AC 29/4/2013 Item no. 4.75

UNIVERSITY OF MUMBAI

Revised Syllabus

Program- Bachelor of Engineering

Course- Electrical Engineering

(Second Year – Sem. III & IV)

Under

FACULTY OF TECHNOLOGY

(As per Credit Based Semester and Grading System from 2013-14)

From Dean's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education.The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance.Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande
Dean,
Faculty of Technology,
Member - Management Council, Senate, Academic Council
University of Mumbai, Mumbai

Preamble:

The overall technical education in our country is changing rapidly in manifolds. Now it is very much challenging to maintain the quality of education with its rate of expansion. To meet present requirement a systematic approach is necessary to build the strong technical base with the quality. Accreditation will provide the quality assurance in higher education and also to achieve recognition of the institution or program meeting certain specified standards. The main focus of an accreditation process is to measure the program outcomes, essentially a range of skills and knowledge that a student will have at the time of graduation from the program that is being accredited. Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Electrical Engineering of University of Mumbai, happy to state here that, Program Educational Objectives (PEOs) were finalized for undergraduate program in Electrical Engineering, more than twenty senior faculty members from the different institutes affiliated to University of Mumbai were actively participated in this process. Few PEOs were finalized for undergraduate program in Electrical Engineering are listed below;

- To provide the overall strong technical foundation to formulate, solve and analyse engineering problems during undergraduate program.
- To prepare students to demonstrate an ability to identify, formulate and solve electrical based issues.
- To prepare students to demonstrate an ability in the area of design, control, analyse and interpret the electrical and electronics systems.
- To prepare students for successful career in industry, research and development.
- To develop the ability among students for supervisory control and data acquisition for power system application.
- To provide opportunity for students to handle the multidisciplinary projects.
- To create the awareness of the life-long learning and to introduce them to professional ethics and codes of professional practice.

The affiliated institutes may include their own PEOs in addition to the above list

To support the philosophy of outcome based education, in addition to stated PEOs, objectives and expected outcomes are also included in the curriculum. I know, this is a small step taken to enhance and provide the quality education to the stake holders.

Dr.M.V.Bhatlkar
Chairman,
Board of Studies in Electrical Engineering,
University of Mumbai

Scheme for Semester IV

Sub Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EEC401	Applied Mathematics – IV*	4	--	1	4	--	1	5
EEC402	Elements of Power System	3	2	--	3	1	--	4
EEC403	Electrical Machines –I	4	2	--	4	1	---	5
EEC404	Signal Processing	4	2	--	4	1	--	5
EEC405	Analog and Digital Integrated Circuits	4	2	--	4	1	--	5
EEC406	Numerical Methods and Optimization Techniques	3	2	--	3	1	--	4
		22	10	1	22	5	1	28

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Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 & Test 2					
EEC401	Applied Mathematics – IV*	20	20	20	80	25		--	125
EEC402	Elements of Power System	20	20	20	80	25		25	150
EEC403	Electrical Machines –I	20	20	20	80	25	25	--	150
EEC404	Signal Processing	20	20	20	80	25	--	-	125
EEC405	Analog and Digital Integrated Circuits	20	20	20	80	25	25	--	150
EEC406	Numerical Methods and Optimization Techniques	20	20	20	80	25	--	--	125
Total		--	--	120	480	150	50	25	825

*****Common for Electrical, Bio-medical Engineering, Instrumentation, Electronics and Electronics & Telecommunication branches.

Subject Code	Subject Name	Teaching Scheme(Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EEC 401	Applied Mathematics IV	04	--	01	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
EEC 401	Applied Mathematics IV	20	20	20	80	25	--	--	125

Subject Code	Subject Name	Credits
EEC401	**Applied Mathematics IV**	**05**
Course Objectives	This course will present the method of calculus of variations (CoV), basic concepts of vector spaces, matrix theory, concept of ROC and residue theory with applications. • To provide students with a sound foundation in mathematics and prepare them for graduate studies in Electronics and Telecommunication Engineering • To provide students with mathematics fundamental necessary to formulate, solve and analyze engineering problems. • To provide opportunity for students to work as part of teams on multi disciplinary projects.	
Course Outcomes	• Students will able to apply method of calculus of variations to specific systems, demonstrate ability to manipulate matrices and compute eigenvalues and eigenvectors, Identify and classify zeros, singular points, residues and their applications. • Students will demonstrate an ability to identify formulate and solve Telecommunication Engineering problem using applied mathematics. • Students who can participate and succeed in competitive exams like GATE, GRE. • Students will be able to make more efficient programs.	

Module No.	Unit No.	Topics	Hrs.
1. 0		**Calculus of variation**	**10**
	1.1	Euler Langrange equation, solution of Euler's Langrange equation (only results for different cases for function) independent of a variable, independent of another variable, independent of differentiation of a variable and independent of both variables	
	1.2	Isoperimetric problems, several dependent variables	
	1.3	**Functions involving higher order derivatives:** Rayleigh-Ritz method	
2.0		**Linear algebra: vector spaces**	**12**
	2.1	**Vectors in n-dimensional vector space**: Properties, dot product, cross product, norm and distance properties in n-dimensional vector space.	
	2.2	Metric spaces, vector spaces over real field, properties of vector spaces over real field, subspaces.	
	2.3	Norms and normed vector spaces	
	2.4	Inner products and inner product spaces	
	2.5	The Cauchy-Schwarz inequality, orthogonal Subspaces, Gram-Schmidt process	
3.0		**Linear Algebra: Matrix Theory**	**15**
	3.1	Characteristic equation, Eigenvalues and Eigenvectors, properties of Eigenvalues and Eigenvectors	
	3.2	Cayley-Hamilton theorem, examples based on verification of Cayley-Hamilton theorem	
	3.3	Similarity of matrices, Diagonalisation of matrix	
	3.4	Functions of square matrix, derogatory and non-derogatory matrices	
	3.5	Quadratic forms over real field, reduction of quadratic form to a diagonal canonical form, rank, index, signature of quadratic form, Sylvester's law of inertia, value-class of a quadratic form of definite, semi- definite and indefinite	
	3.6	Singular Value Decomposition	
4.0		**Complex variables: Integration**	**15**
	4.1	**Complex Integration:** Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula	
	4.2	Taylor's and Laurent's series	

	4.3	Zeros, singularities, poles of f(z), residues, Cauchy's Residue theorem	
	4.4	Applications of Residue theorem to evaluate real Integrals of different types	
		Total	**52**

Text books:

1) A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar & J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune

2) Mathematical Methods in science and Engineering, A Datta (2012)

3) Higher Engg. Mathematics by Dr. B.S. Grewal, Khanna Publication

Reference Books:

1) Todd K.Moon and Wynn C. Stirling, Mathematical Methods and algorithms for Signal Processing, Pearson Education.
2) Kreyszig E., Advanced Engineering Mathematics, 9th edition, John Wiley, 2006.
3) Linear Algebra- Hoffman & Kunze (Indian editions) 2002
4) Linear Algebra- Anton & Torres (2012) 9th Indian Edition.
5) Complex Analysis – Schaum Series.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.

2. The students need to solve total 4 questions.

3: Question No.1 will be compulsory and based on entire syllabus.

4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work/Tutorial:

At least 08 assignments covering entire syllabus must be given during the **Class Wise Tutorial**. The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per **Credit and Grading System** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
EEC402	Elements of Power System (abbreviated as EPS)	3	2	3	1	4

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC402	Elements of Power System	20	20	20	80	03	25	25	150

Subject Code	Subject Name	Credits
EEC402	**Elements of Power System (abbreviated as EPS)**	**5**
Course Objectives	• To enhance the basic knowledge of the different components of power system network and helps them in industry oriented learning	
Course Outcomes	• Students will be familiar with various elements of power system network and their significance towards enhancement of efficiency of power system network • Helps in understanding of impact of power solutions on the society and will be aware of contemporary issues	

Module	Contents	Hours
1	**Introduction:**Typical AC supply system, comparison between DC and AC supply system, choice of working voltage for transmission and distribution	02
2	**Transmission line parameters** **Resistance:** Resistance, skin effect and proximity effect **Inductance** Definition of inductance, inductance of single phase two wire line, conductor types, bundled conductors. Inductance of composite conductor, single circuit three phase line, double circuit three phase line	10

	Capacitance Potential difference between two conductors of a group of parallel conductors, capacitance of a two wire line, three phase line with equilateral spacing, three phase line with unsymmetrical spacing earth effect on transmission line capacitance, bundled conductors, method of GMD	
3	**Performance of transmission line** **Representation of power system components** Single phase solution of balanced three phase networks. One line diagram, impedance and reactance diagram. Per unit (p.u.) system, per unit impedance diagram, representation of loads **Transmission line model** Short, medium, and long line model. Equivalent circuit of a long line. Ferranti effect. Tuned power lines, surge impedance loading, power flow through transmission lines (Numerical compulsory)	9
4	**Overhead Transmission Line** **Mechanical design of transmission line** Components of overhead lines, types of towers- A type, B type, C type, D type and double circuit tower, cross arms, conductor configuration, spacing and clearance span lengths, sag and tension (Numerical compulsory) **Overhead line Insulators** Types of insulators. String efficiency, methods of equalizing potential (Numerical compulsory)	7
5	**Underground Cable** General construction, types of cable- PVC insulated, XLPE, Paper impregnated, mineral insulated, insulation resistance of single core cable, capacitance of single core cable, grading of cable, selection of cable, Comparison between overhead line transmission with underground cabling system	4
6	**Grounding and safety techniques** Measurement of earth resistance. Soil resistivity, tolerable limits of body currents, tolerable step and touch voltage, actual step and touch voltage, measurement of tower footing resistance, counterpoise methods of neutral grounding, grounding practices	4

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text Books:

1. Wadhwa C.L. '*Electrical power system'*, New Age International,4th edition,2005
2. J B. Gupta, '*A Course In Power Systems'*, S. K. Kataria & Sons, 2009
3. Soni M.L., Bhatanagar U.S, Gupta P.V, 'A *course in electrical power'*, Dhampat Rai and Sons., 1987
4. D. P. Kothari, I. J. Nagrath, '*Modern Power System Analysis'*, Mc Graw Hill
5. B.R. Gupta*, 'Power System Analysis And Design'*, S.Chand

Reference Books:

1. Stevenson, *Modern power system analysis*, TMH publication
2. Mehta V.K., *Principle of power system*, S Chand

Term work:

Term work shall consist of minimum eight combination of experiments, tutorials and simulations (minimum two) , assignments(min two)

The distribution of marks for term work shall be as follows:

Laboratory work (Experiment/ programs and journal) **:10 marks**

Assignments **:** **10 marks**

Attendance (Theory and Practical) **:** **05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
EEC403	Electrical Machines- I (abbreviated as EMC-I)	4	2	4	1	5

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC403	Electrical Machines –I	20	20	20	80	03	25	25*	150

Subject Code	Subject Name	Credits
EEC403	**Electrical Machines- I (abbreviated as EMC-I)**	**05**
Course Objectives	• To expose the students to the concepts of DC machines, single phase transformer and their applications. • To impart industry oriented learning.	
Course Outcomes	• Students will be knowing the working principle, performance, control and applications of Electrical Machines • An ability to design and conduct performance experiments, as well as to identify, formulate and solve machine related problems.	

Module	Contents	Hours
1	**Basics of Magnetism** Magnetic field, Magnetic circuit, Numerical from series parallel magnetic circuit, Flux linkage, Inductance and energy, Faraday's laws, Hysteresis and eddy current losses.	04
2	**Electromechanical Energy Conversion** Principle, Energy stored in magnetic field, Torque in singly excited magnetic field, Reluctance motor, Doubly excited magnetic field, Torque from energy and Co- energy. Dynamic equations	08

3	**DC Machines** Construction of machine, Armature winding, Principle of operation, MMF and flux density waveforms, Significance of commutator and brushes in DC machine, EMF and Torque equation, Methods of excitations, Armature reaction, Methods to minimize the effect of armature reaction, Process of commutation, Methods to improve commutation.	10
4	**DC Motors** Characteristics of DC Motors, Concept of braking of DC separately excited motors (Rheostatic, Regenerative and plugging). Starters for shunt and series motors, Design of grading of resistance for starter, Speed Control, Losses and efficiency, Applications of DC motor.	10
5	**Testing of DC Motors** Retardation, Brake load, Swinburne, Hopkinson's, Field test.	04
6	**Transformer – Single Phase** Review of EMF equation, Equivalent Circuit and Phasor diagram of Transformer. Voltage Regulation of Transformer: - Voltage Regulation, Condition for Zero Voltage Regulation, Condition for Maximum Voltage Regulation. Transformer Losses and Efficiency - Losses, Efficiency, Condition for Maximum Efficiency, Energy Efficiency, All day Efficiency, Separation of Hysteresis and Eddy current losses Testing of Transformer: - Polarity Test, Load Test, Review of OC and SC test, Sumpner's Test, Impulse test. Autotransformer:- Autotransformer Working, Advantages of Autotransformer over Two winding Transformer, Disadvantages Parallel Operation: No load Operation, On load Operation:- Equal Voltage Operation and Unequal Voltage Operation Introduction to High Frequency Transformer, Pulse Transformer, Isolation Transformer and its applications.	12

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text Books:

1. Bimbhra P.S., *Electric Machinery* , Khanna Publisher,
2. Bimbhra P.S., *Generalized Machine Theory*, Khanna Publisher,
3. Kothari D.P, Nagrath I.J., *Electric Machines*, TMH Publishcations
4. A.E. Fitzgerald, Kingsly, Stephen., *Electric Machinery*, Tata McGraw Hill
5. Umanand L, Bhat S.R., "Design of Magnetic Components for Switched mode Power Converters", Wiley Eastern Ltd.

Reference Books:

1. M.G. Say and E. O. Taylor, *Direct current machines*, Pitman publication
2. Ashfaq Husain, *Electric Machines*, Dhanpat Rai and co. publications
3. M.V. Deshpande, *Electric Machines*, PHI
4. Smarajit Ghosh, *Electric Machines*, PEARSON

List of Experiments Recommended:

1) O.C.C of Separately excited DC generator
2) Load Test on DC Shunt Motor
3) Load Test on DC SeriesMotor
4) Load Test on DC Compound Motor
5) Speed Control of DC shunt Motor (Armature and Field Control)
6) Swinburne's Test
7) Hopkinson's Test
8) Field's Test
9) O.C & S.C. Test on 1Φ Transformer
10) Sumpner's Test on 1Φ Transformer
11) Separation of iron loss into hysteresis and eddy current loss components in a1Φ Transformer
12) Load Test on 1Φ Transformer
13) Parallel operation of 1Φ Transformer

Term work:

Term work shall consist of minimum eight experiments, assignments (min two)

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) **:**	**10 marks**
Assignments :	**10 marks**
Attendance (Theory and Practical) **:**	**05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
EEC404	Signal Processing (abbreviated as SP)	4	2	4	1	5

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC404	Signal Processing	20	20	20	80	03	25	-	125

Subject Code	Subject Name	Credits
EEC404	**Signal Processing (abbreviated as SP)**	**05**
Course Objectives	• To enhance the analytical ability of the students in facing the challenges posed by growing trends in communication, control and signal processing areas. • To develop ability among students for problem formulation, system design and solving skills	
Course Outcomes	Students: • Will be able to analyse the system in Time and Frequency domain through its respective tools. • Will demonstrate knowledge of complex number, Fourier series and ability to design electrical and electronics systems, analyse and interpret data.	

Module	Contents	Hours
1	-Definition and classification of signals and systems -Sampling process and Sampling Theorem (derivation not included) -Operations on signals (Continuous and Discrete Time) -Convolution (Continuous and Discrete Time)	12
2	-Fourier Series , Power spectrum, Power spectral density -Fourier Transform, Energy spectrum, Energy spectral density	04

3	-Z-Transform (single & double sided), ROC determination -Properties of Z-Transform -Inverse Z-Transform	10
4	-Solution of difference equation -Magnitude and phase response of LTI system -Pole-zero diagram	04
5	Frequency Domain Analysis of DT systems:- - Domain analysis using analytical and graphical technique - System classification based on pass band - System classification based on phase response and location of zeros as minimum phase, maximum phase mixed phase	09
6	-DTFT (Discrete time Fourier Transform) -DFT -DFT properties -FFT (redix-2, DIT)	09

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text Books:

1. Salivahan S., "*Digital Signal Processing*", TMH Publication,2001.
2. Oppenhein & Schafer, "*Discrete Time Signal Processing*", PHI Publication 1989.
3. Haykin S and Van Veen B., "*Signal & Systems*", Wiley Publication, 2nd Ed.
4. Linder D.K., "*Introduction to Signal & Systems*", McGraw Hill International,1999.

Reference Books:

1. Proakis & Manolakis, "*Digital Signal Processing*" , PHI Publication, 1995
2. Lathi B.P., "*Signal & Systems*", Oxford University press, 2nd Ed. 1998
3. Mitra S.K., "*Digital Signal Processing*", TMH Publication, 2001.
4. Oppenhein & Schafer, "*Discrete Time Signal Processing*", PHI Publication 1989.
5. Luis F Chaparro, "Signals and Systems using MATLAB", Elsevier Publisher, Academic Press
6. Li Tan, " Digital Signal Processing, Fundamentals and Applications", Elsevier Publisher, Academic Press

Term work:

Term work shall consist of minimum six experiments/six simulations/combination of experiments and simulations, tutorials , assignments(min two)

The distribution of marks for term work shall be as follows:

Laboratory work (Experiment/ programs and journal) **:10 marks**

Assignments : **10 marks**

Attendance (Theory and Practical) **: 05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
EEC405	Analog and Digital Integrated Circuits	4	2	4	1	5

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC405	Analog and Digital Integrated Circuits	20	20	20	80	03	25	25*	150

Subject Code	Subject Name	Credits
EEC405	**Analog and Digital Integrated Circuits (abbreviated as ADIC)**	**05**
Course Objectives	• To introduce the basic building blocks, theory and applications of linear integrated circuits. • To develop ability among students for problem formulation, system design and solving skills	
Course Outcomes	• Students will be able to build, design and analyze analog to digital conversion • Students will be able to design digital and analog systems and components.	

Module	Contents	Hours
1	**Operational Amplifiers: Fundamentals** Basics of an Op-amp, Op-amp parameters, Frequency response	03
2	**Application of Operational Amplifiers** Voltage follower, design of inverting and non- inverting amp, adder, subtractor, integrator and differentiator, V to I and I to V converter, precision rectifier, Schmitt trigger, sample and hold circuits, clipping and clamping, active filters: LP, HP and BP, Instrumentation amplifier, Optical isolation amplfier **Linear Voltage Regulators -** IC -78xx, 79xx, LM 317. Design of adjustable voltage source using IC- LM317, Low Dropout (LDO) voltage regulator	18

	IC – 555 – functional block diagram, Application of IC555 – Design of Multivibrator (Monostable and Astable), VCO	
3	**Analog-to-Digital converter (ADC)** – Characteristics and types of ADC – i) Successive approximation, ii) Flash ADC, iii) Dual slope, Serial ADC Basics of Digital to Analog converter (DAC)	05
4	**Logic families :** Review of Number formats: Binary, hexadecimal, BCD and their basic math operations like addition and subtraction Introduction to Logic gates and Boolean Algebra Specifications of Digital IC, Logic Families: TTL, TTL variant families: like standard, LS, HS, Tristate gate, CMOS logic, Comparison of logic families, Interfacing of TTL and CMOS different families.	06
5	**Combinational Logic Circuit:** K-Maps and their use in specifying Boolean expressions upto 4 variables, Minterm, Maxterm, SOP and POS implementation Implementing logic function using universal gates, Binary Arithmetic circuits: Adders, Subtractors (Half and Full), BCD adder – Subtractor, Carry look ahead adder, Serial adder, Multiplier Magnitude comparators, Designing code converter circuit e.g binary to gray, BCD to Seven segment parity generator, Arithmetic Logic units. Multiplexer (ULM), Shannon's theorem, De- multiplexers, Designing using ULMS. Hazards in combinational circuits.	10
6	**Sequential Logic Circuits** : Comparison of combinational & sequential circuit **Flip-flops:**SR, T, D, JK, Master Slave JK, Converting one flip-flop to another, Use of debounce switch **Counters:** Modulus of counter, Design of Synchronous, Asynchronous counters, Ripple counters, Up/Down Counter, Ring counter, Johnson counter, Sequence generator. Unused states and locked conditions. **Shift Registers**	06

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text Books:

1. Gayakwad Ramakant A, Op-amps and Linear Integrated Circuits, Prentice Hall PTR,
2. Boatkar K. R., "Integrated Circuits", Khanna Publication.

3. D. Roy Choudhury, Shali B Jain, "Linear Integrated Circuits" New Age International Publication.
4. Millman and Halkias, '*Integrated Electronics*', Tata McGraw Hill,
5. A. Anand Kumar, *"Fundamentals of Digital Circuits",* PHI-2009
6. Jain R.P., *"Modern Digitals Electronic*s", Tata McGraw Hill, 1984.
7. Roger L. Tokheim, "Digital Electronics", Tata McGraw Hill

Reference Books:

1 Design with OPAMP analog Ics by Sergio Franco. McGraw Hill 1998 2nd edition.
2 Boylestad Robert and Nashelsky Louis - '*Electronic Devices and Circuits*', Prentice-Hall of India,
3 Newman D.A., '*Electronic Circuit Analysis and Design'*, McGraw Hill International.
4 David Bell, *Electronic Devices and Circuits,*5e Oxford University Press
5 George Clayton, Steve Winder, *'Operational Amplifiers',* Newnes
6 Alan b. Marcovitz, "*Introduction to logic Design",* McGraw Hill International 2002.
7 Malvino & Leach, *"Digital principal and Application"*, Tata McGraw Hill, 1991.
8 Bignell James& Donovan Robert "*Digital Electronics",* Delmar, Thomas Learning, 2001.
9 Jog N.K. *'Logic Circuits",* 2nd Edition, Naidu Publishers & Printers Pvt. Ltd 1998.
10 Paul M. Chirlian*, "Analysis and Design of Integrated Electronic Circuits"*, 2nd Edition, John Wiley and Sons
11 Morris M. Mano. "*Digital Design",* Prentice Hall International – 1984.
12 Donald D. Givone, "Digital Priciples and Designs" Tata McGraw Hill

List of Experiments Recommended:

Any Four experiments can be performed From First seven and four from remaining six.

1 Linear applications of op-amp
2 Non linear applications of op-amp
3 Active filters
4 Design and implementation of variable voltage regulator using IC 317
5 Design and implementation of astable multivibrator
6 Design and implementation of monostable multivibrator
7 Design and implementation of VCO.
8 Implementing a Binary to Gray, gray to binary or Binary to XS3 code converter using gate ICs.
9 Constructing flip-flops like SR, D, JK and T using all NAND gates and a debounce switch.
10 Designing a mod N counter where N <14 using J K flip-flops and D flip-flops.
11 Design of a ripple counter / OR a two bit comparator using gate ICs.
12 Building of a ring counter and twisted ring counter using D flip-flop ICs.
13 Any one of the following.
(i) Full Adder using Gates and using Decoder or a Multiplexer.
(ii) Using a shift register as a sequence generator.

Term work:

Term work shall consist of minimum eight experiments, assignments (min two)

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) **:**	**10 marks**
Assignments **:**	**10 marks**
Attendance (Theory and Practical) **:**	**05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
EEC406	Numerical Methods and Optimization Techniques (abbreviated as NMOT)	3	2	3	1	4

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC406	Numerical Methods and Optimization Techniques	20	20	20	80	03	25	--	125

Subject Code	Subject Name	Credits
EEC406	**Numerical Methods and Optimization Techniques (abbreviated as NMOT)**	**04**
Course Objectives	• To provide constructive methods for obtaining solutions in a numerical form. • To develop ability among students for problem formulation, system design and solving skills	
Course Outcomes	Students : • Will be capable of analyzing various techniques and choosing the best technique for any particular application. • Will demonstrate knowledge of differential calculus, partial differentiation and its solution.	

Module	Contents	Hours
1	Error Analysis: Types, estimation, error propagation.	02
2	Roots of equation: Bracketing Methods- The bisection method, the false-position method, Open methods-The Newton-Raphson method, The secant method, Systems of Nonlinear Equations-Newton Raphson method. Application for the design of an electric circuit. Linear Algebraic Equations: LU Decomposition, Solution of currents and voltages in Resistor circuits.	06
3	Curve Fitting: Interpolation with Newton's divided- difference interpolating polynomials, Lagrange interpolating polynomials, Coefficients of interpolating polynomials, Inverse interpolation, curve fitting with sinusoidal functions.	06
4	Solution of ordinary differential equation: Predictor –corrector methods, Milne's method, Adams-Bashforth method, solution of simultaneous first order & second order differential equations by Picard's and Runge-Kutta methods. Simulating transient current for an electric circuit.	06
5	One dimensional unconstrained Optimization: Golden-section search, quadratic interpolation, Newton's method.	04
6	Constrained Optimization: Introduction of L.P.P., Formulation of the L.P.P., Canonical and Standard forms of L.P.P., solution of L.P.P. by Graphical Method, Introduction to Simplex Method, General Linear Programming Problem, Procedure of simplex method. Non-linear programming: Introduction, Single variable optimization, Multivariable optimization with equality constraint-Lagrange's method, Multivariable optimization with non-equality constraint- Kuhn-Tucker conditions	12

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text Books:

1. Chapra Seven C, Canale R P , *Numerical Methods for Engineers*, Tata McGraw Hill.
2. Schilling, Robert J.,Numerical Methods for Engineers (using MATLAB and C). Thomson Asia Pvt. Ltd.
3. Nita H. Shah '*Numerical Methods With C++ Programming*' PHI learning Ltd.
4. S. S. Rao, '*Engineering Optimization'*, New Age International Publishers.

Reference Books:

1 David G Luenberger, "Linear and Non Linear Programming", 2nd Ed, Addison-Wesley Pub.Co.,Massachusetts, 1973

2 Kalyanmoy Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice Hall India- 1998.

Term work:

Term work shall consist of minimum four tutorials and simulations/ programs(minimum four) and assignments(min two)

The distribution of marks for term work shall be as follows:

Laboratory work (Tutorials/ programs)**:**	**10 marks**
Assignments**:**	**10 marks**
Attendance (Theory and Practical)**:**	**05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.