION	(3 - 0 - 0) 3 credits

Introduction to RF communication, RF transmitter, RF receiver, Microwave Network Analysis; Scattering matrix parameters, Transmission matrix, Signal flow graph, Impedance matching, Single and double stub tuning, problems. Microwave wave-guide and planar-based passive devices, Microwave resonators, Power dividers, directional couplers and filters, Isolator, Circulator, phase shifter, Microwave signal generators: Klystron, magnetron and TWT. Microwave systems design, Microwave Amplifier design, Gain and stability, Oscillator design, Broadband systems, noise figure and link budget.

Textbook:

- David M. Pozar, David M. Pozar, 2nd Ed., John Wiley & Sons, Inc. 2004.

References:

1. R.E. Collin, Foundations for Microwave Engineering, McGraw-Hill, 1992.
2. S.M. Liao, Microwave Devices and Circuits, Prentice Hall Of India Private Limited.
3. P.A. Rizzi, Microwave Engineering, Prentice-Hall, Englewood Cliffs, NJ, 1988.
4. T.S. Laverghetta, Modern Microwave Measurements and Techniques, Artech House, Norwood, MA, 1988.

AV224	COMPUTER ORGANIZATION AND OS	(3 - 1 - 0) 4 credits

Overview: functions of Operating systems, layered architecture; basic concept; interrupt architecture, system calls and notion of a process and threads; synchronization and protection issues; scheduling; memory management including virtual memory management including virtual memory and paging techniques; i/o architecture and device management; file systems; distributed file systems; Case studies of Unix , Windows NT Introduction to computer organization: Structure and function of a computer - Processing unit: Characteristics of CISC and RISC processors - Performance of a processing unit. Memory subsystem : Memory hierarchy - Main memory unit - Internal organization of a memory chip - Organization of a main memory unit - Error correction memories - Interleaved memory units - Cache memory unit - Concept of cache memory - Mapping functions - organization of a cache memory unit - Fetch and Write mechanisms - Memory management unit - Concept of virtual memory - Address translation - hardware support for memory management. Input / Output subsystem: Access of I/O devices - I/O ports. - I/O control mechanisms - Program controlled I/O - Interrupt controlled I/O - DMA controlled I/O - I/O interfaces - System buses - peripherals - Terminals - Video displays - Magnetic storage disks - magnetic tapes - CD ROMs. High-Performance processors: Instruction pipe lining - Pipe line - Hazards - Super scalar processors - Performance considerations. Multi processor systems: Shared memory systems - Interconnection networks - Caches in multi processor systems.

Textbook:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne Operating System Concepts, 7th Edition, Wiley publications, 2005.

References:

1. Tanenbaum A.S., Operating systems:Design and implementation, Prentice Hall, 1992.
2. Tanenbaum A.S., Structured computer organization, 4th edition, PHI, 1999.
3. Stallings W, Operating systems, second edition, prentice Hall, 1995.
4. Hayes, J.P, Computer architecture and Organisation, McGraw Hill, 1998.

HS222 INTRODUCTION TO ECONOMICS (2 - 0 - 0) 2 credits

Exploring the subject matter of Economics: why we study economics – types - definitions – economic systems – economics as a science.

Principles and Concepts of Micro Economics: demand – supply – production – costs – markets – equilibrium.

Basics of Macro Economics: role of government – national income concepts – inflation concepts – classical vs. Keynesianism.

Economic Problems and Policies: meaning of development – problems of growth – population – agriculture and industry – balance of payments – planning – study report related to economics of space program.

Textbooks:

1. Samuelson, Paul A. and William D. Nordhaus, Economics, 17th ed., McGraw-Hill (2005).
2. Dewett, K. K., Modern Economic Theory, 22nd ed., S. Chand & Co.
3. Thirlwall, A. P., Growth and Development with Special Reference to Developing Economies, Palgrave (2003).

References:

1. Gardner, A., Macroeconomic Theory, Surjeet Publications (1998).
2. Koutsoyiannis, A., Modern Microeconomics, 2nd ed., Palgrave Macmillan (2003).
3. Black, J., A Dictionary of Economics, Oxford Univ. Press (2003).
4. Meir, J. M. and Rauch, J. E., Leading Issues in Economic Development, 7th ed., Oxford Univ. Press (2005).
5. Todaro, M. P. and Smith, S. C., Economic Development, 8th ed., Pearson Education Ltd. (2008).
6. Economic Survey 2008, Government of India, Ministry of Finance.
7. O'Connor, D. E., The Basics of Economics, Greenwood Press (2004).

AV241 DIGITAL ELECTRONICS LAB (0 - 0 - 3) 1 credit

1. Design and implementation of combinational circuits using basic gates for arbitrary functions, code converters, parity generator / checker, magnitude comparator etc.
2. Design and implementation of application using multiplexers, Decoders/encoders.
3. Design and implementation of synchronous & asynchronous sequential circuit.
4. FPGA and Programming.

AV242	VLSI DESIGN LAB	(0 - 0 - 3) 1 credit

1. Modeling of Combinational Digital system using VHDL/Verilog
2. Modeling of Sequential Digital system using VHDL/Verilog.
3. Writing Test Benches Using Verilog / VHDL
4. Design and Simulation of ALU using FPGA.

AV243	MICROPROCESSOR AND MICROCONTROLLER LAB	(0 - 0 - 3) 1 credit

1. Programming with 8086 – 8-bit / 16-bit multiplication/division using repeated addition/subtraction
2. Programming with 8086 - code conversion, decimal arithmetic, bit manipulations.
3. Programming with 8086 - matrix multiplication, floating point operations
4. Programming with 8086 – String manipulation, search, find and replace, copy operations, sorting. (PC Required)
5. Experiment based on Interfacing and control application
6. PIC/ATmel Microcontroller based experiments – Simple assembly language programs (cross assembler required).
7. PIC/ATmel Microcontroller based experiments – Simple control applications (cross assembler required).

AV244	RF AND MICROWAVE COMMUNICATION LAB	(0 - 0 - 3) 1 credit

RF Experiments

1. Analyze the radiation patterns of the different antennas.
2. Experiments on Coaxial Line Section:
    - Measurement of VSWR
    - Measurement of unknown impedance
    - Stub matching
    - Measurement of Gain and Noise figure
3. Simulation and Testing of RF Circuits:
    - RF Tuned Amplifier
    - RF Oscillator
    - RF Crystal Oscillator
    - IF Amplifier
    - RF Mixer
    - RF Filters (LP, HP, BP, Notch Filter)
4. Stability

Microwave Experiments

1. Characteristics of Reflex Klystron Oscillator
2. Characteristics of Gunn Diode Oscillator
3. Study of Power Distribution in directional coupler, E / H Plane Tee, Magic Tee.
4. Radiation pattern of Horn Antenna.
5. Frequency Measurement
6. Impedance measurement by Slotted Line Method.

SEMESTER V

MA311	PROBABILITY AND STATISTICS	(3 - 0 - 0) 3 credits

Probability Distributions: binomial distribution, hyper geometric distribution – Poisson approximation to the binomial, geometric distribution, normal distribution – normal approximation to the binomial distribution, uniform distribution, gamma distribution, beta distribution, and Weibull distribution – mathematical expectation and moments, mean, variance, moment generating function, and characteristic function – random Variable, discrete and continuous random variables

Sampling Distributions and Inference Concerning Means: population and samples – central limit theorem – sampling distributions of mean and variance – point estimation – confidence interval for mean, variance and proportions – tests of hypotheses, the null hypotheses and the significance tests – control charts for variables and attributes – acceptance sampling by attributes – simple, double and sequential sampling plans – design of experiments.

Correlation and Regression Analysis: curve fitting by the method of least squares – chi-square test of goodness of fit – contingency tables – inference based on the least square estimators – regression – correlation – inference concerning correlation coefficient.

Textbook:

1. Walpole, W. E., Myers, R. H., Myers, S. L., and Ye, K., Probability & Statistics for Engineers & Scientists, 9th ed., Pearson Education (2012).

References:

1. Johnson, R. A., Miller & Freund's Probability and Statistics for Engineers, 6th ed., Prentice Hall (2000).
2. Levin, R. I. and Rubin, D. S., Statistics for Management, 7th ed., Prentice Hall (1998).
3. Milton, J. S. and Arnold, J. C., Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, McGraw-Hill (2002).
4. Ross, S. M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd ed., Academic Press (2004).
5. Feller, W., An Introduction to Probability Theory and Its Applications, vol.1 & vol.2, John Wiley (1968).
6. Hogg, R. V., Craig, T., and McKean, J. W., Introduction to Mathematical Statistics, 6th ed., Prentice Hall (2004)
7. Hogg, R. V. and Tanis, E. A., Probability and Statistical Inference, 7th ed., Prentice Hall (2005).
8. Larsen, R. J. and Marx, M. L., An Introduction to Mathematical Statistics and Its Applications, 4th ed., Prentice Hall (2005).
9. Mendenhall, W., Wackerly, D., and Scheaffer, R. L., Mathematical Statistics with Applications, 7th ed., Duxbury Press (2007).

AV311	DIGITAL SIGNAL PROCESSING	(3 - 0 - 0) 3 credits

Discrete time signals and systems- DFS, DTFT, DFT – FFT computations using DIT and DIF algorithms Infinite Impuse Response Digital Filters, Finite Impulse Response Digital filters, Finite Word length effect, Introduction to Multirate Signal Processing, Introduction to programmable DSPs-Architecture of TMS 320C5X.

Textbook:

1. John G Proakis, Dimtris G Manolakis, Digital Signal Processing Principles, Algorithms and Application, PHI, 3rd Edition, 2000.
2. B.Venkataramani & M. Bhaskar, Digital Signal Processor Architecture, Programming and Application, TMH 2002.

References:

1. Alan V Oppenheim, Ronald W Schafer, John R Back, Discrete Time Signal Processing, PHI, 2nd Edition 2000
2. Avtar singh, S.Srinivasan, DSP Implementation using DSP microprocessor with Examples from TMS32C54XX, Thamson / Brooks cole Publishers, 2003
3. S.Salivahanan, A.Vallavaraj, Gnanapriya, Digital Signal Processing, McGraw-Hill / TMH, 2000.
4. Johny R.Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1984.
5. S.K.Mitra, Digital Signal Processing- A Computer based approach, Tata McGraw-Hill, 1998, New Delhi.

AV312	DIGITAL COMMUNICATION	(3 - 0 - 0) 3 credits

Fundamentals of Digital communications, channel capacity, bit error rate, media characteristics, FDM, TDM, TDD,FDD,CDMA, Statistical Multiplexing; Framing and Synchronization; M-array modulation – Formatting – Pulse schemes – Pulse code modulation – Sampling – Quantization– Correlative coding, Base Band Demodulation/Detection - Maximum Likelihood - Matched Filter, Inter Symbol Interference, Equalization. Signal-space Analysis-Band-pass Modulation: Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Demodulation-correlative receiver. Communication Link Analysis, Synchronization, Source-Coding, Multiplexing and Multiple Access, Spread Spectrum Techniques, Fading Channels.

Textbook:

1. Simon Haykin, Digital Communication, John Wiley & Sons Paperback edition, 2006.

References:

1. Bernard Sklar, Digital Communication, 2nd Ed., Pearson Education, 2001.
2. Couch L.W., , Digital and Analog Communication Systems, Prentice Hall, 1996.
3. Rodger E Ziemer/William H Tranter, Principle of Communications, 5th Ed., Wiley publications.
4. R P Singh, S D Sapre, Communication Systems Analog and Digital, Tata McGraw-Hill.

5. John G Proakis, Digital Communications, 4th Ed., McGraw-Hill International, 2000.
6. John G Proakis, Mosoud Salehi, Fundamentals of Communication Systems, Pearson Education,
7. M K Simen, Digital Communication Techniques, Signal Design and detection, Prentice Hall of India,1999.

AV313 CONTROL AND GUIDANCE SYSTEMS (3 - 1 - 0) 4 credits

Control systems: Introduction to control theory- control system components, Modeling of physical -transfer function, block diagram, signal-flow graph and state-space representation. Time domain and Frequency domain response -relationship between the time and frequency domain responses. Stability - concept of pole and zero - Routh-Hurwitz Criteria, Nyquist criteria, Root locus and Bode-plot; P-I, P-D, P-I-D controller design, tuning of controllers; lead and lag compensators. Sampled-data systems sample and hold operations for digital control, controller design for digital control systems.

Guidance: Fundamentals of guidance Basic results in interception and avoidance Taxonomy of guidance laws, command and booming guidance, classical guidance laws Comparative study of guidance laws from the point of view of time, missdistance, launch boundaries, control effort and implementation difficulties. Basic concepts of launch vehicle guidance, Explicit and Implicit guidance, Flat Earth guidance, Perturbation guidance, Velocity to be gained guidance concept, Delta guidance, Q guidance, Cross product steering, linear perturbation guidance, Open loop and Closed loop guidance.

Textbook:

1. Katsuhiko Ogata, Modern Control Engineering, 4th Edition, Prentice Hall of India publishers, New Delhi, 2006.

References:

1. Gopal I and Nagrath N, Control systems, Wiley Eastern Ltd, NewDelhi, 1985.
2. Norman S Nise, Control Systems Engineering, Wiley India, 4th edn, 2003
3. D'Azzo, Houpis, Feedback Control System Analysis and Synthesis, CRC Press, 2007
4. M.Gopal, Control systems, Principle and Design, Tata McGraw Hill publishing Co,m New Delhi, 1997.
5. Kuo B.C., Automatic control systems, Prentice Hall India ltd, New Dehli, 1995.
6. Mutambara, Design and Analysis of Control Systems, CRC Press, 2008
7. Xue, Chen, Atherton, Linear Feedback Control Analysis and Design with MATLAB, SIAM Publications, 2006.
8. Qiu, Zhou, Introduction to Feedback Control, Prentice Hall, 2009.

AV314 INSTRUMENTATION AND MEASUREMENT (3 - 0 - 0) 3 credits

Introduction to measurement, error analysis, Static and dynamic performance characteristics of instruments. Basic voltmeter and Ammeter wattmeter and energy meter design, Electronic voltmeter, Digital Measurement systems (DMM, Frequency, A/D and D/A), spectrum analyzer, filter design, Hall effect devices. DC bridges for resistance measurements. A.C. Bridges- Measurement of inductance and capacitance, Earth resistance measurements.

Frequency and Power factor meters, Potential and Current Transformers, D.C. and A.C. potentiometer, Instrumentation amplifiers. Transducers - strain gauges, inductive and capacitive transducers, piezoelectric and Hall-effect transducers, Temperature sensors, photo-diodes & transistors, digital transducers, signal conditioning and telemetry, introduction to smart sensors and MEMS, Data Acquisition Systems.

Textbook:

1. A.K. Sawhney, A course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons, New Delhi, 2006.

References:

1. Doebelin, E.O., Measurement systems: Application and Design, 5th ed., McGraw hill, 2003.
2. Golding E.W. and Widdis F.E., Electrical measurements and measuring instruments, Sir Issac Pitman and Sons pvt ltd, 1995.
3. Albert D. Helfrick, William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques., Prentice Hall of India Private Limited.

CH311	ENVIRONMENTAL SCIENCE AND ENGINEERING	(2 - 0 - 0) 2 credits

Awareness of the impact of environment on quality of life – natural resources – biological systems – bio-geo chemical cycles – chemical processes; water treatment operations, water sampling, storage, quality measurement – oxygen demand – detection of pollutants – current environmental issues; pollutants, global warming, causes and consequences, air pollution, organic and inorganic air pollutants, smog-acid mine drainage, accumulation of salts in water – soil formation; micro and macro nutrients in soil, pollutants in soil – green chemistry: an alternative tool for reducing pollution – engineering interventions; flow sheets, waste minimization, e-waste management, ASP, reverse osmosis, trickling filter – environmental management; solid, liquid waste management, hazardous wastes, ISO standards – Kyoto protocol, Montreal protocol, Euro norms.

Textbook:

1. Rao, V., Textbook of Environmental Engineering, Prentice Hall of India (2002).

References:

1. Baird, C. and Cann, M., Environmental Chemistry, 3rd ed., W. H. Freeman and Company (2005).
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, GOI (1999).
3. Manual on Sewerage and Sewage Development, CPHEEO, Ministry of Urban Development, GOI (1993).
4. Hauser, B. A., Practical Hydraulics Hand Book, Lewis Publishers (1991).
5. Hammer, M. J., Water and Wastewater Technology, Regents/Prentice Hall (1991).
6. Sharma, J. P., Comprehensive Environmental Studies, Laxmi Publications (2004).

7. Garg, S. K., Environmental Engineering (vol. 1 and 2), Khanna Publishers (2004).
8. Kiely, G., Environmental Engineering, McGraw-Hill (1997).
9. Bharucha, E., Textbook of Environmental Studies, University Grants Commission (2004).
10. Vanloon, G. W. and Duffy, S. J., Environmental Chemistry: A Global Perspective, Oxford Univ. Press (2000).

AV331	DIGITAL SIGNAL PROCESSING LAB	(0 - 0 - 3) 1 credit

1. Study of DFT
2. IIR Filter Design
3. FIR Filter Design
4. FIR Kaiser and Equiripple Filter Design
5. Comparison of FIR and IIR Filter Design
6. Study of Simulink and Signal Processing Tool Box
7. Multirate Signal processing
8. DSP Processor,TMS 320C6713,DSK Experiments
9. TMS 320C6713-Real Time Processing

AV332	DIGITAL COMMUNICATION LAB	(0 - 0 - 3) 1 credit

1. Design and implementation of Pulse Amplitude Modulator and Demodulator.
2. Design and implementation of ASK, FSK, and PSK modulators and demodulators
3. Design and implementation of PWM and PCM modulators and demodulators
4. Design and implementation of DM and ADM modulators and demodulators
5. Design and study Time Division Multiplexer.
6. Design and study Frequency Division Multiplexer.
7. Eye Diagram -for studying the effects of intersymbol interference and other channel impairments.
8. Analysis of signal space constellation of different modulation schemes.
9. Comparison of different modulation with Bit Error rate using Simulink

AV333	CONTROL AND GUIDANCE LAB	(0 - 0 - 3) 1 credit

1. Modeling Simulation, control and implementation for
   Inverted pendulum
   Magnetic Levitation system
   Twin Rotor MIMO system
2. Realization and practical issue of PID controller
3. Actuator control for launch vehicle control
   Hands on experience with LEGO Programmable Robots

AV334	INSTRUMENTATION AND MEASUREMENT LAB	(0 - 0 - 3) 1 credit

1. Resistance measurement through Wheatstone bridge
   - DC excitation
   - AC excitation

2. Measurement of capacitance
    - Wein bridge
    - Schering bridge
    - Small variation in capacitance
3. Inductive transducers
    - Inductance measurement
    - LVDT
4. Variable resistivity transducers
    - Strain guage
    - Resistance of a salt solution
    - Variable area transducer
5. Measurement of temperature
    - Thermocouple
    - Thermistor
    - RTD
6. Light detector
    - Photo resistor
    - Photo transistor
    - Photo diode
7. Calibration of flow and level
8. Calibration of Value and pressure gauges
9. Dead weight tester for pressure calibration
10. PC based temperature calibrator
11. Mini Project

SEMESTER VI

AV321	COMPUTER NETWORKS	(3 -0 - 0) 3 credits

Network Topology, OS layers, Point to point and broadcast communications, Multi access protocols: Aloha, CSMA and its variations, Token Ring; Error Control Techniques; Flow control; Bridges, Repeaters, Switches and the spanning tree protocol. Network: Routing, Congestion control, LAN, WAN, MAN, Ethernet, TCP/IP protocols; Multicast and mobile routing, Sensor networks.

Textbook:

1. Andrew S. Tannenbaum, Computer Networks, PHI, Fourth Edition, 2003.

References:

1. James .F. Kurouse & W. Rouse, Computer Networking: A Topdown Approach Featuring, Pearson Education.
2. Behrouz A. Foruzan, Data communication and Networking, Tata McGraw-Hill, 2004.
3. William Stallings, Data and Computer Communication , Sixth Edition, Pearson Education, 2000.

AV322	POWER ELECTRONICS	(3 - 0 - 0) 3 credits

Elements of Power Electronics ; Converters - Converter Dynamics and Control; DC to DC conversion - Buck, Boost and Buck-Boost converters - circuit configuration and analysis with different loads ; Inverters - single phase and three phase bridge inverters and PWM inverters, Single phase AC voltage regulators and cyclo converter ; Applications - Drive application of power electronic converter, UPS, SMPS active power filters, electronic ballast, induction heater and advanced control of power electronic circuits using microprocessors, Introduction to conductor EMI.

Textbooks:

- M.H. Rashid, Power Electronics – Circuits, devices and applications, PHI, New Delhi, 1995.

References:

1. P.C. Sen, Modern Power Electroncis, Wheeler Publishers, New Delhi, 1998.
2. G.K. Dubey Doradia, S.R. Joshi and R.M. Sinha, Thyristorised Power Controllers, New Age International Publishers, New Delhi, 1996.
3. Ned Mohan, Tore M. Undeland, William P. Robbins, Power Electronics: Converters, Applications, and Design, 2nd Ed., 2005.

AV323	RADAR SYSTEMS	(3 - 0 - 0) 3 credits

Nature of Radar and Applications, Simple form of Radar Equation, Radar Block Diagram and Operation, Prediction of Range Performance, Minimum Detectable Signal, Radar Receivers,

Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, CW and Frequency Modulated Radar, MTI and Pulse Doppler Radar, Tracking Radar, Detection of Radar Signals in Noise, Airborne Radar, Space borne Radar, Synthesis aperture radar, SHAR and MST radar.

Textbooks/References:

1. M.I. Skolnik, Introduction to Radar Systems, McGraw hill, 2000.
2. M.I. Skolnik, Radar Handbook, McGraw hill, 2nd edition, 1990.
3. A.K. Sen and A.B. Battacharya, Radar Systems andRadar Aids to Naviation, Khanna Publications, 1988.

E01	ELECTIVE I	(3 - 0 - 0) 3 credits

ES321	INTRODUCTION TO SPACE SCIENCE AND APPLICATIONS	(2 - 0 - 0) 2 credits

Astronomy: overview of astronomy – know the sky – coordinate system – telescopes – flux magnitudes – stars, formation – solar system.

Atmospheric Science: earth's atmosphere, structure, classification, constituents – greenhouse effect – radiation budget – differential heating – general circulation – cloud formation and classification – solar radiation – interaction with planetary atmosphere.

Remote Sensing: basic concepts of remote sensing and data acquisition – satellite data processing – definition, need – examples of satellite data at different stages of correction.

Orbital Mechanics ans Satellites: Kepler's laws of planetary motion – equations of motion - orbit determination – concept of subsatellite point and ground trace – propagation of state vector from epoch to any desired time. Concept of attitude of satellite: impact of positive and negative roll, pitch and yaw on the image. Different types of sensors used: pushbroom whiskbroom, 2 D array, mirror scan – concept of integration time – instantaneous field of view – quantisation – resolution, spatial, temporal, radiometric and spectral. Choice of orbits: low earth orbiting – sun synchronous – definition – need and how to achieve the same - geostationary orbits.

Textbooks:

- Lecture Notes

HS321	PRINCIPLES OF MANAGEMENT SYSTEMS	(3 - 0 - 0) 3 credits

Personnel Management: Introduction – changing role of personnel manager – new people management – manpower planning – recruitment and selection – performance appraisal – workers participation in management – grievance handling.

Industrial Management: Management Functions – organization – principles of planning – management by objectives – organization structures – principles of organizing – span of control –

delegation, leadership, directing, and controlling.

Project Management: Development of project network – project representation – project scheduling – linear time-cost trade-offs in projects: a heuristic approach – project monitoring and control with PERT.

References:

1. Koontz H., O'Donnel, C., and Weihrich, H., Essentials of Management, McGraw-Hill (1990).
2. Venkataratnam, C. S. and Srivastava, B. K., Personnel Management and Human Resources, Tata McGraw-Hill (1991).
3. Mazda F., Engineering Management, Prentice Hall (1997).
4. Gido, J. and Clements, J. P., Successful Project Management, 2nd ed., South-Western College Publishing (2003).
5. Khanna, O. P., Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd. (2003).
6. Memoria, C. B. and Gankar, S. V., Personnel Management - Text and Cases, Himalaya Publishing House (2007).

AV341	COMPUTER NETWORKS LAB	(0 - 0 - 3) 1 credit

1. Basics of Network Simulator NS-2
2. Usage of 'awk' parser and trace file formats.
3. Goodput Vs Throughput measurement
4. Comparison of Static Vs Dynamic Routing
5. Ethernet behaviour
6. Early Packet Drop Regimes
7. Switching schemes
8. Routing Protocols
9. Multicast Routing Protocols
10. TCP Congestion Control methods

AV342	POWER ELECTRONICS LAB	(0 - 0 - 3) 1 credit

Part I – Simulation using MATLAB and PSpice

- Uncontrolled and Controlled rectification
- Dc-dc converters
- Inverters
- Drives

Part II – Laboratory practice

- Study of SCR and determination of SCR parameters
- R and RC firing circuits for thyristors
- Controlled and uncontrolled rectifier circuits.
- Dc Motor Speed Control
- Linear and Switching Regulator
- DC - DC converter design

- Motor Drive experiments
- Solar power array simulation.

SEMESTER VII

AV411	NAVIGATION SYSTEMS AND SENSORS	(3 - 1 - 0) 4 credits

Introduction to navigation, vehicle modeling, beacon-based navigation systems. Introduction to Inertial Sensors and Inertial Navigation. Initial Calibration and Alignment algorithms. Global Positioning System (GPS). GPS /INS data fusion algorithms. Simultaneous Localization and Mapping (SLAM), Practical applications of vehicle navigation systems in both structured and unstructured environments, sensor fusion.

Textbooks/References:

1. Slater J.M., Donnel C.F.O, Onertial Navigation analysis and design, McGraw Hill, New York, 1964.
2. Myron Kyton, Walfred Fried, Avionics Navigation systems, 2nd edition, John Willy & Sons, 1997.
3. Albert D Helfrick, Modern Aviation Electronics: 2nd Ed., PHI, 1994.

E02	ELECTIVE II	(3 - 0 - 0) 3 credits

E03	ELECTIVE III	(3 - 0 - 0) 3 credits

E04	ELECTIVE IV	(3 - 0 - 0) 3 credits

I01	INSTITUTE ELECTIVE	(3 - 0 - 0) 3 credits

AV431	NAVIGATION SYSTEMS AND SENSORS LAB	(0 - 0 - 3) 1 credit

- 3D Gyro
- Servo Accelerometer
- Checkout Systems
- Un manned aerial vehicle system
- Hexapod

AV451	SUMMER INTERNSHIP AND TRAINING	(0 - 0 - 0) 3 credit

AV452	COMPREHENSIVE VIVA-VOCE I	(0 - 0 - 0) 2 credits

SEMESTER VIII

AV453	**COMPREHENSIVE VIVA-VOCE II**	**(0 - 0 - 0) 3 credits**

AV454	**PROJECT WORK**	**(0 - 0 - 0) 12 credits**

ELECTIVE COURSES

AV461	ADVANCED CONTROL THEORY	(3 - 0 - 0) 3 credits

State space Approach: State space modeling of physical systems – diagonal and Jordan canonical forms - Solution of Linear Time Invariant (LTI) state equation – Cayley Hamilton theorem – Controllability and Observability Tests – Kalman decomposition technique - Controller design by state feedback – Full order/reduced order observer design – observer based state feedback control - stability definitions in state space domain.

Adaptive control theory: System Identification – Frequency – Impulse – Step Response methods –Off-line – on line methods – Least square – Recursive least square – fixed memory – stochastic approximate method. MRAS & STC: The gradient approach – MIT rule Liapunov Functions – Pole placement control – minimum variance control – Predictive control.

Text Books:

1. Karl.J.Astrom, Bjorn Witten Mark, Adaptive Control, 2nd Ed., Pearson Education Pvt. Ltd.
2. M.Gopal, 'Digital Control Systems and State Space Method', 3rd Ed., TMH, 2008.

References:

1. Katsuhiko Ogata, 'Modern Control Engineering', PHI -India, New Delhi 1989.
2. Fairman, 'Linear Control Theory: State Space Approach', John Wiley, 1998.
3. John S. Bay, 'Fundamentals of Linear State Space Systems', McGraw Hill, 1998.
4. Isermann R, 'Digital Control System vol. I & II', Narosa Publishing House, Reprint 1993.
5. Mendal JM, 'Discrete Technique of Parameter Estimate', Marcel Dekkas, New York, 1973.

AV462	EMBEDDED SYSTEM AND REAL TIME OS	(3- 0 - 0) 3 credits

Review of Embedded Hardware: Gates - Timing Diagram- Memory –microprocessors. Interrupts Microprocessor Architecture-Interrupt Basics-Shared Data Problem-Interrupt latency. Software Development: Round–Robin, Round robin with Interrupts, function-Queue- Scheduling Architecture, Algorithms. Introduction to - Assembler- Compiler –Cross Compilers and Integrated Development Environment (IDE). Object Oriented Interfacing, Recursion, Debugging strategies, Simulators. Embedded Microcomputer Systems - Motorola MC68H11: Motorola MC68H11 Family Architecture, Interfacing methods Microchip PIC Micro controller: Introduction, CPU Architecture- Registers- Instruction sets addressing modes- Loop timing- Timers- Interrupts, Interrupt timing, I/O Expansion, I2C Bus Operation Serial EEPROM, Analog to Digital converter, UART-Baud Rate-Data Handling-Initialization, Special Features – Serial Programming-Parallel Slave Port.

Real Time Operating Systems: Task and Task States, Tasks and data, Semaphores and shared Data Operating system Services-Message queues-Timer function-Events-Memory Management, Interrupt Routines in an RTOS environment, Basic design using RTOS.

Text/Reference Books:

1. Wayne Wolf, Computers as Components - Principles of Embedded Computer System Design, Morgan Kaufmann Publisher, 2006.
2. David E-Simon, An Embedded Software Primer, Pearson Education, 2007.
3. K.V.K.K.Prasad, Embedded Real-Time Systems: Concepts, Design & Programming, dreamtech press, 2005.
4. Tim Wilmshurst, An Introduction to the Design of Small Scale Embedded Systems, Pal grave Publisher, 2004.

5. Sriram V Iyer, Pankaj Gupta, Embedded Real Time Systems Programming, Tata Mc-Graw Hill, 2004.
6. Tammy Noergaard, Embedded Systems Architecture, Elsevier,2006.

AV463 SOFT COMPUTING (3- 0 - 0) 3 credits

Introduction of Soft-computing tools - Neural Networks, Fuzzy Logic, Genetic Algorithm, and Probabilistic Reasoning; Neural network approaches in engineering analysis, design and diagnostics problems; Applications of Fuzzy Logic concepts in Engineering Problems; Engineering optimization problem solving using genetic algorithm; applications of probabilistic reasoning approaches.

Text/Reference Books:

1. S. Rajasekaran and G.A.Vijaylakshmi Pai.. Neural Networks Fuzzy Logic, and Genetic Algorithms, Prentice Hall of India.
2. K.H.Lee.. First Course on Fuzzy Theory and Applications, Springer-Verlag.
3. J. Yen and R. Langari.. Fuzzy Logic, Intelligence, Control and Information, Pearson Education.

AV464 ADVANCED DSP AND ADAPTIVE FILTER (3- 0 - 0) 3 credits

Discrete Random Process: Expectation, Variance and Co-variance, Uniform, Gaussian and Exponentially distributed noise, Hillbert space and inner product for discrete signals, Energy of discrete signals, Parseval's theorem, Wiener Khintchine relation, power spectral density, Sum decomposition theorem, Spectral factorization theorem. Spectrum Estimation : periodogram, Non – parametric methods of spectral estimation Correlation method, WELCH method –AR, MA, ARMA models. Tule – Walker method. Linear Estimation and Prediction: ML estimate – Efficiency of estimator, Cramer Rao bound - LMS criterion. Wiener filter – Recursive estimator – Kalman estimator – Linear prediction, Analysis and synthesis filters, Levinson resursion, Lattice realization. Adaptive filters: FIR adaptive filter – Newton's Steepest descent algorithm – Widrow Hoff LMS adaptation algorithms – Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellors.

Text/Reference books:

1. M. Hays: Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996.
2. Simon Haykin: Adaptive Filter Theory, Prentice Hall, 1996
3. "Adaptive Filters :Theory and Applications", by B. Farhang-Boroujeny, John Wiley and Sons, 1999.
4. John G Proakis and Manolakis, " Digital Signal Processing Principles, Algorithms and Applications", Pearson, Fourth Edition, 2007.
5. Sophocles J. Orfanidis, Optimum Signal Processing, An Introduction, McGraw Hill,1990.

AV465 ROBUST AND OPTIMAL CONTROL (3- 0 - 0) 3 credits

Signals and systems, Vector space, Norms, Matrix theory: Inversion formula, Schur's complement, Singular Value Decomposition, Positive definiteness; Linear Matrix Inequality: Affine function, Convexity, Elimination lemma, S-procedure; Calculus of variation, Euler's Theorem, Lagrange multiplier. Linear fractional transformation (LFT), Different uncertainty structures: Additive, Multiplicative, Uncertainty in Coprime factors; Concept of loop shaping, Bode's Gain and phase relationship, Small Gain theorem. LQR, LQG, Hamiltonian matrix, Riccati

equation, H-infinity control, H-infinity Controller design via DGKF and LMI techniques, H-infinity loop shaping technique, Structured singular value (mu) synthesis, Design examples.

Text/Reference Books:

1. D.S.Naidu, Optimal Control Systems, CRC Press
2. Sinha, Linear Systems Optimal and Robust Control, CRC Press
3. D.E.Kirk, Optimal Control Theory An Introduction, PHI.
4. K.Morris, Introduction to Feedback Control, Academic Press.
5. Helton, Merino, Classical Control using H∞ Methods, 1/e, SIAM Publications
6. Ozbay, Introduction to Feedback Control Theory, CRC Press
7. Gu, Petkov, Konstantinov, Robust Control Design with MATLAB, Springer India
8. Qiu, Zhou, Introduction to Feedback Control, Prentice Hall, 2009.

AV466 ESTIMATION AND STOCHASTIC THEORY (3- 0 - 0) 3 credits

Elements of probability theory - random variables-Gaussian distribution-stochastic processes-characterizations and properties-Gauss-Markov processes-Brownian motion process-Gauss-Markov models - Optimal estimation for discrete-time systems - fundamental theorem of estimation-optimal prediction.

Optimal filtering - Weiner approach-continuous time Kalman Filter-properties and implementation-steady-state Kalman Filter-discrete-time Kalman Filter-implementation-sub-optimal steady-state Kalman Filter-Extended Kalman Filter-practical applications.

Optimal smoothing - 0ptimal fixed-interval smoothing optimal fixed-point smoothing-optimal fixed-lag smoothing-stability-performance evaluation.

Text/Reference books:

1. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan: Statistical Signal Processing with Applications, PHI, 1996.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon: Statistical and Adaptive Signal Processing, McGraw Hill, 2000.
3. S. M. Kay: Modern Spectral Estimation, Prentice Hall, 1987.
4. H. V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2/e, 1998.
5. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993.
6. M.S. Grewal, A.P. Andrews, “Kalman filtering : Theory and Practice”, Second edition, John Wiley & Sons, 2001.
7. C.K. Chui, G. Chen, “Kalman Filtering with Real-Time Applications”, Third edition, Springer-Verlag,1999.
8. R.G. Brown, Y.C. Hwang, “Introduction to Random Signals and Applied Kalman Filtering”, Second edition, John Wiley & Sons, 1992.

AV467 INTRODUCTION TO OPTIMIZATION AND OR (3- 0 - 0) 3 credits

Vector spaces and matrices, transformations, eigenvalues and eigenvectors, norms; geometrical concepts -- hyperplanes, convex sets, polytopes and polyhedra; unconstrained optimization -- condition for local minima; one dimensional search methods -- golden section, fibonacci, newtons, secant search methods; gradient methods -- steepest descent; newton's method, conjugate direction methods, conjugate gradient method; constrained optimization -- equality conditions, lagrange condition, second order conditions; inequality constraints -- karush-kuhn-tucker condition; convex optimization; introduction to assignment problem, decision analysis,

dynamic programming and linear programming;

Text/Reference Books:

1. An Introduction to Optimization, Edwin K. P. Chong and Stanislaw H. zak, Wiley Interscience, 2008.
2. D. G. Luenberger, Optimization by vector space methods, New York, Wiley, 1969.
3. Convex Optimization Theory, D. P. Bertsekas, Athena Scientific optimization and computation series, 2009
4. Introduction to Operations Research, rederick S. Hillier, Gerald J. Lieberman, McGraw-Hill, 2010

AV468	DIGITAL CONTROL SYSTEM	(3- 0 - 0) 3 credits

Digital control systems – sample and hold systems - Jury stability criterion – Implementation of digital controllers – tunable PID controllers – Digital compensator design using root locus and frequency response methods.

Linear versus nonlinear systems - Describing function analysis - common nonlinearities - Analysis of non-linear systems using phase plane technique - condition for stability - Stability in the sense of Lyapunov and absolute stability - Popov's stability criterion - Lure's Transformation. Non-linear control system design problem - Concept of variable - structure controller and sliding control.

Text Book:

1. M.Gopal, 'Digital Control and State variable methods: Conventional and Intelligent control systems', Tata McGraw Hill, 3rd Ed., 2009.

Reference books:

1. H. K. Khalil, 'Nonlinear Systems', Prentice Hall, 3rd Ed., 2002.
2. S.Sastry, 'Nonlinear Systems: Analysis, Stability and Control', Springer, 1999.
3. Nijmeijer, Henk, Schaft, Arjan van der, 'Nonlinear Dynamical Control Systems', Springer, 1990.
4. Graham, McRuer, Analysis of Nonlinear Control Systems.

AV469	EMI / EMC	(3- 0 - 0) 3 credits

Aspects of EMC with examples, Common EMC units, EMC requirements for electronic systems, Radiated emissions, Conducted emissions, ESD. Application of EMC design, Wires, PCB lands, Component leads, resistors, capacitors, inductors, and ferrites. Electromechanical devices, Digital circuit devices. Mechanical switches (as suppression) , Simple emission models for wires and PCB lands, Lice impedance stabilization network (LISN) , Power supply filters. Power supplies including SMPS. Three conductor lines and crosstalk, Shielded wires, Twisted wires, Multiconductor lines and effects of incident fields, Shielding, Origin effects, prevention of ESD event, its hardware and immunity. System design for EMC, Grounding, System configuration, PCB design.

Text/Reference books:

1. William Duff G., & Donald White R. J, "Series on Electromagnetic Interference and Compatibility", Vol. 5, EMI Prediction and Analysis Technique – 1972.

2. V.P. Kodali, “Engineering Electromagnetic Compatibility”, S. Chand, 1996.
3. Weston David A., “Electromagnetic Compatibility, Principles and Applications”, 1991.
4. Kaiser B. E., “Principles of Electromagnetic Compatibility”, Artech House, 1987.

AV470	DIGITAL IMAGE PROCESSING	(3- 0 - 0) 3 credits

Digital Image Fundamentals: Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations.
Image fundamentals and image restoration: Spatial Domain methods-Spatial filtering:- Frequency domain filters –Model of Image Degradation/restoration process – Noise models – Inverse filtering -Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse – Singular value decomposition.

Multi-resolution Analysis and Compression: Multi Resolution Analysis: Image Pyramids – Multi resolution expansion – Wavelet Transforms. Image compression: Fundamentals Elements of Information Theory – Error free compression – Lossy Compression – Compression Standards. Wavelet coding – Basics of Image compression standards: JPEG, MPEG, Basics of Vector quantization.

Image Segmentation and Image Analysis: Edge detection – Thresholding - Region Based segmentation – Boundary representation: boundary descriptors: Texture, Motion image analysis. Color Image Processing – Color Models-Color Image enhancement-Segmentation
Object Recognition and Image Understanding: Patterns and pattern classes - Decision-Theoretic methods - Structural methods-3D Vision

Text Book:

1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Education 2009.

References:

1. William K Pratt, Digital Image Processing John Willey, 2001.
2. Millman Sonka, Vaclav hlavac, Roger Boyle, Broos/colic, Image Processing Analysis and Machine Vision –, Thompson Learniy, 1999.
3. A.K. Jain, Fundamentals of Digital Image Processing, PHI, New Delhi, 1995.
4. Chanda Dutta Magundar , Digital Image Processing and Applications, Prentice Hall of India, 2000.

AV471	VLSI DESIGN	(3- 0 - 0) 3 credits

Introduction, Manufacturing process: CMOS integrated circuits, Device Physics: MOSFET, CMOS inverter: Characteristics, Static and Dynamic Logic Gates, Sequential logic Gates, Implementation for Digital ICs. Timing Issues in Digital Circuits, Designing Memory and Array Structures.

Text Book:

1. Jan M Rabaey,Anantha Chandrakasan,Borivoje Nikolic, Digital Integrated Circuits, Prentice Hall, 2002.

Reference Books:

1. Pucknell, Basic VLSI Design, Prentice Hall, 2008.
2. Fabricius, Eugene D, Introduction to VLSI Design, McGraw-Hill, 1990.

3. Neil H E Weste,Kamran Eshraghian, Principles of CMOS VLSI Design,A system perspective, Addison-Wesley, 1985.
4. R Jacob Baker ,Harry ,David E, CMOS Circuit Design ,Layout ,and Simulation, Willy, 2011.

AV472	OPTO - ELECTRONICS AND FIBER OPTICS COMMUNICATION	(3- 0 - 0) 3 credits

Review of P-N jn-characteristics – semiconductor-hetero junction-LEDs (-spontaneous emission-LED structure-surface emitting-Edge emitting-Injection efficiency- recombination efficiency-LED characteristics-spectral response-modulation-Band width. Laser diodes-Basic principle-condition for gain-Laser action-population inversion-stimulated emission-Injection faster diode-structure-temperature effects-modulation-comparison between LED and ILDs. Optical detectors-principle-absorption coefficient-detector characteristics-Quantum efficiency-responsivity-response time-bias voltage-Noise in detectors P-N junction-photo diode -B. W-Noise-photo transistor. Optical Fibre-structure - propagation-wave equation-phase and group velocity-transmission characteristics-attenuation-absorption-scattering losses-dispersion-fibre bend losses-source coupling, splices and connectors-wave length division multiplexing. Optical fibre system-system design consideration-fibre -source limitations -pre-amplifier-equalization-Fibre-optic link analysis-typical lira design.

Text Book:

1. Gerd Keiser, Optical Fiber Communications, 3rd Edition, McGraw Hill Publications, 2000.

Reference Books:

1. Pallab Bhattacharya, Semiconductor Opto electronics Devices, Pearson Education
2. John M Senior Optical fibre Communication Systems-Principles and practice, PHI.
3. John Gower, Optical communication Systems, PHI.

AV473	INFORMATION THEORY AND CODING	(3- 0 - 0) 3 credits

Sources-memoryless and Markov; Information; Entropy; Extended sources; Shannon's noiseless coding theorem; Source coding; Mutual information; Channel capacity; BSC and other channels; Shanon's channel capacity theorem; Continuous channels; Comparison of communication systems based on Information Theory; Channel Coding-block and convolutional. Block codes-majority logic decoding; Viterbi decoding algorithm; Coding gains and performance.

Text/Reference books:

1. Shu Lin & Daniel J. Costello.Jr., Error Control Coding : Fundamentals and Applications, Prentice Hall Inc.,Englewood Cliffs, NJ.
2. Thomas M. Cover, Joy A. Thomas, Elements of Information theory, 2nd ed., John Wiley & Sons Pvt. Ltd.
3. Simon Haykin. Communication Systems, 3rd ed., John Wiley & Sons Pvt. Ltd.
4. Taub & Schilling. Principles of Communication Systems, 2nd ed., TataMcGraw Hill, New Delhi.
5. Das, Mullick & Chatterjee. Principles of Digital Communication, Wiley Eastern Ltd.
6. The theory of error-correcting codes by F. J. MacWilliams and N. J. A. Sloane (North-Holland publishers).
7. Algebraic codes for data transmission by Richard Blahut (Cambridge).

AV474	CRYPTOGRAPHY	(3- 0 - 0) 3 credits

Introduction to number theory – Symmetric key and Public key crypto systems which includes pseudorandom functions and permutations, block ciphers, symmetric encryption schemes, security of symmetric encryption schemes, hash functions, message authentication codes (MACs), security of MACs, PKI, public-key(asymmetric) encryption, digital signatures, security of asymmetric encryption and digital signature scheme.

Chaos base cryptography systems – quantum computing – introduction to smartcard technology.

Text/Reference books:

1. William Stallings, "Cryptography And Network Security – Principles and Practices", Pearson Education, Third Edition, 2003.
2. Behrouz A. Foruzan, "Cryptography and Network Security", Tata McGraw-Hill, 2007
3. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.
4. Wade Trappe and Lawrence C. Washington , " Introduction to Cryptography with coding theory" , Pearson Education, 2007.
5. Wenbo Mao, " Modern Cryptography Theory and Practice" , Pearson Education, 2007.
6. Thomas Calabrese, "Information Security Intelligence: Cryptographic Principles and Applications", Thomson Delmar Learning,2006.

AV475	MOBILE COMMUNICATION	(3- 0 - 0) 3 credits

Cellular Concept: Frequency Reuse, Channel Assignment, Hand Off, Interference and System Capacity, Tracking And Grade Of Service, Improving Coverage and Capacity In Cellular Systems.

Mobile Radio Propagation : Free Space Propagation Model, Outdoor Propagation Models, Indoor Propagation Models, Small Scale Multipath Propagation, Impulse Model, Small Scale Multipath Measurements, Parameters Of Mobile Multipath Channels, Types Of Small Scale Fading, Statistical Models For Multipath Fading Channels.

Modulation Techniques: Minimum Shift Keying, Gaussian MSK, M-ARY QAM, M-ARY FSK, Orthogonal Frequency Division Multiplexing, Performance of Digital Modulation In Slow-Flat Fading Channels And Frequency Selective Mobile Channels.

Equalization: Survey of Equalization Techniques, Linear Equalization, Non-Linear Equalization, Algorithms for Adaptive Equalization. Diversity Techniques, Rake Receiver. **Coding:** Vocoders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM Codec and RS Codes for CDPD.

Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Capacity of Cellular CDMA and SDMA.

Wireless Systems and Standards: Second Generation and Third Generation Wireless Networks and Standards, WLL, Blue Tooth. AMPS, GSM, IS-95 and DECT

Text Book:

1. T. Rappaport, "Wireless Communication: Principles and Practice", Prentice Hall PTR

References:

1. Palanivelu, T. G. ,Nakkeeran, R, "Wireless And Mobile Communication", PHI.
2. **Stüber**, Gordon L.," Principles of Mobile Communication**"** 2nd ed., Springer publications.

AV476	MICROWAVE INTEGRATED CIRCUITS	(3- 0 - 0) 3 credits

Introduction to microwave integrated circuits: Active and passive components. Analysis of microstrip lines: variational method, conformal transformation, numerical analysis; losses in

microstrip lines; Slot line and Coupled lines; Design of power dividers and combiners, directional couplers, hybrid couplers, filters. Microstrip lines on ferrite and garnet substrates; Isolators and circulators; Lumped elements in MICs. Technology of MICs: Monolithic and hybrid substrates; thin and thick film technologies, computer aided design.

Text/Reference books:

1. Davis W. Alan, Van, Microwave Semiconductor Circuit Design, Nostrand, Reinhold, 1984.
2. Gonzalez G., Microwave Transistor Amplifier: Analysis and Design, Prentice Hall 1984.
3. Samuel Y. Liao, Microwave Circuit Analysis and Amplifier Design, Prentice Hall 1987.
4. Ralph S. Carson, High Frequency Amplifier, Wiley Interscience, 1982.

AV477 ANTENNA ENGINEERING (3- 0 - 0) 3 credits

Antenna Fundamentals -Common Types of Antennas -Fundamentals and Definitions - Directivity -Antenna Gain and Efficiency -Antennas in Communications Links -Wire Antennas- Radiation Integrals and Auxiliary Potential Functions - Solutions of the Inhomogeneous Vector Potential Wave Equation - Linear Wire Antennas – The Ideal Dipole - Electrically Short or Small Dipoles - The Half-Wave Dipole - The Dipole of Arbitrary Length - Antennas on or Near PEC Ground Planes - Antenna Arrays and Impedance - Antenna Arrays - Graphical Method for Developing the Radiation Pattern- Pattern Multiplication Theorem with Examples - Half-Power Beam Width (HPBW) -Directivity - Even Element Linear Array with Uniform Spacing and Nonuniform Excitation - Directivity for Binomial Arrays -Planar Arrays -Mutual Impedance and Driving Point Impedance of Antenna Arrays -Yagi-Uda Antennas

Text/Reference Books:

1. Constantine A. Balanis, Antenna Theory, Analysis and Design, Second edition, John Willey and Son, Inc.
2. Warren L. Stutzman, Gary A. Thiele, Antenna Theory and Design, 2nd Edition, John Willey and Son, Inc.

AV478 SATELLITE COMMUNICATION (3- 0 - 0) 3 credits

Basic Principles- General features, frequency allocation for satellite services, properties of satellite communication systems. Satellite Orbits- Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping. Satellite Construction - attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification. Satellite Links-, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain. Earth Station - earth station subsystem, different types of earth stations. The Space Segment Access and Utilization-space segment access methods, TDMA, FDMA, CDMA, SDMA, assignment methods.

Text Book:

1. Dennis Roddy, Satellite Communications, McGraw-Hill Publication Third edition 2001

Reference Books:

1. Timothy Pratt – Charles Bostian & Jeremy Allmuti, Satellite Communications, John Willy & Sons (Asia) Pvt. Ltd. 2004.
2. Wilbur L. Pritchars Henri G.Suyder Hond Robert A.Nelson, Satellite Communication Systems Engineering, Pearson Education Ltd., Second edition 2003.
3. M.Richharia, Satellite Communication Systems Design Principles, Macmillan Press Ltd. Second Edition, 2003.

AV479 COMPUTER GRAPHICS (3- 0 - 0) 3 credits

Graphics hardware and display devices; graphics primitives- drawing lines and curves; 2d and 3d transformations; segments and their applications; generating curves, surfaces and volumes in 3d, wire-frame models, Bezier and spline curves and surfaces; geometric modeling- elementary geometric algorithms for polygons, boundary representations, constructive solid geometry, spatial data structures; hidden surface and line elimination; rendering- shading, light models, realistic image synthesis techniques, textures and image-based rendering; video games and computer animation.

Text/Reference Books:

1. Foley, van Dam, Feiner and Hughes, Computer Graphics (Principles and Practice), Addisen Wesley.
2. D Hearn and P M Baker, Computer Graphics, Printice Hall of India.
3. D F Rogers, Mathematical Elements for Computer Graphics, McGraw Hill.
4. D F Rogers, Procedural Elements for Computer Graphics, McGraw Hill.
5. Edward Angele, Interactive Computer Graphics, A top-down approach with OpenGL, Addisen Wesley.
6. G Farin, Curves and Surfaces for Computer Aided Geometric Design, Academic Press.

AV480 GRAPH THEORY AND OR (3- 0 - 0) 3 credits

Graphs -- paths and circuits, trees and fundamental circuits, cut-sets and cut-vertices, planar and dual graphs, vector spaces of graphs, matrix representation of graphs; transport networks, maximal flow, linear programming, minimal cut, maxflow-mincut theorem, minimal-cost flows, multicommodity flow, activity network, game theory.

Text/Reference Books:

1. Narsingh Deo, Graph Theory With Applications To Engineering And Computer Science, PHI, Indi, 1974
2. T. B. Boffey, Graph theory in operations research, Macmillan, 1982

AV481 MODERN ALGEBRA AND TENSORS (3- 0 - 0) 3 credits

Sets, groups, fields, rings, isomorphisms, vector spaces, modules; vectors and tensors in a finite-dimensional space, vector and tensor analysis in euclidean space, curves and surfaces in three-dimensional euclidean space, eigenvalue problem and spectral decomposition of second-order tensors, fourth order-tensors.

Text/Reference Books:

1. William J. Gilbert, W. Keith Nicholson, Modern Algebra with Applications, John Wiley and Sons, 2004.
2. Mikhail Itskov, Tensor Algebra and Tensor Analysis for Engineers, Springer, 2008.

AV482	DATA STRUCTURE AND DBMS	(3- 0 - 0) 3 credits

Review of basic data structures and their realization in object oriented environment. The following topics will be covered with emphasis on formal analysis and design, Dynamic Data structures; 2-3 trees, Red-black trees, binary heaps, binomial and Fibonacci heaps, Skip lists, universal hashing. Data structures for maintaining ranges, intervals and disjoint sets with applications. Basic algorithmic techniques like dynamic programming and divide- and-conquer, Sorting algorithms with analysis, integer sorting algorithms with analysis, integer selection, Graph algorithms like DFS with applications, MSTs and shortest paths.

Database System Architecture - Data Abstraction, Data Independence, Data Definition and Data Manipulation Languages. Data Models - Entity-Relationship, Network, Relational and Object Oriented Data Models, Integrity Constraints, and Data Manipulation Operations. Relational Query Languages: Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE. Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design. Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms. Storage Strategies: Indices, B-trees, Hashing; Transaction Processing : Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic Concurrency Control schemes. Advanced Topics; Object-oriented and Object Relational Databases, Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.

Text/Reference Books:

1. Gregory L. Heileman , Data Structure, Algorithm and OOP, Tata Mc Graw Hill, NewDelhi.
2. Adam Drozdek, Data Structures & Algorithm in C++,Vikas publication House.
3. Silberschatz, H. Korth, Database System Concepts, 5th Edition, McGraw-Hill.
4. Raghu Ramakrishnan, Database Management Systems, Johannes Gehrke 4th Edition, McGraw-Hill

AV483	SOFTWARE ENGINEERING	(3- 0 - 0) 3 credits

S/W life cycle; problem of S/W production and the need for S/W engineering; Concepts and techniques relevant to production of large software systems: Structured programming, top-down design and development, information hiding; strength, coupling and complexity measures; procedural, data, and control abstraction; specifications; organization and management of large software design projects; program libraries; documentation, design methods and testing; several programming projects of varying size undertaken by students working singly and in groups using software specification tools, S/W project management; parameter for cost estimation.

Text/Reference Books:

1. Roger Pressman.S., Software Engineering : A Practitioner's Approach,(3rd Edition), McGraw Hill, 1997.
2. I Sommerville, Software Engineering V edition: , Addison Wesley, 1996.
3. P fleeger, Software Engineering, Prentice Hall, 1999.
4. Carlo Ghezzi, Mehdi Jazayari, Dino Mandrioli, Fundamental of Software Engineering, Prentice Hall of India 1991.

AV484	WIRELESS MESH NETWORK	(3- 0 - 0) 3 credits

Introduction and overview of Wireless Mesh Networks, Evolution of Wireless Mesh Networks, Architectural issues in Wireless Mesh Networks, Capacity of Wireless Mesh Networks, Layer-wise Protocol design issues in Wireless Mesh Networks, MAC layer protocols for Wireless Mesh Networks, Network layer protocols for Wireless Mesh Networks, Transport layer protocols for Wireless Mesh Networks, Load Balancing in Wireless Mesh Networks, Wide Area Wireless Mesh Networks, Design issues for Wide Area Wireless Mesh Networks, Resource allocation problems in Wireless Mesh Networks, Hybrid wireless mesh networks including WiMAX networks, and Layer-wise open research problems on protocol design for Wireless Mesh Networks.

Text/Reference Books:

1. Yan Zhang, Jijun Luo, and Honglin Hu, Wireless Mesh Networking: Architectures, Protocols and Standards, Auerbach Publications, December 2006.
2. Ian Akyildiz and Xudong Wang, Wireless Mesh Networks, John Wiley and Sons, March 2009.
3. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks: Architectures and Protocols, Prentice-Hall PTR, New Jersey, May 2004.

AV485	MICROELECTRONICS AND MICROSYSTEM TECHNOLOGIES	(3- 0 - 0) 3 credits

Introduction to Microelectronics and Microsystems: Classical scaling in CMOS, Moore's Law - Clean room concept, Growth of single crystal Si, Cleaning and etching -Thermal oxidation of silicon - Dopant diffusion in silicon - Thin film deposition (PVD, CVD, ALD etc.) - Ion-implantation – Lithography – Etching - CMOS Process integration- Advanced CMOS devices.

Microelectronic technologies for MEMS: MEMS Materials , Surface and Bulk Micromachining - MEMS Micro sensors, and applications - Mechanical, Inertial, Biological, Chemical, RF Applications etc. - Bonding & Packaging of MEMS - CMOS-MEMS Integration

Text/Reference books:

1. James Plummer, M. Deal and P.Griffin, Silicon VLSI Technology, Prentice Hall Electronics
2. Stephen Campbell, The Science and Engineering of Microelectronics, Oxford University Press, 1996
3. S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill, 1988
4. C.Y. Chang and S.M.Sze (Ed), ULSI Technology, McGraw Hill Companies Inc, 1996.
5. Marc Madau, Fundamentals of Microfabrication Science of Miniaturization, CRC Press
6. Tai-Ran Hsu MEMS & Microsystems: Design, Manufacture, and Nanoscale Engineering, 2nd Edition
7. S. D. Senturia, Microsystem Design, 2005.
8. G. K. Ananthasuresh , K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat , V. K. Aatre Micro and Smart Systems Technology and Modeling, 2012