Civil, Electrical & Mechanical Engineering Department

1st Semester

Teaching Scheme

Division A

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
MA 181001	Mathematics (Calculus)	3	2	0	5
PH 181001	Physics-I	2	1	0	3
HS 181001 / HS 181002	Indian English Literature & Language / Functional English & Comprehension	3	0	2	4
CE 181001 / EE 181001 / ME 181001	I to I civil/Elec/Mech	2	0	0	2
PH 181101	Physics Laboratory	0	0	3	1.5
CH 181001	Chemistry	3	1	0	4
GE 181001	Engineering Graphics	2	0	3	3.5
CH 181101	Chemistry Laboratory	0	0	3	1.5
	Total	**15**	**4**	**11**	**24.5**

Division B

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
MA 181001	Mathematics (Calculus)	3	2	0	5
PH 181001	Physics-I	2	1	0	3
HS 181001 / HS 181002	Indian English Literature & Language / Functional English & Comprehension	3	0	2	4
CE 181001 / EE 181001 / ME 181001	I to I civil/Elec/Mech	2	0	0	2
PH 181101	Physics Laboratory	0	0	3	1.5
CS 181001	Computer Science	2	1	3	4.5
GE 181002	Manufacturing Science and Workshop	2	0	3	3.5
	Total	**14**	**4**	**11**	**23.5**

Civil, Electrical & Mechanical Engineering Department

2nd Semester

Teaching Scheme

Division A

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
MA 181002	Mathematics (ODE+Linear Algebra with V. calculus)	4	2	0	6
PH 181002	Physics-II	3	2	0	5
EE 181002	Basic Electrical And Electronics Engineering	2	1	2	4
CS 181001	Computer Science	2	1	3	4.5
GE 181002	Manufacturing Science and Workshop	2	0	3	3.5
	Total	**13**	**6**	**8**	**23**

Division B

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
MA 181002	Mathematics (ODE+Linear Algebra with V. calculus)	4	2	0	6
PH 181002	Physics-II	3	2	0	5
EE 181002	Basic Electrical And Electronics Engineering	2	1	2	4
CH 181001	Chemistry	3	1	0	4
GE 181001	Engineering Graphics	2	0	3	3.5
CH 181101	Chemistry Laboratory	0	0	3	1.5
	Total	**14**	**6**	**8**	**24**

Mathematics Curriculum for Semester - I

I	Course Code	**MA 181001**			
II	Course Title	**Mathematics I : Calculus**			
III	Credit Structure	L	T	P	C
		3	2	0	5
IV	Course Content	1. Limit, Continuity, Limit at infinity, infinite limits, asymptotes, limit of sequences, Continuity and differentiability, IVT 2. Linear Approximation and differentials, Maximum and Minimum Values, The Mean Value Theorems, Increasing and decreasing functions, concavity and curve sketching ,Indeterminate Forms and L'Hospital's Rule, Taylor's theorem 3. Area, Riemann sums, the definite integral, the fundamental theorem of calculus 4. Application of Definite integrals-Areas between Curves, Volumes 5. Volumes by Cylindrical Shells, Work, Average Value of a Function, Arc Length, Area of a Surface of Revolution, Improper Integrals. 6. Three-Dimensional Coordinate Systems, Equations of Lines and Planes, Cylinders and Quadric Surfaces, Cylindrical Coordinates, Spherical Coordinates 7. Functions of Several Variables, Limits and Continuity, Partial Derivatives, Tangent Planes and Linear Approximations, The Chain Rule, Directional Derivatives and the Gradient Vector 8. Vector functions, Vector Functions and Space Curves, Derivatives and Integrals of Vector Functions, Arc Length and Curvature, Motion in Space: Velocity and Acceleration 9. Vector fields, Gradient, Curl and Divergence 10. Extreme values and saddle points of functions of several variables, Constrained optimization, Lagrange Multiplier Method.			
V	Text/References	1. Thomas, G.B., and Finney, R.L., Calculus and Analytic Geometry, 9th Edition, ISE Reprint, Addison-Wesley, 1998. 2. Stewart, J., Calculus, 5th Edition, Thomson, 2003. 3. Marsden, J.E., Tromba, A.J., and Weinstein, A., Basic multivariable calculus, Springer India, 2004. 4. Apostol, T.M., Calculus, Volumes 1 and 2, 2nd Edition, Wiley Eastern, 1980. 5. Hughes-Hallett et al, Calculus - Single and Multivariable (3rd Edition), John- Wiley and Sons 2003			

Mathematics Curriculum for Semester II

I	Course Code	**MA 181002**			
II	Course Title	**Mathematics II: Linear Algebra with vector calculus and ODE**			
III	Credit Structure	L	T	P	C
		4	2	0	6
IV	Prerequisites	MA 1001			
V	Course Content	**Linear Algebra with Vector Calculus:** Double Integrals over Rectangles, Iterated Integrals, Double Integrals over General Regions, changing the order of integration, Change of Variables in Multiple Integrals, Double Integrals in Polar Coordinates, Applications of Double Integrals Triple Integrals, Triple Integrals in Cylindrical Coordinates, Triple Integrals in Spherical Coordinates, Applications Line Integrals, The Fundamental Theorem for Line Integrals, conservative vector fields and path independence, Green's Theorem Parametric Surfaces and Their Areas, Surface Integrals, Stokes' Theorem, The divergence theorem Vectors in , Systems of Linear equations, Matrices and Gauss elimination, Elementary matrices, Determinants and rank of a matrix Eigenvalues and eigenvectors, Characteristic polynomials, Eigenvalues of special matrices, Multiplicity, Diagonalizability Abstract vector spaces, Subspaces, Linear independence, dependence, basis and dimension Linear transformations, Matrix of a linear transformation, Change of basis and similarity, Rank-nullity theorem Inner product spaces, Gram-Schmidt process, Orthonormal Bases, Diagonalization, Spectral theorem, Quadratic forms **ODE:** Exact equations, Integrating factors and Bernoulli's equation Orthogonal trajectories; Lipschitz condition, Picards theorem, Reduction of order Linear ODEs with constant coefficients, Cauchy-Euler equations Wronskians, Abel-Liouville formula, Method of undetermined coefficients, Method of variation of parameters Laplace transforms, Shifting theorems, Convolution theorem			
V	Text/References	1. Anton, H., Elementary linear algebra with applications, 8th edition, John Wiley & Sons, 1995. 2. David Poole, Linear Algebra:A modern Introduction, Cengage Learning, 4th edition 3. Apostol, T.M., Calculus, Volume 2, 2nd Edition, Wiley Eastern, 1980. 4. Boyce, W.E., and DiPrima, R., Elementary Differential Equations, 9th Edition, John Wiley & Sons, 2005. 5. Kreyszig, E., Advanced Engineering Mathematics, (9th Edition), Wiley India 6. Strang, G., Linear algebra and its applications, 4th Edition, Thomson, 2006.			

Physics Curriculum for Semester I

I	Course Code	**PH 181001**			
II	Course Title	**Physics - I**			
III	Credit Structure	L	T	P	C
		2	1	0	3
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	Special Theory of Relativity: Problems with classical physics, Inertial and non-inertial frames of reference, Postulates of special theory of relativity, Galilean and Lorentz transformation, Length contraction and Time dilation, Relativistic addition of velocities, Energy momentum relationships. Quantum Mechanics: Black-body radiation, Photoelectric effect and Compton effect, Wave nature of matter, Davisson-Germer experiment, Group and Phase velocities, Heisenberg's uncertainty principle, Schrodinger equation, Wave function and Normalization, Probability density and probability, Operators, Expectation values, Eigenvalues and Eigenfunctions, Particle in infinite and finite square wells, Particle in one, two and three dimensional box, Degenerate states, Potential barrier, Tunneling through a barrier, Eigenvalue and Eigenfunction of 1D simple harmonic oscillator without complete derivation.			
VI	Text/References	1. C. Richtmyer and Kennard, Introduction to Modern Physics, 6th Edition, McGraw-Hill, 1969. 2. R. Eisberg and R. Resnick, Quantum Physics, 2nd Edition, John Wiley 2002. 3. H.S. Mani and G.K. Mehta, Introduction to Modern Physics, 1st Edition, East-west Press Pvt. Ltd.-New Delhi, 2000. 4. A. Beiser, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., 2009. 5. R. P. Feynman, R.B. Leighton, and M. Sands, The Feynman Lectures on Physics -Vol III, Narosa Publishing House, 2010. 6. R.A. Serway, C.J. Moses and C.A. Moyer, Modern Physics, 3rd Edition, Thomson Learning, Inc. 2005.			

Physics Curriculum for Semester II

I	Course Code	**PH 181002**			
II	Course Title	**Physics- II**			
III	Credit Structure	L	T	P	C
		3	2	0	5
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	Vector Calculus: Gradient, Divergence, Curl and Laplacian, Line, Surface and Volume integrals, Gauss-divergence and Stokes theorems, Spherical polar and Cylindrical coordinate systems. Electrostatics: Electric field and Gauss's law, Electrostatic potential, Multipole expansion, Electrostatic energy, Conductors, Uniqueness theorem, Laplace's solution, Image method, Electrostatic boundary conditions, Electrostatic Fields in matter, Capacitors. Magnetostatics: Lorentz force law, Continuity equation, The Biot- Savart's law, Ampere's law, Magnetic vector potential, Magnetism in materials, Magnetostatic boundary conditions. Electrodynamics: Electromotive force, Faraday's law and Lenz's law, Inductance, Displacement current, Maxwell's equations, Electromagnetic (EM) waves in vacuum and media.			
VI	Text/References	1. D. J. Griffiths, Introduction to Electrodynamics, 3rd Edition, PHI Learning, 2009. 2. J. R. Reitz, F. J. Milford, R.W. Christy: Foundations of Electromagnetic Theory, 4th Edition, Pearson Addison Wesley, 2009. 3. A. Mahajan, A. Rangwala, Electricity and Magnetism, 1st Edition, Tata McGraw Hill, 1988. 4. E. M. Purcell, Berkeley Physics Course, Electricity and Magnetism, Volume 2, 2nd Edition, Tata McGraw Hill, 2007. 5. R. P. Feynman, R.B. Leighton, and M. Sands, The Feynman Lectures on Physics -Vol II, Narosa Publishing House, 2010.			

Physics Practical Curriculum for Semester I

I	Course Code	**PH 181101**			
II	Course Title	**Physics Laboratory**			
III	Credit Structure	L	T	P	C
		0	0	3	1.5
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	1. Compound Pendulum: Determine the acceleration due to gravity and the radius of gyration of the given compound pendulum. 2. Young's Modulus by Koenig's Method: Determine Young's modulus of the material of a rectangular bar by Koenig's method. 3. Thermal Conductivity by Lee's Disc: Measure the thermal conductivity of a poor conductor by electrically heated Lee's disc apparatus. 4. Kundt's Tube: Measure the velocity of sound in air using Kundt's tube apparatus and calculate the "γ" of air at room temperature. 5. Helmoltz Coil: Verify the principle of superposition and to examine the uniformity of the magnetic field produced by Helmholtz coils. 6. Fresnel's Biprism: Determine the wavelength of light using Fresnel's bi- prism. 7. Hydrogen Spectrum: Measure the wavelengths of visible spectral lines in Balmer series of atomic hydrogen and to determine the value of Rydberg's constant. 8. Grating Spectrometer: Determine the wavelengths of spectral lines of mercury and the angular dispersive power of a diffraction grating. 9. Single Slit Diffraction: Study the diffraction at a single slit and verify Heisenberg's uncertainty principle. 10. Four Probe Method: Study the resistivity of the semiconductor by Four Probe Method at different temperatures and determine the band gap. 11. Photoelectric Effect: Determine the value of Planck's constant using photoelectric effect. 12. Hall Effect: Determine the carrier concentration and type of carrier using Hall effect.			
VI	Text/References	1. Practical Physics, G. L. Swuires, 4th Edition, Cambridge University Press,2012. 2. Physics, Vols 1 & 2, D. Holliday, R. Resnick and K. S.Krane, John Wiley and Sons, 5th Edition, 2002. 3. Optics, Ajoy Ghatak, 5th Edition, Tata McGraw Hill, 2012. 4. Introduction to Geometrical and Physical Optics, B. K. Mathur, Gopal Printing, 1967. 5. Introduction to Solid State Physics, C. Kittle 8th Edition, Wiley Publications,2004.			

Chemistry Curriculum for Semester I & II

I	Course Code	**CH 181001**			
II	Course Title	**Chemistry**			
III	Credit Structure	L	T	P	C
		3	1	0	4
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	Chemical Kinetics: Rate laws, Rate constant and equation, order and molecularity, Complex reactions, Arrhenius equation, collision theory, Reaction cross section, Harpoon mechanism, Organic reaction mechanism Catalysis: Homogeneous and Heterogeneous Catalysis, Adsorption, Biocatalysis, Important Industrial applications (at least two), Catalytic converter Basics of Spectroscopy: Rotational, Vibrational and Electronic spectroscopy Basics of Electrochemistry, Fuel Cell, Corrosion and its prevention Water and its treatment Polymer: Classification, Molecular weight and MWD, Thermal and mechanical properties, Compounding of polymer, Commodity plastic and engineering plastic			
VI	Text/References	1. Elements of Physical Chemistry, P.W. Atkins & De Paula, Oxford, 2017. 2. Heterogeneous Catalysis, D. K. Chakravarty & B. Vishwanathan, New Age International, 2011. 3. Polymer Science - V. R. Gowarikar, N. V. Viswanathan & Jayadev Sreedhar, New Age International, 2006 (reprint). 4. Organic Chemistry, R. T. Morrison & R. N. Boyd, Pearson Education India, 2010. 5. Fundamentals of molecular spectroscopy, C. N. Banwell & E. M. McCash, McGraw Hill Education (India) Private Limited, 2013 6. Spectroscopy of Organic compounds, P. S. Kalsi, New Age International, 2007. 7. Applications Of Absorption Spectroscopy Of Organic Compounds, J. R. Dyre, Prentice Hall India Learning Private Limited, First Edition, 1978. 8. Heterogeneous Catalysis: Principles & Applications, G. C. Bond, Clarendon Press ; New York : Oxford University Press, 1987 9. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publishing Company, 2015 10. A text book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Limited, 2017 11. Chemical kinetics, K. J. Laidler, Pearson Education India, 2003.			

Chemistry Practical Curriculum for Semester I & II

I	Course Code	**CH 181101**			
II	Course Title	**Chemistry Laboratory**			
III	Credit Structure	L	T	P	C
		0	3	0	1.5
IV	Prerequisite (if any)	Nil			
V	Course Content	1. Complexometric Titration: To estimate hardness of a given water sample bycomplexometric method 2. Estimation of Acetamide: To estimate Acetamide present in a given solution by hydrolysis method 3. Organic preparation: To prepare acetanilide from aniline 4. Organic preparation: To prepare p-nitro acetanilide from acetanilide 5. Chemical Kinetics (Hydrolysis of an Ester): To determine the rate constant and order of reaction for acid catalyzed hydrolysis of methyl acetate 6. Potentiometric titration: To determine the normality of hydrochloric acid potentiometrically 7. Conductometric titration: To determine the strength of sodium hydroxide solution conductometrically 8. Conductometric titration: To determine the milk adulteration by conductivity measurements. 9. pH metric titration: To determine the strength of HCl solutions in mixture using pH meter 10. Iodometry: To Determine Dissolved Oxygen of a given Water Sample by Winklers Iodometric Method 11. Iodimetric Titration: To determine the strength of given ascorbic acid solution by titrating against standard 0.1 N iodine solution 12. Chemical Oxygen Demand: To determine the Chemical Oxygen Demand (COD) for a given polluted water sample			
VI	Text/References	1. D.P. Shoemaker, C.W. Garland and J.W. Nibler: Experiments in Physical Chemistry, McGraw Hill International Edition, 1996 2. V.D. Athawale and P. Mathur: Experimental Physical Chemistry, 1st Edition, New Age International Publication, New Delhi, 2001. 3. J.B. Yadav: Advanced Practical Physical Chemistry, Goel Pub., Meerut, 2003 4. S. M. Khopkar: Basic Concepts of Analytical Chemistry, 3rd Edition, New Age International Publication, New Delhi, 2008 5. P. Samnani: Experiments in Chemistry, Anmol Publication Pvt. Ltd. New Delhi, 2007			

Civil Infrastructure Curriculum for Semester I

I	Course Code	**CE 181001**			
II	Course Title	**Introduction to Civil Infrastructure**			
III	Credit Structure	L	T	P	C
		2	0	0	2
IV	Prerequisite (if any)	None			
V	Instructor(s)				
VI	Course Content	**Unit 1:** Introduction to Infrastructure scenario in India. Urban and Rural infrastructure in India. Bird-eye view to various specializations in Civil Engineering discipline and their practical relevance for the infrastructural development.Basics of infrastructure planning. **Unit 2:** Role of Civil Engineering in the following infrastructure sectors: a) Transportation infrastructure b) Hydraulic infrastructure c) Building infrastructure d) Water supply and wastewater infrastructure e) Energy infrastructure f) Smart Infrastructure **Unit 3:** Environmental and sustainability aspects for the design of infrastructure, New challenges for the future infrastructure development			
VII	Text/References	1. Irrigation and Hydraulic Structure S K Garg, 1st Edition, Khanna Publishers. 2. Environmental Engineering - N.N.Basak, 1st Edition, Mcgraw Higher Ed. 3. Highway Engineering S K Khanna and C E Justo, 10th Edition, Nem Chand Brothers. 4. Railway Engineering - Satish Chandra and Agrawal, Oxford University Press. 5. Building Planning and Drawing: SS Bhavikatti and M. V. Chitawa, I K International Publishing House Pvt. Ltd. 6. Reinforced Concrete Design by S. N. Sinha, Tata McGraw Hill. 7. Steel Structures-Design and Practice, N. Subramanian, Oxford University Press. 8. Textbook of Geotechnical Engineering by B M Das, Cengage Learning. 9. Building Materials, S. S. Bhavikatti, Vikas Publishing House. 10. Smart Civil Structures by You-Lin Xu and Jia He, CRC Press, Taylor and Francis. Open source information/literature available through World Wide Web, MOOCS, NPTEL, and Institution Library etc.			

Electrical Infrastructure Curriculum for Semester I

I	Course Code	**EE 181001**			
II	Course Title	**Introduction to Electrical Infrastructure**			
III	Credit Structure	L	T	P	C
		2	0	0	2
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	Introduction to electrical infrastructure requirements in transportation systems, Electrical Energy Scenario, Basics of Electrical Drives, Basic characteristics of DC and 3-phase induction motors, Electrical Traction Systems (Railways, Metro-rails, Tramways), electric power generation, transmission and distribution systems, Information and Communication, environmental aspects, energy considerations, conventional power plants, Renewable energy infrastructure: Solar Parks, Wind Farms, Biogas plants etc., laws of illumination, factory and street lighting, hybrid electric vehicles and electric vehicles, emergency power systems, Central Emergency Power Stations (CEPS), Central Power Stations (CPS) and Central Energy Plant (CEP), Power Control and Monitoring Systems (PCMS).			
VI	Text/References	1. ”Utilization of Electric Power & Electric Traction” by J.B.Gupta, Katson Publishers. 2. ”Fundamentals of Internal Combustion Engines” by H.N. Gupta, PHI Publications. 3. Utilization of Electrical Power by Soni, Bhatnagar and Gupta			

Mechanical Infrastructure Curriculum for Semester I

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 181001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Introduction to Mechanical Infrastructure</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>IV</td><td>Prerequisite, if any</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Unit 1: History and overview
Overview of infrastructure requires all of engineering, Classification and different sectors of infrastructure, Developmental role of mechanical infrastructure, Some historically important people and their contributions in infrastructure (Marquis of Pombal, Isambard Kingdom Brunel, Mokshagundam Visvesvaraya, etc.).
Unit 2: Introduction to Transportation Infrastructure.
Railway Infrastructure:
Introduction to the railway industry, their impacts on the society and on the environment, types of coaches, engine and machines in railway engineering. Involvement in country GDP, Future need of country, creation and maintenance of railway infrastructure.
Airways Infrastructure:
Introduction to airway infrastructure, need and importance of air transport, basic working and control method of airplane, construction and working of jet engines, method to reduce cost of air transport, socio-economic impact of airways infrastructure, creation and maintenance of airway infrastructure.
Roadways infrastructure:
Introduction to roadways infrastructure, need and importance of road transport, basic working and control method of commercial and noncommercial vehicle, creation and maintenance of roadway infrastructure.
Water transport infrastructure:
Introduction to water transport infrastructure, need and importance of water transport, basic working and control method of commercial and non- commercial water vehicles, creation and maintenance of water transport infrastructure.
Unit 3: Introduction to Energy Infrastructure:
Introduction, types of energy, source of energy, conventional and non-conventional source of energy, working principle thermal, solar, hydroelectric, wind and nuclear power plant, recent advancement and challenge to meet the demand for aforesaid power plant, energy distribution, energy transport, its use for human comfort and maintenance of power plant.
Unit 4: Case Studies
Different case studies in the field of related infrastructures and one case study assignment for the students.
Unit 5: Field visits
Field visit to industrial establishment such as power plants, manufacturing and maintenance industry and submission of final report.</td></tr>
<tr><td>VI</td><td>Textbooks/References</td><td colspan="4">1. Donaldson, Dave. Railroads of the Raj: Estimating the impact of transportation infrastructure. No. w16487. National Bureau of Economic Research, 2010.
2. Banister, David. Transport and urban development. Routledge, 2003.
3. Nag, P. K. Power plant engineering. Tata McGraw-Hill Education, 2002.
4. Drbal, Larry, Kayla Westra, and Pat Boston, eds. Power plant engineering. Springer Science & Business Media, 2012.
5. Vasigh, Bijan, and Ken Fleming. Introduction to air transport economics: from theory to applications. Routledge, 2016.
6. Ashford, Norman, and Paul H. Wright. Airport engineering. New York: Wiley, 1979.</td></tr>
</table>

Engineering Graphics Curriculum for Semester I & II

I	Course Code	**GE 181001**			
II	Course Title	**Engineering Graphics**			
III	Credit Structure	L	T	P	C
		2	0	3	3.5
IV	Prerequisite (if any)	Nil			
V	Course Content	Introduction to the engineering design process and the importance of technical. Graphics/Drawings; Integrated design and 3D modelling, visualization - sketching & computer aided drawing, geometrics - geometry construction, shape description, multi-view drawings - orthographic projection, isometric views, axonometric projections, auxiliary & section views; Dimensioning; Assembly drawings.			
VI	Text/References	1. Ostrowsky, O., Engineering Drawing with CAD Applications, Elsevier Science & Technology, 1989 2. Banach, D. T., and Jones, T., Autodesk Inventor 2011 Essentials Plus, Cengage Learning, Inc, 2010 3. Jensen, C. H., Helsel, J. D., and Short, D. R., Engineering Drawing and Design, 7th edition, McGraw Hill, 2007			

Basic Electrical and Electronics Engineering Curriculum for Semester II

I	Course Code	**EE 181002**			
II	Course Title	**Basic Electrical And Electronics Engineering**			
III	Credit Structure	L	T	P	C
		2	1	2	4
IV	Prerequisite (if any for the students)	No			
V	Course Content	Elements in an Electrical circuit: R, L, C, Voltage and current sources (independent and dependent/controlled sources with examples). DC circuits, KCL, KVL, Network theorems, Mesh and nodal analysis. Step response in RL, RC, RLC circuits. Basics of semiconductor physics,P-N junction,diode characteristic,diode circuits - clippers.Characteristics of BJTs.Common Emitter,Common collector configurations of BJTs,biasing of BJTs and its small signal modeling.Basics of operational amplifiers.			
VI	Text/References	1 R. J. Smith and R. C. Dorf, Circuits, Devices and Systems, Wiley, 5th edition, 1992. 2 E. Hughes, Electrical Technology, Pearson, 7th edition. 3 Bobrow, Fundamentals of Electrical Engineering, Oxford Univ Press. 4 Hayt, W. H., Kemmerly, J. E., Durbin, S. M., Engineering Circuit Analysis, sixth edition, Tata Mc-Graw Hill, 2006. 5 R. Prasad, Fundamentals of Electrical Engineering Book, Prentice Hall India Learning Private Limited; Third edition (2014)			

Computer Science Curriculum for Semester I & II

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">CS 181001</td></tr>
<tr><td>II</td><td>Title of Course</td><td colspan="4">Computer Science</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>3</td><td>4.5</td></tr>
<tr><td>IV</td><td>Prerequisite(for the student)</td><td colspan="4">Concept of algorithm</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">1. Introduction to the state of the art in computing focusing on hardware and its architecture, operating systems, memory management. Numeric information representation in computers : 2s complement representation of integers and IEEE 754 standard for representing floating point numbers. ASCII and Unicode systems for representing character data.
2. Computers, algoritms and programming. A programmers view of a computer system. Lower Level and higher level programming languages, general characteristics of programming languages and classification of programming constructs.
3. Scalar and non-scalar data, variables, types and objects. Arithmetic, relational, logical and assignment operators. Strings, string operations and slicing.
4. Data structures, supported operations. Mutable and immutable types. Lists, tuples, dictionaries and sets. Iterables and iterative traversal of sequential structures.
5. Conditional and iterative control structures. Nested controls. Break and continue statements.
6. Library modules and their use. User defined functions and modular programming. Developing function libraries. Recursive functions.
7. Algorithms and their implementation. Introduction to algorithmic complexity and computational complexity. Euclids algorithm, prime number programs.
8. Classes and objects. Object oriented programming. Inheritance.
9. Scientific and engineering computation examples. Numpy and Scipy libraries. Computations with multi-dimensional arrays.
10. Reading and writing files. Matplotlib library for plotting graphs, and displaying images. Handling CSV files with Pandas library.</td></tr>
<tr><td>VI</td><td>Text Books and web resources</td><td colspan="4">1. John V Guttag, Introduction to Computation and Programming Using Python, 2 Edition, Prentice Hall India & MIT Press, 2014.
2. Mark Lutz . Learning Python: Powerful Object-Oriented Programming: 5th Edition, OReilly/SPD, 2013
3. https://docs.python.org/3/ Python 3.6 online documentation.
4. https://docs.python.org/3/tutorial/index.html Python online tutorial
5. Python tutorials with Jupyter notebooks</td></tr>
<tr><td>VII</td><td>MOOCs</td><td colspan="4">1. www.edx.org, Introduction to Computer Science and Programming Using Python, Free online course offered by Eric Grimson, John Guttag from MIT.
2. www.coursera.org Programming for Everybody (Getting Started with Python), Charles Severance, University of Michigan</td></tr>
<tr><td>VIII</td><td>Software Resources</td><td colspan="4">Jupyter notebooks</td></tr>
</table>

Manufacturing Science and Workshop Curriculum for Semester I & II

I	Course Code	**GE 181002**			
II	Course Title	**Manufacturing Science and Workshop**			
III	Credit Structure	L	T	P	C
		2	0	3	3.5
IV	Prerequisite, if any	NIL			
V	Course Content	**Introduction to manufacturing processes:** Brief history of manufacturing, product design and concurrent engineering, Selection of materials, significance of material properties with respect to selection of manufacturing processes. **Safety:** Importance of safety and general Safety considerations in manufacturing. **Traditional Manufacturing process:** ***Fitting Tools & Equipment,*** practice in filing, making 'V' Joints, Square, Dovetail joints and key making plumbing. **Carpentry Tools and Equipment-** Planning practice, Making Half Lap, Dovetail, Mortise & Tenon joints. **Principles of heat treating;** annealing, normalizing, hardening and tempering. **Casting Process:** Basic concepts of castings, patternmaking, types of Pattern, Pattern allowances, Moulding sand, Types and properties of Moulding sand, cores, elements of gating system, Defects in casting system, special types of casting processes. **Metal Forming Process:** Basic concepts of plastic deformation. Hot & cold working. Common bulk deformation processes (Rolling,Forging, Extrusion and Drawing). Common sheet metal forming processes. **Machining Process :** Mechanics of cutting, cutting forces and power, cutting tool materials and cutting fluids, Tools geometry, Tool life: wear and failure ***Traditional machining process:*** Turning process, Lathe and lathe operations, Boring and Boring Machine, Drilling and Drilling machines, Milling and Milling Machines, Planing and shaping, Broaching and Broaching machines, Grinding & other Finishing processes. **Welding & Other Joining Processes:** Fundamentals & classification of Joining processes, Welding- Gas arc & resistance welding, Brazing and soldering, Adhesive bonding, Mechanical fastening. **Manufacturing of Polymer and Powder Products:** Classification of polymers, Introduction to extrusion, injection molding, blow molding, compression and transfer molding. Powders & Green compacts from powders including slip casting of ceramics. Sintering. **Modern Trends in Manufacturing:** ***Non-Traditional machining process:*** Need of Non-Traditional machining process, Working principle, advantages and disadvantages of ECM (Electro chemical machining), EDM (Electrical-discharge machining), LBM (Laser Beam Machining), EBM (Electron Beam Machining). ***Non Traditional Forming Process:*** Working principle, advantages and disadvantages of Explosive Forming process ***Non-Traditional Joining process*** Working principle, advantages and disadvantages of LBW (Laser Beam welding process) ***Fabrication of Microelectronic devices:*** Semiconductors and silicon, crystal growing and wafer preparation, film deposition, Lithography, etching, Diffusion and ion implantation, Printed Circuit Boards. ***Additive manufacturing:***Introduction to the Basic Principles of Advanced/Additive Manufacturing. Advantages, disadvantages and its application. ***Automation of manufacturing process and operations:*** Automation, Numerical control: Advantages and Disadvantages of NC system, comparison between conventional and NC machines, Adaptive control. Industrial Robots: structure of robot and its application in manufacturing. Computer-aided manufacturing, Computer integrated manufacturing systems			

VI	Text/References	1. Schey, J. A., Introduction to Manufacturing Process, 3rd Edition, McGrawHill, 2000. 2. Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology, 7th Edition, Pearson, 2018. 3. B. S. Nagendra Parashar, R. K. Mittal, Elements of Manufacturing Processes, PHI, 2016. 4. Singh, D. K., Fundamentals Of Manufacturing Engineering, Ane Books Pvt Ltd, new Delhi, 2nd Ed., 2009. 5. Hajra Choudhary, S. K., Elements of Workshop Technology, Media Promotors & Publishers Pvt Ltd, 12th Edition, 2002.

Indian English Literature & Language for Semester I

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">HS 181001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Indian English Literature & Language</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>IV</td><td>Course Coordinator</td><td colspan="4">Dr. Meera Vasani</td></tr>
<tr><td>V</td><td>Course Objective</td><td colspan="4">To have in depth practice of extensive reading and writing</td></tr>
<tr><td>VI</td><td>Course Contents</td><td colspan="4">Literature Units: (Can be revised every year)
The Last Tonga Ride (Ruskin Bond)
I have Three Visions for India (A P J Abdul Kalam)
The shroud (Munshi Premchand)
First Selfie in Space (Sujata Reddy)
My Birth Place (Nirad C. Chaudhuri)
A Wrong Man in Workers Paradise (Rabindranath Tagore)
Toasted English (R. K. Narayan)
Crime and Punishment (R. K Narayan)
Grammar of Anarchy (B R Ambedkar)
Punishment in Kindergarten (Kamala Das)
Grammar:
Idioms & Phrases, Synonyms, Antonyms, One word substitution, Technical Vocabulary, Homophones, Direct-Indirect, Punctuation
Writing:
Report Writing
Letter Writing
Precis
Note-making
Paragraph Writing
Statement of Purpose</td></tr>
<tr><td>VII</td><td>Text/References</td><td colspan="4">T. Vijay Kumar, K. Durga Bhavani, YL Srinivas (Ed); English in Use; Macmilan Education
J Kumar Singh, F Bharateeya, D Trivedi (Ed); College Collage; Macmillan Education
H. Raviya, A. Pandya, et.al (Ed); Mosaic; Macmillan
Spectrum- A textbook for college students; Macmillan education
Thomas L. Means, Ed. D.; English and Communication for colleges; Cengage
M. Hemamalini; Technical English; Wiley
Grammar books for practice</td></tr>
</table>

Functional English & Comprehension for Semester I

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">HS 181002</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Functional English & Comprehension</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisites (if any)</td><td colspan="4">Basic knowledge of English.</td></tr>
<tr><td>IV</td><td>Course Coordinator</td><td colspan="4">Dr. Meera Vasani</td></tr>
<tr><td>V</td><td>Course Objective</td><td colspan="4">• To understand the use of basic grammar.
• To comprehend the concepts written in the second language.
• Make them more towards the correct usage of grammar in both verbal and written communication.
• Introduce them with the phonetics so as to lead them to the correct pronunciation of words.</td></tr>
<tr><td>VI</td><td>Course Contents</td><td colspan="4">Part I. Grammar Topics :
• Articles; Tenses; Prepositions; Modals; Moods of Verb; Concord
• Active Passive; Direct-Indirect; Punctuation
• Idioms and phrases; phrasal verbs; Synonyms; Antonyms; words often confused; homophones;.
• Common errors;
• Jumbled Sentences;
• Comprehensions
Part II. Writing Section:
• Email writing
• Sentence Completion
• Paragraph Completion
• Notice writing
• Note Making
• Message writing
• Letter Writing
Lab Activities: Grammar exercises; Comprehension exercises; general etiquettes; greetings; self-introduction; basic conversation;</td></tr>
<tr><td>VII</td><td>Text/References</td><td colspan="4">1. Competitive English; Edi. Pradyumansinh Raj; Azhar Siddiqui, Shaili Kaviya ad.; Macmillan Publisher India Pvt. Ltd.; latest edition.
2. Technical English: Vocabulary and Grammar. By Nick Brieger & Alison Pohl. Publication Details: Cengage Learning, 2014.
3. Grammar Books with exercises</td></tr>
</table>

BACHELOR OF TECHNOLOGY

Electrical Engineering Department

Semester - III

Course Scheme

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
HS 192001	Introduction to Sociology	3	0	0	3
MA 192001	Mathematics III (Complex Analysis and Differential Equations II)	4	2	0	6
EE 192001	Electronic Devices and Circuit Theory	3	1	3	5.5
EE 192002	Network Theory	3	1	0	4
EE 192003	Signals and Systems	3	1	0	4
	Total	**16**	**5**	**3**	**22.5**

Electrical Engineering Department

Semester : III

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">HS 192001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Introduction to Sociology</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Coordinators</td><td colspan="4">Dr. Shukkoor. T</td></tr>
<tr><td>VI</td><td>Course Content</td><td colspan="4">Unit- 1
Sociology:
Origin and Development; Nature, Scope and Significance; Founders of Sociology; Sociological Perspectives

Unit-2
Basic Concepts:
Society, Community, Social Structure, Status and Role; Culture, Norms and Values, Socialization; social stratification, Groups- Types of group, Social organisations; Social control; Deviance, Social change, Social protests, Social movements

Unit-3
Social Institutions- Features and Functions:
Family, Education, Economy, Religion, State

Unit-4
Social Problems- definition and characteristics:
Corruption, Unemployment, Poverty

Unit- 5
Sociology of Science and Technology: Society and Technology: Technology and Development, The Social Construction of Technology, Technology and Social Relations, Social responsibilities of scientists and technocrats, Gender and Technology</td></tr>
</table>

VII	Text/References	1. Giddens, Anthony (2013): Sociology (seventh edition), Cambridge, Polity Press 2. Das,Veena (2005): Handbook of Indian Sociology, New Delhi: Oxford University Press 3. Harlambos, M. (2014): Sociology: Themes and Perspectives, London: Harper Collins 4. MacIver and Page (1974): Society: An Introductory Analysis, New Delhi: Macmillan & Macmillan 5. Inkeles, Alex (1987): What is Sociology? New Delhi: Prentice-Hall of India 6. Johnson, Harry M. (1995): Sociology: A Systematic Introduction, New Delhi: Allied Publishers 7. Ahuja, Ram (2001): Indian Social System, New Delhi: Rawat Publication. 8. Ahuja, Ram (2003): Society in India, New Delhi: Rawat Publication. 9. Abercrombie, N., Hill, S., Turner, B.S: Dictionary of Sociology (2005): Penguin Reference
VIII	Evaluation scheme for the course	Assignments : 25 % (First assignment-10 %, second assignment-15%) Mid semester examination: 25 % End semester examination: 50%

Electrical Engineering Department

Semester : III

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">MA 192001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Mathematics III (Complex Analysis and Differential Equations II)</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>4</td><td>2</td><td>0</td><td>6</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Complex Analysis: Definition and properties of analytics functions; Cauchy-Riemann equations, Harmonic functions; Power series and their properties;Elementary functions; Cauchys theorem and its applications; Taylor series andLaurent expansions; Residues and the Cauchy residue formula; Evaluation ofimproper integrals; Conformal mappings.
Differential Equations:Laplace transforms, Shifting theorems, Convolution theorem,Review of power series and series solutions of ODEs; Legendres equationand Legendre polynomials; Regular and irregular singular points, method ofFrobenius; Bessels equation and Bessels functions; SturmLiouville problems;Fourier series; DAlembert solution to the Wave equation; Classification oflinear second order PDE in two variables; Vibration of a circular membrane;Fourier Integrals, Heat equation in the half space</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Kreyszig, E., Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, 1999.
2. Boyce, W.E., and DiPrima, R., Elementary Differential Equations, 8thEdition, John Wiley & Sons, 2005.
3. Churchill, R.V., and Brown, J.W., Complex variables and applications, 7thedition, McGrawHill, 2003.
4. Churchill, R.V., and Brown, J.W., Fourier series and boundary value Problems, 7th Edition, McGraw-Hill, 2006.
5. Howie, J.M., Complex Analysis, Springer-Verlag, 2004.
6. Ablowitz, M.J., and Fokas, A.S., Complex variables: Introduction and Applications, Cambridge University Press, 1998(Indian Edition).</td></tr>
</table>

Electrical Engineering Department

Semester-III

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 192001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Electronic Devices and Circuit Theory</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>3</td><td>5.5</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Basic Electrical and Electronics Engineering</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Energy bands in silicon, intrinsic and extrinsic silicon, direct and indirect bandgap semiconductors, Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers; Introduction to semiconductor equations and carrier statistics: Poisson's and continuity equations, Fermi-Dirac statistics and Boltzmann approximation to the Fermi-Dirac statistics. PN Junction diode: operation, characteristics, applications, fabrication process, junction capacitance, small signal model. Zener diode and tunnel diode. BJT: operation, characteristics, applications, fabrication process, equivalent circuit models (Ebers-Moll and Hybrid-Pi). Review of BJT Biasing. BJT as Amplifier and Switch. Common Emitter (CE), Common Base (CB) and Common Collector Amplifier (CC). MOSFET Biasing. Common Source (CS), Common Gate (CG), Common Drain (CD) Amplifier. Class A, Class B, Class AB, Class C and Class D Amplifiers, Single- and Multi-Stage Amplifiers; BJT and FET Amplifier Frequency response; Miller's theorem; Current Mirror, Cascade and Cascode amplifiers; differential amplifiers; OPAMPs, feedback and stability, Barkhausen criterion, effect of feedback on amplifier poles; positive feedback and sinusoidal oscillators-Wien bridge oscillator, other op-amp based RC oscillators; 555 Timers.</td></tr>
<tr><td>VI</td><td>Textbook/References</td><td colspan="4">S. M. Sze, Semiconductor Devices Physics and Technology, John Wiley and Sons, Third Edition, 2012
D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago) 1997.
Boylestad, Electronic Devices and Circuit Theory, Pearson.
B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995.
J. Millman and A. Grabel, Microelectronics, McGraw Hill, International, 1987.
A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
R.T. Howe and C.G. Sodini, Microelectronics : An integrated Approach, Prentice Hall International, 1997.
T. M. Floyd, Electronic Devices, Prentice Hall; 9 edition, 2011</td></tr>
</table>

Electrical Engineering Department

Semester-III

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 192002</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Network Theory</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Basic Electrical and Electronics Engineering</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Classification of elements and circuits, modified nodal and mesh analysis, time domain analysis, initial conditions, introduction of Laplace transform, steady state analysis, natural and forced response,

state variable analysis, active and reactive power, balanced and unbalanced 3-phase circuits, elements of graph theory and application, Tellegen's theorem, two-port networks description in terms of different sets of parameters and interrelations, transition from field model to circuit model, introduction to network synthesis.</td></tr>
<tr><td>VI</td><td>Textbook/References</td><td colspan="4">1. Network Analysis by M.E Van Valkenburg, PHI Publication
2. Linear Network Theory: Analysis, Properties, Design and Synthesis by N Balabanian and T.A. Bickart, Matrix Publishers, Inc. 1981</td></tr>
</table>

Electrical Engineering Department

Semester-III

I	Course Code	**EE 192003**			
II	Course Title	**Signals and Systems**			
III	Credit Structure	L	T	P	C
		3	1	0	4
IV	Exposure				
V	Course Content	Introduction to signals, signal classification, continuous & discrete time signals, significance of basic signals, basic operations on signals, vector-space interpretations in terms of basic signals useful for evolving various transforms, definition and classification of systems, linear time invariant (LTI) systems, properties of LTI systems, impulse response, convolution, causality, stability, impulse Response of discrete time systems, discrete time convolution, difference equations and analysis, necessity of representations of signals & systems in time- and transformed-domains, introduction to Fourier Analysis, Fourier Series for periodic signals, properties of Fourier Series, introduction to Fourier transform, properties of Fourier transform, frequency response of continuous time systems, Laplace transform, properties of Laplace transform, inverse Laplace transform, introduction to z-transform, properties of z-transform, region of convergence, inverse z-transform, Fourier analysis of discrete signals, discrete time Fourier transform (DTFT), properties of DTFT, frequency response of discrete time Systems, discrete Fourier transform DFT, sampling, sampling theorem.			
VI	Textbook/References	1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems, Pearson Education. 2. Edward W. Kamen & Bonnies Heck, Fundamentals of Signals and Sys¬tems, Pearson Education. 3. H. P. Hsu, RakeshRanjan Signals and Systems, Schaums Outlines, Tata McGrawHill. 4. Simon Haykins and Barry Van Veen: Signals and Systems, John Wiley & sons. Gabel. 5. Roberts, Signals and Linear Systems Wiley India Pvt. Ltd, 2012. 6. R.F.Ziemer,W.H.Tranter and D.R.Fannin, "'Signals and Systems - Continuous and Discrete"' 4th Edn. Prentice Hall, 1998 7. B.P. Lathi,"'Signal Processing and Linear Systems"' Oxford University Press, 1998			

Electrical Engineering Department

Semester : IV

Teaching Scheme for Electrical Engineering – Semester IV

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
EE 192005	Electrical Machines - I	3	0	3	4
EE 192006	Power Systems - I	3	1	0	4
EE 192004	Linear Integrated Circuit Applications	3	0	0	3
EE 192007	Digital Systems	3	0	2	4.5
MA 192003	Probability and random Processes	3	1	0	4
EE 194006	Fundamentals of Nanoscience and Nanotechnology	3	0	0	4
AE 194001	Dynamics and Control of Aerial Robotics	2	1	0	3
	Total	**20**	**3**	**5**	**26.5**

Electrical Engineering Department

Semester : IV

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 192005</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Electrical Machines - I</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>IV</td><td>Course Content</td><td colspan="4">Magnetic materials, ac and dc magnetisation curves, introduction to permanent magnets and characteristics, principles of electromechanical energy conversion. Mechanically commutated machine (DC Machine), working principle, construction, types of the winding, types of machine, circuit model, EMF equation, armature reaction and commutation, characteristics of generator, parallel operation of generator, speed-torque characteristics of motor, starting methods of motor, power stages, testing. Transformer as a magnetically coupled circuit, working principle, construction, circuit model, losses, efficiency, voltage regulation, inrush current, testing, connections, parallel operation, low frequency versus high frequency transformers, corresponding circuit models, tertiary windings. Basics of induction motor, generation of magnetic field. BLDC motor, stepper motors, applications.</td></tr>
<tr><td>V</td><td>Textbook/References</td><td colspan="4">1. A.E. Fitzgerald, C.Kingsley, S.D.Umans, Electrical Machinery, Tata McGraw Hill, Sixth Edition 2002
2. E. Clayton & N N Hancock, The Performance and Design of Direct Current Machines 1st Edition, CBS Publisher
3. P S Bhimbhra, Electrical Machinery (7th Edition), Khanna Publishers
4. D. P Kothari & I J Nagrath, ELECTRIC MACHINES, 4th Edition, McGraw Hill Education (India) Private Limited</td></tr>
</table>

Electrical Engineering Department

Semester : IV

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 192006</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Power Systems – I</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Course Content</td><td colspan="4">Structure of power system: Generation, Transmission and Distribution of electrical power.
Generation of Electrical Power: Introduction to conventional power generation. Schematic representation of steam-turbine driven AC power generating systems. Brief description of power plant components: Boilers, Super heaters, Turbines, Condensers, Chimney, Cooling towers. Specifications of synchronous generators and plant rating.

Economic aspects: Load curve, Load duration and Integrated load duration curves-Load demand, Diversity, Capacity, Utilization and Plant use factors.

Transmission of Electrical Power: Brief introduction to AC and DC transmission systems. AC Transmission line parameters: Types of conductors – ACSR, Bundled and Stranded conductors- Skin Effect- Calculation of inductance and capacitance for single phase and three phase, Single and double circuit lines, Concept of GMR & GMD, Symmetrical and asymmetrical conductor configuration with and without transposition. Effect of ground on Capacitance.

Performance of AC transmission line: Short, Medium and Long lines and their exact equivalent circuits- Nominal-T, Nominal-π. Regulation and Efficiency of transmission lines. Long transmission line-Rigorous solution. A, B, C, D parameters of transmission lines. Surge impedance and Surge impedance loading - Wavelengths and Velocity of propagation, Ferranti effect.

Mechanical design of transmission lines: Overhead line insulators: Types of Insulators, String efficiency and methods for improvement. Phenomenon of corona, Factors affecting corona.

Distribution of Electric power: Classification of distribution systems: DC and AC distribution systems, Underground and Overhead Distribution Systems. Design considerations of distribution feeders: Radial and loop, Primary feeders, Voltage levels, Feeder loading.

Substations: Location of substations: Rating of distribution substation, Service area within the primary feeders. Benefits derived through optimal location of substations. Classification of substations: Air insulated substations - indoor and outdoor substations: Substation layout showing the location of all the substation equipment. Bus bar arrangements in the sub-stations: Single bus bar, Sectionalized single bus bar, Main and transfer bus bar.</td></tr>
</table>

V	Textbook/References	1. Power System Analysis & Design by J. D. Glover, M. S. Sharma, T. J. Overbye, Cengage. 2. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar and A. Chakraborti, Dhanpat Rai & Co. Pvt. Ltd., 1999. 3. Generation Distribution and Utilization of Electrical Power by C.L Wadhwa, New Age International (P) Ltd., 2005. 4. Power System Analysis by J. J. Grainger, W. D. Stevenson Jr., Tata Mc. Graw-hill, 2003. 5. Electrical Power Systems by C. L. Wadhwa, New Age International (p) Ltd. 6. Electrical Power Distribution Systems by Turan Gonen, Mc. Graw-hill, 1986.

Electrical Engineering Department

Semester : IV

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 192004</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Linear Integrated Circuit Applications</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>IV</td><td>Course Content</td><td colspan="4">BJT Differential amplifier, Introduction to op-amps, ideal Characteristics, performance characteristics, input offset current, slew rate, input offset voltage, input bias current, Open and closed loop configurations, Offset and Frequency compensation. Exercise problems. Inverting and non-inverting amplifiers and their analysis, Applications: inverting and non-inverting summers, difference amplifier, differentiator and integrator, Voltage to current converter, Exercise problems.

Instrumentation amplifier, Log and antilog amplifiers. Precision rectifier, Non-linear function generator, solving differential equations using analog computing blocks. Analog IC Multipliers and applications Comparators, regenerative comparators, input - output Characteristics, Astable and Monostable multivibrator, Triangular wave-generators, RC-phaseshift oscillator, Wein's bridge oscillator, Active Filters, Low pass, High pass, Band pass and Band Reject filters, Butterworth, Chebychev filters, Frequency Transformation. 555 Timer functional diagram, monostable and astable operation, applications. Voltage Regulator Series op amp regulator, Three terminal IC voltage regulator exercise problems. IC 723 general purpose regulator, Switching Regulator. PLL- basic block diagram and operation, capture range and lock range; applications of PLL IC 565, AM detection, FM detection and FSK demodulation. VCO IC 566, Weighted resistor DAC, R-2R and inverted R-2R DAC. IC DAC-08, Counter type ADC, successive approximation ADC, Flash ADC, dual slope ADC, conversion times of typical IC ADC.</td></tr>
<tr><td>V</td><td>Textbook/References</td><td colspan="4">1. G B Clayton, Operational Amplifiers, 5 th Edition, Elsevier science, 2003.

2. Sergio Franco, Design with Operational Amplifier and Analog Integrated Circuits, 4 th Edition, TMH, 2011.

3. Roy Choudary D. and Shail B. Jain, Linear Integrated circuits, 4 th Edition, New Age International Publishers, 2010.

4. Ramakant A.Gayakward, Op-Amps and Linear Integrated Circuits, 4 th Edition, PHI, 2010.</td></tr>
</table>

Electrical Engineering Department

Semester : IV

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 192007</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Digital Systems</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4.5</td></tr>
<tr><td>IV</td><td>Prerequisite (if any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Number systems and Boolean algebra: Number systems, Codes, error detection and correction codes. Postulates and theorems. Logic functions, minimization of Boolean functions using algebraic, Karnaugh map and Quine – McClausky methods. Realization using logic gates, Combinational Functions (8) Realizing logical expressions using different logic gates and comparing their performance. Hardware aspects logic gates and combinational ICs: delays and hazards. Design of combinational circuits using combinational ICs: Combinational functions: code conversion, decoding, comparison, multiplexing, demultiplexing, addition, and subtraction.

Analysis of Sequential Circuits
Latches, Flip Flops – SR, JK D T, Flip flop characteristics, truth table, characteristic table, excitation tables, conversions, practical clocking aspects concerning flip-flops, timing and triggering considerations, edge triggering, Master Slave flip-flop.

Design of Digital Systems
Structure of sequential circuits: Moore and Melay machines. Analysis of sequential circuits: State tables, state diagrams and timing diagrams. State reduction. FSM and ASM. State diagrams and their features. Design flow: functional partitioning, timing relationships, state assignment, output racing. Examples of design of digital systems using PLDs, Realization of sequential functions using sequential MSIs: counting, shifting, sequence generation, and sequence detection

Digital Logic Families, Characteristics - Fan Out, Propagation Delay, Power dissipation, DTL,RTL,TTL,CMOS Inverter, VTC of CMOS inverter, pull up and pull down, network, concept of delay, noise margin, latch up. Issues in digital IC design, custom design-semi custom and full custom, gate arrays (FPGA)</td></tr>
</table>

VI	Textbook/References	1. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2010). Digital Systems: Principles and Applications. 10th Edition. Pearson. 2. Floyd, T. L. (2008). Digital Fundamentals. 10th Edition. Pearson Education India. 3. Taub, H., & Schilling, D. L. (1977). Digital integrated electronics. New York: McGraw-Hill. 4. AnandKumar,FundamentalsofDigitalElectronics4hEdition, PHIKharate,DigitalElectronics,Oxford. 5. Roth, J. C. H. and Kinney, L. L. (2013). Fundamentals of logic design. 7th Edition. Cengage Learning. 6. Roth, J. C. H. Digital System Design using VHDL 7. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh S. Gaonkar 8. 8080/8085 Assembly Language Programming Manual

Electrical Engineering Department

Semester : IV

I	Course Code	**MA 192003**			
II	Course Title	**Probability and random Processes**			
III	Credit Structure	L	T	P	C
		3	1	0	4
IV	Prerequisites(If any)				
V	Instructor	Dr. Manoj Choudhuri			
VII	Course Content	Sets and set operations; probability space, Additive and multiplicative laws of probability. Conditional probability and Bayes theorem; Combinatorial probability and sampling models. Random Variables; discrete and Continuous random variables, probability mass function, cumulative distribution function, probability density function, examples of random variables and Some standard distributions; Binomial, Poison, Uniform and Normal distributions. Generating functions and moments. Limit theorems, Strong and weak laws of large numbers, central limit theorem. Joint distributions, functions of one and two random variables. Joint moments, random vectors, Independence of random variables, correlation matrix, covariance matrix, Gaussian random vectors, scaling and translation, Standard Gaussian, Joint Gaussianity, linear transformation. Gaussian random vectors, Conditional distribution, densities and moments. Random processes, basic definitions; second-order statistics, Wide-sense stationarity and strict stationarity, Ergodicity. Power spectral density, Gaussian random processes, Noise modeling.			

Electrical Engineering Department

Semester : IV

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 194006</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Fundamentals of Nanoscience and Nanotechnology</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite</td><td colspan="4">NIL</td></tr>
<tr><td>V</td><td>Course Coordinator</td><td colspan="4">Dr. Dheeraj Kumar Singh (Physics)</td></tr>
<tr><td>VI</td><td>Course Content</td><td colspan="4">Basics: Introduction to nanotechnology, Bottom up and Top down approach for the synthesis of nanomaterials.

Synthetic methodologies: Sol-gel method, Micromulsion, CVD, PVD, Molecular beam epitaxy, Vapor-liquid-solid growth, (VLS or SLS), Spary pyrolysis, Template based synthesis, Lithography.

Various kind of Nanostructures: Carbon Nanotubes (CNT), Graphenes, Fullerenes, Quantum Dots and Semiconductor Nanoparticles, Metal-based Nanostructures, Nanoclusters and Nanowires, Polymer-based Nanostructures including dendrimers, metal oxide nanoparticles, Self-assembly of nanostructures, Core-shell nanostructures, Nanocomposites.

Physical properties of nanomaterials: Photocatalytic, Dielectric, Magnetic, Optical, Mechanical.

Characterization of nanomaterial's: Measurement of properties-particle size, TEM, SEM, STM, AFM, Spectroscopy and magnetic resonance Properties of individual nanoparticles, Engineering and Bio applications and recent advancement in Nanotechnology.</td></tr>
<tr><td>VII</td><td>Textbook/References</td><td colspan="4">1. G. Cao, Nanostructures and Nanomaterials, Synthesis, Properties and Applications, Imperial College Press 2004.

2. T. Pradeep, Nano: The Essentials Understanding nanoscience and nanotechnology, Tata McGraw-Hill Publishing Company Limited New Delhi, 2007.

3. A. S. Edelstein and R C Cammarata, Nanomaterials Synthesis, Properties and Applications, IOP Publishing Ltd 1996.

4. Charles P Poole Jr. and F. J. Owens, Introduction to Nanotechnology, Wiley 2003

5. H. S. Nalwa (Editor), Nanostructured Materials & Nanotechnology Concise Edition, Academic 2001

6. W. A. Goddard, D. W. Brenner, S. E. Lyshevski, Goddard III, Handbook of Nanoscience, Engineering, and Technology CRC Press, 2003</td></tr>
</table>

Electrical Engineering Department

Semester : IV

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">AE 194001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Dynamics and Control of Aerial Robotics</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>IV</td><td>Prerequisite (if any for the student)</td><td colspan="4"></td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Quadrotor Kinematics and Dynamics: Quadrotor Kinematics, Rigid Body Dynamics; Forces and Moments; Simplified Models: Model for Estimation; Model for Control Design; Sensors: Rate Gyros, Accelerometers, Camera; State Estimation; Control Design: Vision based attitude Hold, Roll Attitude Hold, Pitch Attitude hold, Vision based position tracking, Reading Heading hold, Feedforward, Linearization, Controllability, Observability; Levels of Autonomy, Autopilot Architecture and Design.</td></tr>
<tr><td>VI</td><td>Textbook/References</td><td colspan="4">1. R. W. Beard, T. W. McLain, Small Unmanned Aircraft: Theory and Practice, Princeton University Press, ISBN: 978069114</td></tr>
</table>

BACHELOR OF TECHNOLOGY

Electrical Engineering Department

Semester - V

Course Scheme

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
HS 203001	HSS – 3 (Advanced English)	3	0	0	3
EE 203001	Power Electronics-I	3	1	3	5.5
EE 203002	Microprocessors	3	0	3	4.5
EE 203003	Electromagnetic Waves	3	0	0	3
EE 203004	Control Systems	3	1	2	5
	Total	**15**	**2**	**8**	**21**

Electrical Engineering Department

Semester - V

I	Course Code	**HS 203001**			
II	Course Title	**HSS – 3 (Advanced English)**			
III	Credit Structure	L	T	P	C
		3	0	0	3
IV	Prerequisites (if any)	Nil			
V	Course Coordinator	Dr Meera Vasani & Dr Wati Longkumer			
VI	Course Objective	-To develop oral skills with emphasis on conversational practice -To advance writing skills through guided composition -To equip the students with the basics right of communication and presentation skills for academic and professional purposes -To assist the second language learners acquire fluency in both spoken and written English to communicate information with clarity, precision and confidence especially in the professional sphere.			

VII	Course Contents	**Remedial grammar:** -Basic language structures with focus on practice, and the use of fundamental grammatical elements. -Reading Comprehension -Guided and free composition essays of expository, descriptive, narrative, argumentative, and reflective types. **Speaking & Writing:** Rhetorical devices- Logos/Pathos/Ethos **Reading:** What is Reading? Types of Reading Critical reading **Writing:** Preparing technical project report: Abstract, Acknowledgment Report Writing CV/Resume/Bio-data **Literature:** Short essays/articles -Bon Bibi Legend and 'Ethnic Cleansing' of India's Forests: Amitav Ghosh -The Danger of a Single Story: Chimamanda Ngozi Adiche -Mother Tongue: Amy Tan -List of 7 Rules for Beginning Writers: V.S. Naipaul (more to be included, if needed) Classic Short stories -The Cactus: O Henry -A Child's Dream of a Star: Charles Dickens -The Man who could work miracles: HG Wells -My Own True Ghost Story: Rudyard Kipling -The Music on the Hill: Suki -Rain: W. Somerset Maugham -A School Story: M R James (more to be included, if needed)

Electrical Engineering Department

Semester - V

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 203001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Power Electronics-I</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>3</td><td>5.5</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">NIL</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Power semiconductor devices – construction, characteristics, datasheet interpretation, driver and protection circuits; AC-DC converters – topologies, operation principle, performance analysis, applications; DC-DC converters – topologies, operation principle, performance analysis, applications; DC-AC converters – topologies, operation principle, performance analysis, applications.</td></tr>
<tr><td>VI</td><td>Textbook/References</td><td colspan="4">Andrzej M. Trzynadlowski, Introduction to Modern Power Electronics, Wiley-India, second edition, 2011.
Philip T. Krein, Elements of Power Electronics, Oxford University Press, 2012.
Ned Mohan, Tore M. Undeland, William P. Robbins, Power Electronics: Converters, Applications and Design, Wiley-India, 2007.
Muhammad H. Rashid, Power Electronics Handbook, Academic Press, Second edition, 2009.</td></tr>
</table>

Electrical Engineering Department

Semester - V

I	Course Code	**EE 203002**			
II	Course Title	**Microprocessors**			
III	Credit Structure	L	T	P	C
		3	0	3	4.5
IV	Prerequisite (if any for the student)	Nil			
V	Course Content	A block diagram view of a general purpose processor; elements of hardware and software architectures; introductory data and control paths concepts, registers and memory organization. Instruction set basics and assembly language programming: Instruction structure and addressing modes, instruction encoding, detailed study of 8085A instruction set and interfacing basics: memory interfacing, principles of I/O interfacing, polled and interrupts I/O handshaking principles. Examples of I/O devices: parallel port, serial port, keypad, display, etc. Introductory micro controllers: architectures, instruction set, programming, input-output interfacing, interrupts. **Laboratory:** Supplements the theory 8085-microprocessor kit based experiments: Software experiments demonstrate the use of the instruction set and assembly language programming. Hardware experiments for memory interfacing, parallel port, serial ports, interrupt driven I/O Simple microcontrollers based experiments.			

Electrical Engineering Department

Semester - V

I	Course Code	**EE 203003**			
II	Course Title	**Electromagnetic Waves**			
III	Credit Structure	L	T	P	C
		3	0	0	3
IV	Prerequisite(If any for the student)	NIL			
V	Course Content	Transmission line equations. Impedance of loaded and unloaded transmission lines. Reflections and VSWR. Smith chart and its use in impedance matching and other transmission line problems. Propagation of electromagnetic waves in different media. Reflection and refraction at different boundaries. Total reflection and polarizing angle. Ground wave and sky wave propagation. Parallel plane and rectangular waveguides. Attenuation in wave guides .Radiation of electromagnetic waves. Dipole and array of dipoles for medium wave and short wave transmission			
VI	Textbook/References	1. R K Shevgaonkar, Electromagnetic Waves, McGraw Hill Education, India 2006. 2. D K Cheng, Fundamentals of Eleectromagnetics, Addison Wesley, MA 1993. 3. E.C. Jordon and E.G. Balmain, Electro-magnetic Waves and Radiation Systems, 2nd Ed.Prentice Hall India, 1986.			

Electrical Engineering Department

Semester - V

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 203004</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Control Systems</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>2</td><td>5</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Basic concepts: Notion of feedback; open- and closed-loop systems. Modeling and representations of control systems: Ordinary differential equations; Transfer functions; Block diagrams; Signal flow graphs; State-space representations, Performance and stability: Time-domain analysis; Second-order systems; Characteristic-equation and roots; Routh-Hurwitz criteria, Frequency domain techniques: Root-locus methods; Frequency responses; Bode-plots; Gain-margin and phase-margin; Nyquist plots; Compensator design: Proportional, PI and PID controllers; Lead-lag compensators. State-space concepts: Controllability; Observability; pole placement result; Minimal representations.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Automatic Control Systems by Benjamin C.Kuo, 8th Edition, Farid Golnaraghi, John Wiley & Sons.
2. Modern Control Engineering by Katsuhiko Ogata, 4th Edition, Prentice Hall of India.
3. Control Systems Engineering by Norman Nise, 6th Edition, Wiley India Pvt. Ltd.
4. Control System: Principals and Design by M Gopal, 3rd Edition, Tata McGraw Hill.
5. Linear System Theory and Design by C T Chen, Oxford, 4th Edition, Oxford University Press.
6. Modern Control Systems by Richard C. Dorf, Robert H. Bishop, 12th Edition, Prentice Hall of India.</td></tr>
</table>

Electrical Engineering

Semester VII

Teaching Scheme

Course Code	Course Name	Lecture Hours	Tutorial Hours	Practical Hours	Credit
HS 4001	Infrastructure Planning and Management	3	0	0	4
EE 4006	Instrumentation and Measurement	3	0	3	5
EE 4501	B.Tech Project - I	0	0	3	4

Elective I

Course Code	Course Name	Lecture Hours	Tutorial Hours	Practical Hours	Credit
EE 4003	Flexible Ac Transmission Systems(FACTS)	3	0	0	4
EE 194005	Advanced Power System Analysis	3	0	0	4

Elective II

Course Code	Course Name	Lecture Hours	Tutorial Hours	Practical Hours	Credit
EE 194001	Special Electric Machines	3	0	0	4
EE 194003	Renewable Energy Infrastructure	3	0	0	4

Open Elective by Department

Course Code	Course Name	Lecture Hours	Tutorial Hours	Practical Hours	Credit
EE 194004	Intelligent Control System	3	0	0	4
CS 194001	Computer Networks	3	0	0	4
MA 194001	Fuzzy Ses, Fuzzy Logic and Fuzzy Control - An Introduction	3	0	0	4

I	Course Code	**HS 4001**			
II	Course Title	**Infrastructure Planning and Management**			
III	Credit Structure	L	P	T	C
		3	0	0	4
IV	Prerequisite(If any for the student)	Completed introductory course in Economics			
V	Course Coordinators	Dr.Pravin Jadhav			
VI	Course Content	The course Infrastructure Planning and Management focuses on the planning and management of infrastructure system with a case analysis of a few infrastructure projects in India. In this course infrastructure will be understood in a broad socio economic sense- the basic structure needed for the operation of a society or enterprises or the services and facilities necessary for an economy to function. The course module includes basics of infrastructure such as meaning, types of infrastructure and the role of infrastructure in an economy; Issues and challenges regarding the provision of infrastructure system, supply and demand for infrastructure, Evaluation of infrastructure investment, risk and risk management for infrastructure project and finally the smart infrastructure through the case studies in India. It is assumed that after completing this course, the students will appreciate how disciplines of social sciences can effectively contribute the current discourse of infrastructure development and the effective planning and management of its provision. Evaluation scheme for the course Assignments 5% Class tests/ Quizzes 10% Projects - 15% Mid semester examination 25% End semester examination 50%			
VII	Reference Books	1. Goodman AS, Hastak M (2006). Infrastructure Planning Handbook: Planning, Engineering, and Economics. McGraw Hill/ ASCE Press. Chapter 1 2. World Bank (2012). Transformation through Infrastructure. Selected pages handed out in class. 3. World Bank (2006). Infrastructure at the Crossroads: Lessons from 20 Years of World Bank Experience. 4. ULI and Ernst & Young (2013) Infrastructure 2013: Global Priorities, Global Insights, The Urban Land Institute, Washington DC. Available free: http://www.uli.org/infrastructure- initiative/infrastructure-2013-explores-global-infrastructure-priorities/ 5. Lee (2009) New Delhi Water and Power. Harvard Kennedy School of Government Case Program #1891			

Lecture #	Prospective contents
1	**Basics of Infrastructure** Understanding of Infrastructure, Types of Infrastructure, Role of Infrastructure, Infrastructure scenarios in India and problems of Infrastructure Development in India .
2	**Urban Infrastructure in India** An overview of Urban Infrastructure in India, Models of Urban Governance, Municipal Finances, Major municipal reforms, Framework for Urban Infrastructure Delivery, Quality of water supply and services, Models of Urban governance, Municipal governance, Urban renewal projects
3	**Rural Infrastructure in India** Road development scenario in India, The state of rural infrastructure in India, Infrastructure and rural growth, Characteristics of rural India, Strategies to improve infrastructure in rural areas, Government initiatives for rural infrastructure improvement, Role of private sector in infrastructure development.
4	**Key Issues of provision of Infrastructure system** Leadership and strategy issues in the funding, financing, development and delivery of new infrastructure in the country Issues regarding the design and technology to be used, priority of location of infrastructure development, cost and level of risks that we have to tolerate
5	**Infrastructure Investment and Finance** Background behind investment and funding required for the financial planning of the infrastructure Various forms of funding available for infrastructure (public, private and combined)
6	**Privatization in Infrastructure Projects** Overview of history of privatization, The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Privatization of road Transportation Infrastructure in India.
7	**Supply and Demand for Infrastructure** **Issues of demand and supply management**
8	**Evaluation of Infrastructure Investments** Cost- benefit analysis Stages of an infrastructure project Lifecycle
9	**Risk and Risk management framework for infrastructure project implementation** • Legal contractual Issues in Infrastructure Projects • Environmental issues in infrastructure development • Challenges in Construction and Maintenance of Infrastructure
10	**Infrastructure Asset Management** Management of infrastructure both at individual as well as network/system level Concepts, theory and methods for infrastructure asset management and asset performance requirements
11	**Smart Infrastructure** The will be done via the case studies on smart cities. These case studies will include both Indian and international cases, with emphasis on Indian cases.

Electrical Engineering
Semester : VII

I	Course Code	**EE 4006**			
II	Course Title	**Instrumentation and Measurement**			
III	Credit Structure	L	T	p	C
		3	0	3	5
IV	Prerequisite(If any for the student)	Power System			
V	Course Content	Accuracy and Precision, Sensitivity, Linearity, Resolution, Hysteresis, Loading Effect. , Measurement of voltage, current, power, energy and power factor, DC and AC Ammeter, DC Voltmeter- Chopper type and solid-state, AC voltmeter using Rectifier, Average, RMS, Peak Responding voltmeters, Multi-meter, Power meter, Bolometer and Calorimeter. Different parts of CRO, Block diagram, Electrostatic focusing, Electrostatic deflection, Post deflection acceleration, Screen for CRTs, Graticules, Vertical and Horizontal deflection system, Time base circuit, Oscilloscope Probes, Applications of CRO, Special purpose CROs- Multi input, Dual trace, Dual beam, Sampling, Storage (Analog and Digital), Oscilloscope. Maxwells bridge (Inductance and Inductance-Capacitance), Hays bridge, Schering bridge (High voltage and Relative permittivity), Wein bridge, Wagner earth detector, Impedance measurement by Q-meter. Non-Electrical Quantities (Transducer): Classification of Transducers, Strain gauge, Displacement Transducer- Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT), Temperature Transducer- Resistance Temperature Detector (RTD), Thermistor, Thermocouple, Piezo-electric transducer, Optical Transducer- Photo emissive, Photo conductive, Photo voltaic, Photo-diode, Photo Transistor, Nuclear Radiation Detector. Signal and Function Generators, Sweep Frequency Generator, Pulse and Square Wave Generator, Beat Frequency Oscillator, Digital display system and indicators, Classification of Displays, Display devices, Light Emitting diodes (LED), Liquid Crystal Display (LCD). Advantages of Digital Instrument over Analog Instrument, Digital-toanalog conversion (DAC) - Variable resistive type, R-2R ladder Type, Binary ladder, Weighted converter using Op-amp and transistor, Practical DAC. Analog-to-digital Conversion (ADC) Ramp Technique, Dual Slope Integrating Type, Integrating Type (voltage to frequency), Successive Approximations, digital voltmeters and multi-meters, Resolution and sensitivity of digital meter, PLC structure, principle of operation, response time and application.			
VI	Text/References	1. H. S. Kalsi: Electronics Instrumentation, TMH. 2. K. Sawhney: Instrumentation and Measurements, Dhanpat Rai and Co. 3. Helfric and Cooper: Modern Electronic Instrumentation and MeasurementTechniques; Pearson.			

Electrical Engineering

Semester : VII

I	Course Code	**EE 4501**			
II	Course Title	**B.Tech Project - I**			
III	Credit Structure	L	T	p	C
		0	0	3	4
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	Students are required to carry out project under the supervision of faculty members for the defined objectives. The project includes the thesis submission and viva-voice.			
VI	Text/References				

Electrical Engineering

Semester : VII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 4003</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Flexible AC Transmission Systems (FACTS)</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Power System</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Principle of compensators - VAr control, Passive reactive power compensation and design aspects- shunt passive compensator and series passive compensator; FACTS controllers based on Thyristors, based on self-commutated switches; Type of FACTS controllers - Shunt connected controllers - Static VAr compensator (SVC) and its configurations and Static Synchronous compensator (STATCOM), performance comparison of SVC and STATCOM; Series connected controllers - TCSC, SSSC and TCPAR, Unified Power flow controller, Applications of FACTS controllers - stability improvement and congestion management in power system, case study discussion in Indian power grid.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Hingorani N.G. and GyugyiL., Understanding FACTS: Concepts and Tech- nology of Flexible AC Transmission Systems, IEEE Press, Standard Publishers Distributors, 1st Indian Edition, 2001.
2. Padiyar, K.R., FACTS Controllers in Power Transmission and Distribution, New Age International, 1st Edition, 2007.</td></tr>
</table>

Electrical Engineering

Semester : VII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 194005</td></tr>
<tr><td>II</td><td>Title of the course</td><td colspan="4">Advanced Power System Analysis</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Exposure</td><td colspan="4">Power System (EE 3005).</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Operating states of power system. State-transition diagram. Introduction to power system security analysis. Major components of on-line security analysis.

Introduction to power system state estimation. Processes involved in state estimation: observability analysis, bad data detection and identification. Power system state estimation using method of least squares: Statistics, errors, and estimates, test for bad data. Structure and formation of H-matrix.

Introduction to synchro-phasor technology, Phasor Measurement Unit (PMU): Structure, operation and applications. Phase angle estimation techniques in distribution systems: Micro PMU, Phase Locked Loop (PLL), and Discrete Fourier Transform (DFT) based approach. OpenPMU.

Phase shifting transformer in transmission lines: Modelling and admittance matrix formulation.

Revision of gauss-seidal and newton-raphson power flow analysis, concept of distributed slack and distributed slack power flow analysis. DC power flow analysis, loss-compensated DC power flow analysis. Optimal power flow analysis: formulation of objective function and constraints.

Representation of loads in power system: constant impedance, constant current and constant power loads. ZIP model and composite load representation

Sparse matrix storage techniques in power system. Fill-in and optimal ordering</td></tr>
<tr><td>VI</td><td>Text/Reference Books</td><td colspan="4">[1] J. Grainger, W. D. Stevenson Jr, “Power System Analysis”, Mc-Graw Hill Publications
[2] Literature work reported in IEEE Xplore digital library.</td></tr>
</table>

Electrical Engineering

Semester : VII

I	Course Code	**EE 194001**			
II	Title of the course	**Special Electric Machines**			
III	Credit Structure	L	T	P	C
		3	0	0	**4**
IV	Prior Exposure	Electrical Machines			
V	Course Content	Permanent Magnet Brushless D.C. Motors - Fundamental equations; EMF and Torque equations; Torque speed characteristics; Rotor position sensing; Sensorless motors; Motion control. Permanent Magnet Synchronous Motors Construction; Principle of operation; EMF and torque equations; Starting; Rotor configurations; Dynamic model. Synchronous Reluctance Motors - Constructional features; axial and radial flux motors; operating principle; characteristics Switched Reluctance Motors - Constructional features; principle of operation; torque production; characteristics; power controllers Stepping Motors Features; fundamental equations; PM stepping motors; Reluctance stepping motors; Hybrid stepping motors; Torque and voltage equations; characteristics			
VI	Text/Reference Books	[1] K. Venkataratnam, "Special Electrical Machines", Universities Press References [2] T. J. E. Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", Oxford Science Publications			

Electrical Engineering
Semester VII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 194003</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Renewable Energy Infrastructure</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>P</td><td>T</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any the students)</td><td colspan="4">Basics of Electrical and Electronics Engineering, Power Systems</td></tr>
<tr><td>V</td><td>Course Contents</td><td colspan="4">Sustainability: Why Energy Matters (and Money); Global Warming (Physics), History and Impact; Renewable Sources that are replenished: Wind, Solar, Ocean Waves, Geothermal; Wind Energy: Forecasting Challenges, Wind Turbines: Dynamics and Control, Wind Wakes; Solar Energy: Harnessing the Power of Sun: Science and Technology of Solar Photovoltaics (PV), Solar PV Connection to virtual Grid, Optimization issues; Renewable Energy storage Issues, Challenges; Hybrid Solar-Wind System; Wind Farm; Solar Farm; Policy and Ethical Issues; Energy Conservation related issues; Hydrogen and Fuel Cells; Bio-energy.</td></tr>
<tr><td>VI</td><td>Reference Books</td><td colspan="4">[1] Wind Energy Handbook, 2nd Edition, Tony Burton, Nick Jenkins, DavidSharpe, Ervin Bossanyi,
[2] Solar Electricity Handbook - 2015 Edition: A simple, practical guide to solarenergy - designing and installing solar PV systems, Michael Boxwell, Greenstream Publishing; 2015 Edition,
[3] Hydrogen and Fuel Cells: A volume in Sustainable World, Bent Sorensen,
[4] Non-conventional Energy Resources, B H Khan, Third Edition, McGrawHill Education</td></tr>
</table>

Electrical Engineering
Semester VII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 194004</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Intelligent Control System</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">– Introduction of artificial Intelligence and background and related fields.
– Biological foundations to intelligent systems II: Fuzzy logic, knowledge representation and inference mechanism, genetic algorithm, and fuzzy neural networks.
– Biological foundations to intelligent systems I: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.
– Fuzzy and expert control (standard, Takagi-Sugeno, mathematical characterizations, design example), Parametric optimization of fuzzy logic controller.
– Application of neuro-fuzzy inference systems to robotics.
– System identification using neural and fuzzy neural networks.
– Genetic Algorithm and applications.
– Stability analysis : Lyapunov stability theory and Passivity Theory.
– Applications to ball and beam system, helicopter system, flight system, robot manipulator, inverted pendulum and inertia wheel pendulum control and visual motor coordination.</td></tr>
<tr><td>VI</td><td>Reference books</td><td colspan="4">– Intelligent Control Systems Using Soft Computing Methodologies, Edited by Ali Zilouchian Mo Jamshidi, CRC press, 2001.
– Intelligent systems and control,:Principles and applications, L. Behera and I Kar, Oxford, 2009
–Intelligent Control A hybrid - Approach Based on Fuzzy Logic, Neural Networks and Genetic Algoorithms by Nazmul siddique , springer2013</td></tr>
</table>

Electrical Engineering

Semester : VII

I	Course Code	**CS 194001**			
II	Course Title	**Computer Networks**			
III	Credit Structure	L	T	P	C
		3	0	0	4
IV	Course Content	Uses of Computer Networks, Network Hardware Section, Reference Models (OSI, TCP-IP), Network Software, Network Standardization, Metric Units, Physical Layer: Theoretical Basis for Data Communication Section, Guided Transmission Media, Wireless Transmission, Communication Satellites, Public Switched Telephone Network, Mobile Telephone System Section, Cable Television Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols, Protocol Verification, Example Data Link Protocols Medium Access Control Sub layer, Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANs, Broadband Wireless Section, Bluetooth, Data Link Layer Switching, Network Layer, Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, Internetworking, Network Layer in the Internet The Transport Layer and its Service, Elements of Transport Protocols, A Simple Transport Protocol, Internet Transport Protocols: UDP, Internet Transport Protocols: TCP, Performance Issues. Application Layer, DNSThe Domain Name System, Electronic Mail, The World Wide Web, Multimedia Section Network Security, Cryptography, Digital Signatures, Communication Security, Authentication Protocols, E-Mail Security, Web Security, Social Issues Section, ATM			
V	Text/References	1. Computer Network By Tanenbaum (Prentice Hall) 2. Data Communication and Networking, By B. A. Forouzan (TMH)			

Electrical Engineering
Semester : VII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">MA 194001 (Open Elective)</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Fuzzy Set, Fuzzy Logic and Fuzzy Control - An Introduction</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>P</td><td>T</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any the students)</td><td colspan="4">NIL</td></tr>
<tr><td>V</td><td>Course Contents</td><td colspan="4">Classical Set Theory: Fundamental Concepts, Relations, Operation on Relations, Interval Arithmetic: Fundamental Concepts, Arithmetic operations on intervals, Algebraic Properties of Interval Arithmetic, Width of an Interval, Interval Matrix Operations, Fuzzy Set Theory: Introduction, Fuzzy set, strong -cut and weak -cut, Convex fuzzy set, Normal fuzzy set, Height and core of a fuzzy set, Resolution Principle, Extension Principle, fuzzy number, Arithmetic operations on fuzzy numbers, Linguistic variables, Fuzzification and Defuzzification, Fuzzy Relations. Fuzzy Logic Theory: Classical logic, Boolean Algebra, Multi-Valued Logic, Fuzzy logic, Approximate Reasoning, Fuzzy Logic Rule Base.
Fuzzy and expert control (standard, Takagi Sugeno, mathematical characterizations, design examples), Parametric optimization of fuzzy logic controller using genetic algorithm; System identification using fuzzy neural networks; Stability analysis: Lyapunov stability theory and Passivity Theory; Adaptive control using fuzzy neural networks, Applications to flight control, robot manipulator dynamic control, under actuated systems such as inverted pendulum and inertia wheel pendulum control.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">Ross, T. J., “Fuzzy Logic with Engineering Applications”, Wiley India Pvt. Ltd., 3rd Ed.
Zimmerman, H. J., “Fuzzy Set theory and its application”, Springer, India Pvt. Ltd., 4th Ed.
Klir, G. and Yuan, B., “Fuzzy Set and Fuzzy Logic: Theory and Applications”, Prentice Hall of India Pvt. Ltd.
Klir, G. and Folger, T.,“Fuzzy Sets, Uncertainty and Information”, Prentice Hall of India Pvt. Ltd.
Guanrong Chen and Trung Tat Pham, “Introduction to fuzzy sets, fuzzy logic and fuzzy control systems” CRC Press, Boca Raton London New York Washington, D.C.</td></tr>
</table>

Electrical Engineering

Semester VIII

Teaching Scheme

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
EE 4005	Renewable Energy Systems	3	0	0	4
EE 4502	B.Tech. Project II	3	0	0	4
EE 5014	Advanced Power System Analysis	3	0	0	4
EE 5015	Digital Image Processing	3	0	0	4
CS 5001	Neural Networks and Deep Learning.	3	0	0	4
HS 4002	Engineering Ethics	3	0	0	4
MA 5004 Ph.D. (I-SEMESTER)	Real and Functional Analysis	3	0	0	4
MA 5005 Ph.D. (I-SEMESTER)	Reliability Engineering	3	0	0	4
	Total	**24**	**0**	**0**	**32**

Electrical Engineering

Semester : VIII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 4005</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Renewable Energy Systems</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>P</td><td>T</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Power System</td></tr>
<tr><td>VI</td><td>Course Content</td><td colspan="4">Sustainability: Why Energy Matters (and Money); Global Warming (Physics), History and Impact; Renewable Sources that are replenished: Wind, Solar, Ocean Waves, Geothermal; Wind Energy: Forecasting Challenges, Wind Turbines: Dynamics and Control, Wind Wakes; Solar Energy: Harnessing the Power of Sun: Science and Technology of Solar Photovoltaics (PV), Solar PV Connection to virtual Grid, Optimization issues; Renewable Energy storage Issues, Challenges; Hybrid Solar-Wind System; Wind Farm; Solar Farm; Policy and Ethical Issues; Energy Conservation related issues; Hydrogen and Fuel Cells; Bio-energy: The plants work and let us reap.</td></tr>
<tr><td>VII</td><td>Reference Books</td><td colspan="4">1. Wind Energy Handbook, 2nd Edition, Tony Burton, Nick Jenkins,DavidSharpe, Ervin Bossanyi, ISBN: 978-0-470-69975-1
2. Solar Electricity Handbook - 2015 Edition: A simple, practical guide to solarenergy - designing and installing solar PV systems, Michael Boxwell, Greenstream Publishing; 2015 Edition, ISBN-13: 978-1907670459
3. Hydrogen and Fuel Cells: A volume in Sustainable World, BentSorensen,ISBN: 978-0-12-387709-3.</td></tr>
</table>

Electrical Engineering

Semester : VIII

I	Course Code	**EE 4502**			
II	Course Title	**B.Tech. Project II**			
III	Credit Structure	L	T	p	C
		3	0	0	4
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	Students are required to carry out project under the supervision of faculty members for the defined objectives. The project includes the thesis submission and viva-voice.			
VI	Text/References				

Electrical Engineering

Semester : VIII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 5014</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Advanced Power System Analysis</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>p</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Power System (EE 3005)</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Formation of network matrices: Bus impedance matrix, modification of bus impedance matrix for changes in the network, admittance matrix. Phase shifting transformer in transmission lines: Modelling and admittance matrix formulation. Revision of gauss-sedan and newton-raphson power flow analysis, concept of distributed slack and distributed slack power flow analysis. DC power flow analysis, loss-compensated DC power flow analysis. Brief discussion on power flow analysis in distribution systems (based on forward sweep/backward sweep criteria) and optimal power flow analysis. Introduction to power system state estimation. Static and dynamic state estimation. Power system state estimation using method of least squares. Sparse matrix storage techniques in power system. Fill-in and optimal ordering.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. G. W. Stagg and H. El-abiad, Computer Methods in Power System Analysis, Mc-Graw Hill Publications.
2. J. Grainger, W. D. Stevenson Jr, Elements of Power System Analysis, Mc-Graw Hill Publications.
3. B. M. Weedy, B. J. Cory, Electrical Power System, Wiley Publications.
4. A. J. Wood, B. F. Wollenberg, Power Generation Operation and Control, Wiley Publications.
5. Literature work reported in IEEE Digital library.</td></tr>
</table>

Electrical Engineering

Semester : VIII

I	Course Code	**EE 5015**			
II	Course Title	**Digital Image Processing**			
III	Credit Structure	L	T	P	C
		3	0	0	4
IV	Prerequisite(If any for the student)	No			
V	Course Content	**Introduction** Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization. **Spatial Domain Filtering** Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian. **Filtering in the Frequency domain** Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering. **Image Restoration** Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections. **Image Compression** Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, JPEG, Lossless predictive coding, Lossy predictive coding, Wavelet based Image Compression **Morphological Image Processing:** Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion. 5 **Image Segmentation** Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Regionbased segmentation, Watershed algorithm			
VI	Text/References	1. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education. 2. A. K. Jain, Fundamentals of digital image processing, Prentice Hall, 1989. 3. W. K. Pratt, Digital image processing, Prentice Hall, 1989.			

Electrical Engineering
Semester : VIII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">CS 5001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Neural Networks and Deep Learning</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>p</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">B.Tech level Linear Algebra, Probability and Optimization. Awareness of programming structures in C,C++,Java or Python. (Tutorial coverage of Python 3.6 and Numpy in course)</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">1. Introduction to Neural Networks, Machine Learning, Biological Neuron as a computational model. Tutorial introduction of Python and Machine learning through Jupyter Notebooks.
2. Single layer Perceptron, Perceptron Learning Theorem and delta learning algorithms, XOR problem and linear separability problem.
3. Multilayer Perceptron, Backpropagation algorithm, Feedforwnetworks, Issue of speed of learning.
4. Learning feature vectors, Object recognition, Optimization for making learning faster
5. Recurrent networks, Unsupervised learning, Hopfield neworks and Boltzman machines. Difficulties of training Recurrent networks.
6. Improving Generalization capabilities of Neural networks, Combination of different neural networks.
7. Restricted Boltzman machines, Deep belief networks, Generative pretraining of neural networks.
8. Deep Learning, Modelling heirarchical structures with neural networks. Study and applications of Google's Tensor Flow software library for deep learning.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Ian Goodfellow, Yoshua Bengio, Aaron Courville,Deep Learning (Adaptive Computation and Machine Learning series), MIT Press, 2016.
2. Christopher M Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
3. Li Deng, Dong Yu, Deep Learning: Methods and Applications, Microsoft Research, 2014.
4. Simon Haykin, Neural Networks and Learning Machines, 3rd Edition,Pearson Education, 2009.</td></tr>
<tr><td>VII</td><td>MOOCs</td><td colspan="4">1. www.coursera.org, Geoffrey Hinton, Neural Networks for Machine Learning, available for auditing.
2. www.kadenze.com, Parag Mittal, Creative Applications of DeeLearning with TensorFlow, available for auditing</td></tr>
<tr><td>VIII</td><td>Software Resources and datasets</td><td colspan="4">TensorFlow software library from Google. Jupyter Notebooks. MNIST dataset(http://yann.lecun.com/exdb/mnist/).Labelled Faces (http://mmlab.ie.cuhk.edu.hk/projects).</td></tr>
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Electrical Engineering

Semester : VIII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">HS 4002</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Engineering Ethics</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>p</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Completed introductory course in Sociology</td></tr>
<tr><td>V</td><td>Course Coordinators</td><td colspan="4">Dr. Shukkoor. T , Dr. Dipankar Deb and Dr. Pravin Jadhav</td></tr>
<tr><td>VI</td><td>Course Content</td><td colspan="4">The purpose of the course Engineering Ethics is to introduce the engineering students to the concepts and practice of engineering ethics. The course tries to address the question of how to educate engineers about the social implications and ethical issues of their work. The course will helps the students with fundamental knowledge to explore and critically examine various ethical issues and dilemmas while discharging duties in professional life. A detailed discussion of case studies which are routinely encountered while implementing projects in industry are also included in the course. Contemporary issues in engineering ethics such as research integrity, professional ethics, human subjects protections, Intellectual Property Rights (IPR), Software/ Patent issues, ethics in performing collaborative research, etc. in the context of engineering teams will be addressed in the class discussion.

The objectives of the course include (1) To provide the students an understanding of the meaning of ethics in engineering profession (2) To introduce an awareness of ethical duties and responsibilities of engineers in the practice of their careers and (3) To provide a sociological understanding of the social impact of technology and engineering (4) To examine some of the classical cases as well as contemporary issues in engineering ethics.

Evaluation scheme for the course
Class tests/ Quizzes 10 %
Seminar/ Presentation 10 %
Mid semester examination 25%
End semester examination 50%
Attendance and participation in class discussion- 5%</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Martin, Mike W., and Roland Schinzinger: Introduction to Engineering Ethics, Second edition (Boston, McGraw- Hill, 2009)

2. Govindarajan M, Natarajan S, Senthil Kumar V.S, Engineering Ethics, Prentice Hall of India, New Delhi, 2004

3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins,Engineering Ethics Concepts and Cases, Cengage Learning, 2009

4. Charles B. Fleddermann, Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.

5. Pillai Radhakrishnan and Sivanandan. D, Chanakyas 7 secrets of Leadership, Jaico, Delhi, 2014

6. Durkheim, Durkheim,Professional Ethics and Civic Morals, Routledge sociology classics, Taylor and Francis, London, 2005</td></tr>
</table>

Lecture #	Prospective contents
1	**Unit 1: Engineering Ethics: Understanding basic concepts** Ethics- Engineering Ethics- Engineering as Profession Difference between occupation and professions- Professional Ethics - Codes of Ethics in Engineering profession- Moral dilemmas and moral autonomy in Engineering profession-Indian Ethos-Chanakyas Nitishastra
2	**Unit 2: Engineering as Social Experimentation** Engineering as experimentation-Engineers as responsible Experimenters-A balanced outlook on Law
3	**Unit 3: Social Impact of Technology and Engineering** Ethos of science and engineering- Ethical leadership in engineering and society, social responsibility of scientist/ researchers, Intellectual property and society, Cross cultural issues in engineering research
4	**Unit 4 : Safety, Responsibilities and Liability** Safety and risk- Assessment of safety and risk Risk management- Risk benefit analysis and reducing risk- Responsible conduct of research- Analysis of case studies
5	**Unit 5: Major Issues in Engineering Ethics** Ethics and Environment- Ethics and sustainable engineering- Computer ethics-Analysing ethical problems in research- Ethics in collaborative research- Engineers as expert consultants and advisors- Corporate Social Responsibility (CSR).

Electrical Engineering

Semester : VIII

I	Course Code	**MA 5004 Ph.D.(I-SEMESTER)**			
II	Course Title	**Real and Functional Analysis**			
III	Credit Structure	L	T	p	C
		3	0	0	4
IV	Prerequisite(If any for the student)	Advanced Calculus /Analysis			
V	Instructors	Dr. Shanti Prasanna			
VI	Course Content	Metric spaces: Open sets, Closed sets, Continuous functions, Completeness, Cantor intersection theorem, Baire category theorem, Compactness, Totally boundedness, finite intersection property. Definition and existence of Riemann-Stieitjes integral, Properties of the integral, Differentiation and integration. Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation. Normed linear spaces: Normed linear spaces, Riesz lemma, characterization of finite dimensional spaces, Banach spaces. Bounded linear maps on normed linear spaces: Examples, linear map on finite dimensional spaces, finite dimensional spaces are isomorphic, operator norm. Hahn-Banach theorems. Uniform boundedness principle, closed graph theorem, open mapping theorem, inner product spaces, orthonormal set, Gram-Schmidt orthonormalization, orthonormal basis, orthogonal complements.			
VI	Text/References	1. N. L. Carothers, Real Analysis, Cambridge University Press (2000) 2. J. Conway, A Course in Functional Analysis, 2nd Ed., Springer. 3. W. Rudin, Principles of Mathematical Analysis, McGraw-Hill (1986). 4. B.V.Limaye Functional Analysis New Age International Publishers.			

Electrical Engineering

Semester : VIII

I	Course Code	**MA 5005 Ph.D.(I-SEMESTER)**			
II	Course Title	**Reliability Engineering**			
III	Credit Structure	L	T	p	C
		3	0	0	4
IV	Prerequisite(If any for the student)	Probability & Distributions			
V	Instructors	Dr. Vikas Kumar Sharma & Dr. Mohit Kumar			
VI	Course Content	Definition of reliability and its measures, mean time to failure, mean time between failure, Maintainability and availability. Concept of failure- Bath tub curve. Life testing & Failure distributions: exponential, Weibull and gamma with their properties and uses. Maximum Likelihood Estimation, Reliability using standard probability models based on complete and censored samples (type I, type II and left right and interval censoring). Non-parametric estimation of reliability: Kaplan-Meier type estimators. Model selection criteria and comparison of nested models (-2logL and AIC). Acceptance sampling based on reliability test, Accelerated life testing. System configurations: series, parallel, bridge and r-out of-n system; their block diagrams, Usefulness of redundancy and improvement factor. Cold and hot redundancy, reliability of stand-by system. Stress-strength reliability model. Competing risks model, Accelerated life testing. Failure analysis: Fault tree analysis, Minimal Cut sets. Introduction to fuzzy set theory, application to reliability analysis.			
VI	Text/References	1. Reliability Engineering, Balagurusamy E., Tata Mc-Graw Hill Publications , New Delhi. 2. Statistical Analysis of Reliability and Life- Testing Models, Bain, L.J, Dekker, New York, 3. Statistical Theory of Reliability and Life Testing Probability Models, Barlow R.E. & Proschan, F., Holt, Rinehart and Winston, New York. 4. Practical Reliability Engineering, Connor, P.D.T.O., John Wiley. 5. An Introduction to Reliability and Maintainability Engineering, Charles E Ebling,, Tata-McGraw Hill 6. Life Testing and Reliability Estimation, Sinha, S.K. and Kale, B.K., Wiley Eastern, Delhi. 7. Mathematical Theory of Reliability, Barlow, R.E. and Proschan, F, John Wiley, New York. 8. Survival Analysis: Techniques for censored and Truncated Data. Klien, J.P. and Moeschberger, M.L.: 2ed. Springer. 9. Statistical Models and Methods for Lifetime Data, Lawless, J. F., J. Wiley, New York. 10. Fuzzy-reliability Engineering: Concepts and Applications A. K. Verma, Ajit Kumar Verma, A. Srividya, Rajesh S. Prabhu Gaonkar, Narosa, 2007 - Technology & Engineering.			