UNIVERSITY OF MUMBAI

Bachelor of Engineering

Electrical Engineering (Sem. V to VIII), Revised course

(REV- 2012) from Academic Year 2014 -15,

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

Preamble

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 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.

Chairman,
Board of Studies in Electrical Engineering,
University of Mumbai

Scheme for Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
EEC601	Power System Analysis	4	2	4	1	5
EEC602	Electrical Machines – III	4	2	4	1	5
EEC603	Utilization of Electrical Energy	3	1	3	1	4
EEC604	Control System – I	4	2	4	1	5
EEC605	Microcontroller and its Applications	4	2	4	1	5
EEC606	Project Management	3	1	3	1	4
Total		**22**	**10**	**22**	**6**	**28**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
EEC601	Power System Analysis	20	20	20	80	03	25	--	125
EEC602	Electrical Machines – III	20	20	20	80	03	25	25*	150
EEC603	Utilization of Electrical Energy	20	20	20	80	03	25	25	150
EEC604	Control System – I	20	20	20	80	03	25	--	125
EEC605	Microcontroller and its Applications	20	20	20	80	03	25	25	150
EEC606	Project Management	20	20	20	80	03	25	-	125
Total		**--**	**--**	**120**	**480**	**--**	**150**	**75**	**825**

*** Includes both Practical and Oral examination**

University of Mumbai						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
	Power System Analysis (Abbreviated as PSA)	Theory	Pract./Tut.	Theory	Pract./tut.	Total
		4	2	4	1	5

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Prac/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC601	Power System Analysis (Abbreviated as PSA)	20	20	20	80	03	25	-	125

EEC601

Course Code	Course Name	Credits
EEC601	**Power System Analysis**	**5**
Course Objectives	• To give the students basic knowledge of the various faults and it's analysis • To give the students basic knowledge of transients occurring in power system	
Course Outcomes	• Students will be able to analyze various types of faults occurring in power system • Engineering knowledge in effects of faults and mitigation of transients	

EEC601 Power System Analysis (Abbreviated as PSA)

Module	Contents	Hours
1	**Symmetrical Fault Analysis:** Introduction to synchronous machine, basic construction and operation and equivalent circuit diagram , short circuit of synchronous machine: no load and loaded machine, transient on a transmission line, selection of Circuit breaker, short circuit MVA, algorithm for SC studies, Z Bus formulation, symmetrical fault analysis using Z bus **(numerical on Z bus formulation upto 3x3 matrix).**	14
2	**Unsymmetrical Fault Analysis:** Symmetrical component transformation, phase shift in star-delta transformers, sequence impedances and sequence network of transmission line, synchronous machine and transformer, power invariance, construction of sequence network of a power system. Fault analysis of unsymmetrical faults, single line to ground (SLG) fault, line to line (L-L) fault, double line to ground (LLG) fault, open conductor faults, bus impedance matrix method for analysis of unsymmetrical shunt faults.	14
3	**Power System Transients**: Review of transients in simple circuits, recovery transient due to removal of short circuit, arcing grounds, capacitance switching, current chopping phenomenon. Travelling waves on transmission lines, wave equation, reflection and refraction of waves, typical cases of line terminations, attenuation, Bewely lattice diagram. Lightning phenomenon, mechanism of Lightning stroke, shape of Lightning voltage wave, over voltages due to Lightning, Lightning protection problem, significance of tower footing resistance in relation to Lightning, insulator flashover and withstand voltages, protection against surges, surge arresters, surge capacitor, surge reactor and surge absorber, Lightning arrestors and protective characteristics, dynamic voltage rise and arrester rating.	08
4	**Insulation Coordination:** Volt time curve, over voltage protection, ground wires, insulation coordination based on lightning, surge protection of rotating machines and transformers	02
5	**Corona:** Phenomenon of corona, Disruptive critical voltage, Visual critical voltage, corona loss, factors affecting corona loss, Radio interference due to corona, practical considerations of corona loss, corona in bundled conductor lines, corona ring, corona pulses- their generation and properties in EHV lines, charge voltage (q-V) diagram and corona loss.	04
6	**Uncompensated Transmission Line**: Electrical Parameters, Fundamental Transmission Line equation, Surge Impedance and Natural Loading, the uncompensated line on Open circuit, the uncompensated line under load- Effect of line length, load power and power factor on voltage and reactive power, Maximum power and stability	06

	considerations.	

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.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Term work: Term work shall consist of minimum Five Tutorials and Three simulations**.**

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

Laboratory work/Tutorials (Journal) : 10 marks
Assignments : 10 marks
Attendance : 05 marks

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

Books Recommended:

Text Books:

1. Wadhwa C.L. *Electrical power system*, New Age International,4th edition,2005
2. Hadi Saadat, Power System Analysis, TMH publications,2002
3. D. P. Kothari, I. J. Nagrath, Modern *Power System Analysis*, Mc Graw Hill,3rd edition,2006
4. B.R. Gupta, *Power System Analysis And Design*, S.Chand,4th edition,2007
5. Begamudre R.D. "Extra High Voltage AC Transmission Engineering", New Age International, 2nd edition
6. Soni M.L., Bhatanagar U.S, Gupta P.V, A *course in electrical power*, Dhnapat Rai sons
7. Timothy J.E.Miller, "Reactive Power Control in Electric Systems" Wiley India Pvt Ltd. 2010.

Reference Books:

1. Stevenson, *Modern power system analysis*, TMH publication
2. Turan Gonen, Modern power system analysis, Wiley,1988
3. Mehta V.K., *Principle of power system*, S Chand,4th edition,2005.
4. Arthur R. Bergen, Vijay Vittal, "Power System Analysis", Pearson Publication, Second Edition.

Tutorial /Assignment based on following topics:

1) Symmetrical Fault Analysis
2) Bus Impedance formulation and symmetrical fault analysis using Z Bus
3) Symmetrical Component
4) Unsymmetrical Fault Analysis
5) Unsymmetrical Fault Analysis
6) Travelling Waves and Corona

University of Mumbai						
Course Code	Course Name	Teaching Scheme(Contact Hours)		Credits assigned		
EEC602	Electrical Machines-III (Abbreviated as EMC-III)	Theory	Pract./Tut.	Theory	Pract.tut.	Total
		4	2	4	1	5

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract. / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC602	Electrical Machines-III (Abbreviated as EMC-III)	20	20	20	80	03	25	25*	150

Course Code	Course Name	Credits
EEC602	**Electrical Machines-III**	**5**
Course Objectives	• To impart the knowledge of working principle, operations, performance and applications of 3φ Synchronous Generators and Synchronous Motors • To develop the d-q model of 3φ Synchronous Machines and Induction Machines	
Course outcomes	• Students will be able to understand the engineering fundamentals of synchronous machines. • Gain an ability to design and conduct performance experiments, as well as to identify, formulate and solve machine related problems.	

Module	Contents	Hours
1	**Synchronous Generator:** Construction, Emf induced in ac winding, winding factors, armature reaction, phasor diagram, OC and SC test, voltage regulation by EMF, MMF, ZPF, ASA, Saturated synchronous reactance method, power flow and maximum power conditions, parallel operation, effect of changing mechanical torque, effect of changing excitation, effect of excitation on alternator connected to infinite bus.	20
2	**Salient Pole Synchronous Generators**: Blondel's two reaction theory, power angle characteristics, synchronizing power and torque.	06
3	**Synchronous Motor:** Principle of operation, phasor diagram, power flow and maximum power conditions, excitation circles, power circles, V curves and O curves, power factor control (Effect of change in excitation on power factor), Hunting, Dampers, Starting methods, Starting against high torques, Measurement of X_d and X_q.	12
4	**Theory of Synchronous Machine:** The ideal synchronous machine, synchronous machine Inductances, Transformation to Direct and Quadrature axis variables, Basic machine relations in dq0 variables, Steady state Analysis.	05
5	**Theory of Induction Machine:** The ideal Induction machine, Transformation to d-q variables, Basic machine relations in d-q variables, Steady state Analysis.	03
6	**Sequence Reactance of Synchronous Generator (Only for practical)** Measurement of positive, negative and zero sequence reactance of Synchronous generator.	02

***Includes both Practical and Oral examination**

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.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Practical and Oral examination:

The distribution of marks shall be as follows:

Performance of Experiments : 15 marks

Oral examination : 10 marks

Term work:

Term work shall consist of minimum **seven** experiments, Assignments (minimum **Two**).

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

Laboratory work (experiments)	: 10 marks
Assignments	: 10 marks
Attendance	: 05 marks

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

Books Recommended:

*Text Books***:**

1. Electrical Machinery by P.S.Bimhhra, VII Edition, Khanna Publisher
2. Electrical Machines by Nagrath and Kothari.TMH Publication.
3. Electrical Machinery by Fitzgerald and Kingsley, Second Edition, Mc Graw Hill Book Company
4. Generalized Theory of Electrical Machines by Dr. P.S.Bimhhra, V Edition, Khanna Publishers
5. Electrical Machines by Smarajit Ghosh, Pearson Education

*Reference Books***:**

1. Performance and Design of AC Machines by M.G.Say, CBS Publishers
2. Electrical Machines, by Charles I. Hubert, Pearson Education
3. Electrical Machines, Drives, and Power System, by Theodore Wildi, Pearson Education

List of Laboratory Experiments Recommended:

1. Construction details of Synchronous machine
2. Regulation of alternator by direct loading.
3. Regulation of alternator by EMF and MMF method
4. Regulation of alternator by ZPF, ASA and saturated synchronous reactance method.
5. To study the Excitation required to maintain terminal voltage of an alternator constant.
6. V and inverted V curves of synchronous motor
7. Determination of X_d and X_q by slip test.
8. Synchronization of Alternators.
9. Parallel operation of alternators.
10. Starting methods of synchronous motor.
11. Use of Synchronous motor as a synchronous condenser.
12. Performance curves of synchronous motor by conducting brake test with rated excitation.
13. To determine positive sequence, negative sequence and zero sequence reactance of an alternator

University of Mumbai						
Course Code	Course Name	Teaching Scheme(Contact Hours)		Credits assigned		
EEC603	Utilization of Electrical Energy (Abbreviated as UEE)	Theory	Pract./Tut.	Theory	Pract.tut.	Total
		3	1	3	1	4

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract. / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC603	Utilization of Electrical Energy (Abbreviated as UEE)	20	20	20	80	03	25	25	150

Course Code	Course Name	Credits
EE603	**Utilization of Electric Energy**	**4**
Course Objectives	• To impart the basic knowledge of some major applications which utilizes electrical energy.	
Course Outcomes	• Recognize the need for technical change & ability to learn in the broadest knowledge of Technical Advancement in Traction, Illumination and other	

	Applications.

Module	Contents	Hours
1	**Systems of Traction:** Diesel Traction, Electric Traction, Various systems of Track Electrification like DC, single phase, Three phase & Composite system. Train Movement & Energy Consumption-Typical Speed /Time Curves, Mechanics of Train Movement, Power & Energy output from the driving axles, Specific Energy consumption, Factors affecting Specific Energy consumption, Dead weight, Accelerating weight and Adhesive weight.	12
2	**Electric Traction Motors & Control:** Suitability of DC/AC motors for traction purpose, Starting & speed control by using rheostat method, series parallel method, Thyristor control method. Power supply for electric traction - Current collection systems and related overhead equipment, substations - location & Distribution System, substation equipment, Traction SCADA & Signaling.	06
3	**Illumination Engineering:** Basic terms in lighting systems, Laws of illumination, Polar curves, Photometry, Measurement of illumination, sources of light, study of different types of lamps ,types of luminaires , various factors related to luminaire selection, their control, and their features .Types of lighting systems, Recommended Illuminance levels for various tasks/activities/ locations.	10
4	**Electric Vehicle (EV) and Hybrid Electric Vehicles (HEV):** Architectures of hybrid EV/HEV power system, Energy Sources for EV /HEV applications, Type of motors used in EV/HEV and their comparison.	03
5	**Other applications of Electrical Energy:** Terminology, Refrigeration cycle, Vapor compression type, vapor absorption type, Electrical circuit of a Refrigerator, Room Air conditioner window type & split type	03
6	**Electric heating & Welding:** Basic working principle of Arc furnace, Induction furnace, Power supply requirement for furnaces, Electric welding equipment & power supply requirements.	02

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.

End Semester Examination: Some guidelines for setting the question papers are six questions to be set each of 20 marks. Out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Term work: Term work shall consist minimum of eight practicals / tutorials.

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

Laboratory work/Tutorials (Journal)	: 10 marks
Assignments	: 10 marks
Attendance	: 05 marks

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

Oral examination: Oral examination will be based on the entire syllabus.

Books Recommended:

Text Books:

1. Utilization of Electric Energy by J.B.Gupta, SK Kataria & Sons
2. Utilization of Electric Energy by R.K.Rajput, Laxmi Publications(P) Ltd
3. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhwa, Wiley Eastern Ltd
4. I. Hussein, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press, 2003.

Reference Books:

1. Art & Science of Utilization of Electric Energy by H.Partap, Dhanpat Rai & Sons
2. Electric Traction By H.Partap, Dhanpat Rai & sons
3. Designing with light-A Lighting Handbook By Anil Valia, Lighting System
4. Generation and Utilization of Electric Energy by S.Sivanagaraju, Pearson Education India
5. M. Ehsani, Y. Gao, S.E. Gay and Ali Emadi, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, CRC Press. 2005

Website Reference:

http://nptel.iitm.ac.in :Introduction to Hybrid and Electric Vehicles - Web course

Tutorials:

Numerical on Module 1, 2 &3

Practicals :

1) Study & Testing of various lamps
2) Measurement of lux levels by using Luxmeter
3) Visit to a railway workshop near by
4) Demonstration of Air conditioning system

University of Mumbai						
Course Code	Course Name	Teaching Scheme(Contact Hours)		Credits assigned		
		Theory	Pract./Tut.	Theory	Pract./tut.	Total
EEC604	Control System-I (Abbreviated as CS-1)	4	2	4	1	5

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract. / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC604	Control System – I (Abbreviated as CS-1)	20	20	20	80	03	25	--	125

Course Code	Course Name	Credits
EEC604	**Control System-I**	**5**
Course Objectives	• To model a system using transfer function and state space.	

	• To determine the system parameters to yield stability. • To analyze and design system parameters to meet transient and steady state error performance specifications.
Course Outcomes	• Knowledge of different techniques for analysing the performance of linear time invariant system.

Module	Contents	Hours
1	**Introduction to control system**: History of control system, open loop and closed loop control system with examples, brief idea of multi variable control system.	02
2	**Modeling in the frequency domain**: Transfer function of electrical (Network and OP Amp) and electro mechanical systems. Transfer function model of AC & DC servomotor, potentiometer & tachogenerator. Block diagram reduction technique and signal flow graph, Mason's rule, Signal flow graph of electrical network.	10
3	**Modeling in the Time domain:** Introduction to state variable, General state space representation, State space representation of Electrical and Mechanical systems. Conversion between state space and transfer function. Alternative representations in state space: (Phase variable, parallel & cascade). Similarity transformations, diagonalizing a system matrix. Laplace Transform solution of state equation.	08
4	**Transient, Steady state and Stability analysis**: Time response analysis of first and second order systems, Under damped second order system with step input. System response with additional poles and zeros. Steady state error for unity feedback systems. Static error constants and system type. Concept of stability, absolute and relative stability using Routh Hurwitz criteria, stability in state space.	12
5	**Root locus techniques**: Definition and properties of root locus, rules for plotting root locus, stability analysis using root locus, Transient response design via gain adjustment.	06
6	**Frequency Response techniques**: Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Gain margin and phase margin via Nyquist diagram and Bode plots. Relationship between Closed loop transient, Closed and open loop frequency responses. Steady state error characteristics from frequency responses.	10

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.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Term work: Term work should consist of four experiments and four programs/ simulations covering all the six modules of the syllabus.

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

Laboratory work/Tutorials (Journal)	: 10 marks
Assignments	: 10 marks
Attendance	: 05 marks

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

Books Recommended:

Text books:

1. Control system engineering by Norman Nise 2nd to latest edition
2. Control System engineering by Nagrath and Gopal, 5th to latest edition , Wiley Eastern
3. Modern control system engineering by K. Ogata, printice Hal
4. Modern control Systems, Twelfth edition, by Richard C Dorf, Robert H Bishop, Pearson.

Reference books:

1. Linear Control system Analysis and design with MATLAB, by J.J. Azzo, C. H. Houpis, S.N. Sheldon, Marcel Dekkar, ISBN 0824740386
2. Feedback control of Dynamic System, G.F. Franklin, Pearson higher education, ISBN 0130980412
3. Control System Engineering, Shivanagraju s. Devi L., New age International latest edition .
4. Control Systems Technology, Curtis Johnson, Heidar Malki, Pearson
5. Control Systems Engineering, S. K. Bhattacharya, Pearson.
6. Control Systems, Theory and applications, Smarajit Ghosh, Pearson

University of Mumbai						
Course Code	Course Name	Teaching Scheme(Contact Hours)		Credits assigned		
EEC605	Microcontroller and its Applications (Abbreviated as MCA)	Theory	Pract./Tut.	Theory	Pract.tut.	Total
		4	2	4	1	5

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC605	Microcontroller	20	20	20	80	03	25	25	150

	and its Applications (Abbreviated as MCA)								

Course Code	Course Name	Credits
EEC605	**Microcontroller and its Applications**	**5**
Course Objectives	• To impart knowledge of PIC microcontrollers along with the programming using assembly language and C language. • To make the students aware of recent microcontroller based design.	
Course outcomes	• Students will understand the basic programming used in microcontroller based systems. • Students will be able to implement any system using microcontrollers	

Module	Contents	Hours
1	**Introduction to microcontroller**: Block diagram of generic microcontroller, Microcontroller versus microprocessor, Overview of the PIC 18 family, A brief history of PIC microcontroller, PIC 18 features and family, Internal bus structure of PIC microcontroller.	04
2	**PIC Controller : PIC 18** Block diagram PIC 18 microprocessor, PIC microcontroller program memory and data (File) memory organization, Special Function Register (SFR), General purpose Register (GPR), CPU registers, WREG register, Status register, BSR register, Instruction register, Program counter and program ROM, Stack pointer and Stack RAM, PIC 18 internal architecture (ALU, EEPROM, RAM, I/O port, Timer, CCP, DAC), Pipelining.	08
3	**PIC 18 Assembly language programming:** Instruction format, Addressing modes, Assembler directives, Assembly language programming structure, Instruction set, Reading writing data in programme memory, Arithmetic and logical instructions: Writing programs to perform arithmetic and logical computations, Rotate instructions: Writing program to perform divide and multiplication operations, Branch instruction, Subroutine and instructions associated with it, Stack and instruction associated with it, Time delays and delay calculations.	10
4	**PIC Programming in assembly and C:** Timer programming for generation of time delay : Timer register, control registers, interrupt register, 16 bit and 8 bit programming, Counter programming to count events: Serial port programming, Basics of serial communication, Synchronous and asynchronous communication, SPBRG, TXREG, RCREG, TXSTA,RCSTA,PIR1, Interrupt programming:, Interrupt versus polling, Interrupt structure, Enabling and disabling interrupt, Programming Timer	16

	interrupt, LCD and Keyboard interfacing.	
5	**Parallel Ports** **I**/O Addressing, Synchronization. Overview of the PIC18 parallel ports, Interfacing with simple output devices.	06
6	**Input/ Output (I/O) port Interfacing** Interfacing matrix keyboard and 7- segment LED display, ADC Interface, Stepper Motor Interface, Dc Motor interface, Interfacing an LCD (Liquid Crystal Display).	04

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.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Term work: Term work shall consist of minimum eight experiments and Assignments (minimum **Two**).

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

Laboratory work (Experiments and Journal) :10 marks.
Assignments :10 marks.
Attendance (Practical and Theory) : 5 marks.

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

Oral examination: Oral examination will be based on the entire syllabus.

Books Recommended:

Reference Book:

1. Fundamentals of Microcontrollers and applications in Embedded System (PIC 18 Microcontroller familiy), Ramesh Gaonkar, Penram International publishing (Ind) pvt. Ltd.
2. PIC Microcontroller and Embedded systems, Mazidi, Muhmmad A. Pearson Education
3. Han Way Huang, PIC Microcontroller, Cengage learning
4. Microprocessor from assembly language to C using PIC 18FXX2, Robert B. Reese, Davinci Engineering press
5. Microcontrollers (Theory and Applications), Ajay Deshmukh, Tata McGraw Hill Edu. Pvt. Ltd.

List of recommended experiments:

The experiments can be performed by using Proteus VSM Platform (any 6)

To design and test circuits

1. Addition , Subtraction
2. BCD Adder
3. Multiplication, Division
4. 4 bit LCD driver
5. Working of ADC/ DAC
6. Demonstration of Traffic light
7. Implement door bell
8. Working of calculator

University of Mumbai						
Course Code	Course Name	Teaching Scheme(Contact Hours)		Credits assigned		
EEC606	Project Management (Abbreviated as PM)	Theory	Pract./Tut.	Theory	Pract./tut.	Total
		3	1	3	1	4

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					

EEC606	Project Management (Abbreviated as PM)	20	20	20	80	03	25	-	125

Course Code	Course Name	Credits
EEC606	**Project Management**	**4**
Course Objectives	• To Introduce the concept of Project Management to the students	
Course Outcomes	• Students will be able to handle the Industrial Projects effectively and efficiently.	

Module	Contents	Hours
1	**Understanding Projects and Project management**: Difference between Project and Operation. Definition of Project & Project Management. Selection and Qualities of a Project Manager. Life cycle of Project. Project Management Methodologies & Growth	03
2	**Project Selection & Appraisal:** Project ideas generation, Pre-Feasibility Analysis (SWOT). Feasibility Analysis-Market& Demand appraisal, Technical appraisal, Financial appraisal (debt/equity ratio, different sources of finance, financial institution, Cash Flows, Profitability projections like PBP, NPV, IRR, Break–Even Analysis). Risk analysis (Sensitivity analysis & Scenario Analysis). Economic Feasibility (SCBA-UNIDO approach). Preparing a detailed Project Proposal (Executive Summary).	12
3	**Project Planning**: Attributes & Definition of planning. WBS. Time Planning (PERT/CPM/Trade off). Material Planning (Procurement logistics & storage). Machines & Technology planning. Human Resource Planning (Project Organization). Planning the cost (Budgeting). QAP. Planning of Risk Management. Statutory Clearances. Resource Allocation & Resource Leveling. Introduction & use of PM software.	12
4	**Project Execution, Monitoring & Controlling:** Motivation (Motivation Theories). Communication & Reporting (Types and Methods). Co-ordination. Management of scope. TQM. Stake Holder Management, Risk Management and Logistics Management.	04
5	**Project Closure & Termination:** Inspection. Testing. Transportation. Commissioning. Trial Run. Documentation required for Project Handover. Preparing a Project Report for Future Reference.	02
6	**Contracts Management:** Types of contracts, Tendering (techno commercial aspects). Negotiations and Awarding the contracts. Contract closure.	03

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.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Term work: Term work shall consist of minimum **six** tutorials, Assignments (minimum **Two**).

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

Tutorials (Journal)	: 10 marks
Assignments	: 10 marks
Attendance	: 05 marks

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

Books Recommended:

Text Books:

1. Project Management & Appraisal, Sitangshu Khatua, Pub. Oxford University
2. Project Preparation , Appraisal, Budgeting & Implementation by Prasanna Chandra(TMH)
3. Project Management & Control by Narendra Singh, Himalaya Pub.

Reference Books:

1. Project Management- a Managerial Approach to Planning, Scheduling, and Controlling
   Harold Kerzner, 10th edition John Wiley & Sons, Inc.
2. Project Management - a Managerial Approach : Jack R. Meredith & Samuel J Mantel, Jr., 7 th Edition John Wiley & Sonns, Inc.
3. Project Management Institute (PMBOK)â Guide, 5th Edition

Tutorials/Practicals Recommended:

1) Case study on Pre-Feasibility(SWOT Analysis)
2) Case Study on Market & Demand Analysis
3) Numerical on Profitability Projections
4) Case study on Preparing Project Appraisal/ Executive Summary
5) Numerical on Network Technique & Trade-off Analysis
6) Hands on experience using the PM software **MS Project 2000**