AC 29/5/2015
Item No. – 4.45

UNIVERSITY OF MUMBAI

Bachelor of Engineering

Mechatronics Engineering

(Second Year – Sem. III & IV, Third Year- Sem V & VI, and Final Year- Sem VII & VIII)

New course (N- 2015) from Academic Year 2015 -16, 2016-17, and 2017-18 respectively

Under

FACULTY OF TECHNOLOGY

(As per Credit Based Semester and Grading System)

Deans 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 to introduce innovative undergraduate program in Mechatronics Engineering along with course objectives and outcomes to be clearly defined. I am happy to state that, the syllabus committee of mechatronics engineering has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, credit based semester and grading system is also introduced to ensure quality of engineering education.

Credit based semester and grading system enables a much-required shift in focus from teacher-centric to learner-centric education. 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. The program of Mechatronics Engineering is introduced from the academic year 2014-2015.

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

Chairman Preamble

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. Furthermore, to achieve the broad horizon of technology system development, the innovative program consisting of interdisciplinary approach is today's need. Considering this requirement and recent thrust in technology, the innovative undergraduate program in Mechatronics Engineering is introduced first time in the University of Mumbai.

To ensure quality in higher education accreditation of program is essential. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Mechanical Engineering of University of the Mumbai, I am happy to state here that, the Program Educational Objectives of this innovative program were finalized in a brain storming session, which was attended by more than 20 senior faculty members from different affiliated Institutes of the University from the various disciplines such as Mechanical, Electrical, Electronics, and Computer Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechatronics Engineering are listed below;

1. To prepare the Learner in building technology systems through the interdisciplinary approach.
2. To prepare the Learner to use modern tools embedding different disciplines of engineering in order to solve real life problems.
3. To prepare the Learner for career in Indian and Multinational Organisations and to excel in their Postgraduate studies. Furthermore to encourage and motivate the art of self-learning.
4. To inculcate a professional and ethical attitude, good leadership qualities in the Learner's thought process.

In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes are also included in the curriculum. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stake holders.

Dr. S. M. Khot

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

Program Structure for B E Mechatronics Engineering

S. E. Mechatronics - (Semester III)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
MTC301	Applied Mathematics III [$]	4	--	4	--	4
MTC302	Thermodynamics and Heat Transfer	4	--	4	--	4
MTC303	Engineering Materials and Metallurgy	4	--	4	--	4
MTC304	Digital Electronics	4	--	4	--	4
MTC305	Applied Electrical and Electronics Engineering	4	--	4	--	4
MTL306	Computer Aided Machine Drawing Laboratory[$]	--	2*+4	--	3	3
MTL307	Object Oriented Programming Laboratory	--	2*+2	--	2	2
MTL308	Applied Electronics Laboratory-I	--	2	--	1	1
MTL309	Engineering Materials and Metallurgy Laboratory	--	2	--	1	1
Total		**20**	**14**	**20**	**7**	**27**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
MTC301	Applied Mathematics III [$]	20	20	20	80	03	--	--	100
MTC302	Thermodynamics and Heat Transfer	20	20	20	80	03	--	--	100
MTC303	Engineering Materials and Metallurgy	20	20	20	80	03	--	--	100
MTC304	Digital Electronics	20	20	20	80	03	--	--	100
MTC305	Applied Electrical and Electronics Engineering	20	20	20	80	03	--	--	100
MTL306	Computer Aided Machine Drawing Laboratory[$]	--	--	--	--	--	50	50	100
MTL307	Object Oriented Programming Methodology Laboratory	--	--	--	--	--	50	50	100
MTL308	Applied Electronics Laboratory-I	--	--	--	--	--	25	25	50
MTL309	Engineering Materials and Metallurgy Laboratory	--	--	--	--	--	25	--	25
Total		**--**	**--**	**100**	**400**	**--**	**150**	**125**	**775**

*** Theory for entire class to be conducted, [$]Course common with Mechanical Engineering**

S. E. Mechatronics -(Semester IV)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
MTC401	Applied Mathematics IV [$]	4	--	4	--	4
MTC402	Kinematics of Machinery	4	--	4	--	4
MTC403	Fluid Mechanics and Machinery	4	--	4	--	4
MTC404	Strength of Materials	4	--	4	--	4
MTC405	Application of Integrated Circuits	4	--	4	--	4
MTC406	Signals and Systems	4	--	4	--	4
MTL407	Applied Electronics Laboratory-II	--	2	--	1	1
MTL408	Electrical and Electronics Workshop	--	2	--	1	1
MTL409	Strength of Materials Laboratory	--	2	--	1	1
Total		**24**	**6**	**24**	**3**	**27**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
MTC401	Applied Mathematics IV[$]	20	20	20	80	03	--	--	100
MTC402	Kinematics of Machinery	20	20	20	80	03	--	--	100
MTC403	Fluid Mechanics and Machinery	20	20	20	80	03	--	--	100
MTC404	Strength of Materials	20	20	20	80	03	--	--	100
MTC405	Application of Integrated Circuits	20	20	20	80	03	--	--	100
MTC406	Signals and Systems	20	20	20	80	03	--	--	100
MTL407	Applied Electronics Laboratory-II	--	--	--	--	--	25	25	50
MTL408	Electrical and Electronics Workshop	--	--	--	--	--	50	25	75
MTL409	Strength of Materials Laboratory	--	--	--	--	--	25	25	50
Total		**--**	**--**	**120**	**480**	**--**	**100**	**75**	**775**

[$]Course common with Mechanical Engineering

CLASS: SE (Mechatronics)	Subject Code: MTC301		Semester:-III
SUBJECT: **Applied Mathematics III**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisite:

1. FEC101 Applied Mathematics I
2. FEC201 Applied Mathematics II

Objectives:

1. To provide sound foundation in the mathematical fundamentals necessary to formulate, solve and analyze engineering problems.
2. To study the basic principles of Laplace Transform, Fourier series, Complex Variables.

Outcomes: Learner will be able to ….

1. Demonstrate the ability of using Laplace Transform and Fourier series in solving the Ordinary Differential and Partial Differential Equations.
2. Identify the analytic function, harmonic function, orthogonal trajectories and to apply bilinear transformations and conformal mappings.
3. Identify the applicability of theorems and evaluate the contour integrals.

Module	Details	Hrs
1	**Laplace Transform** 1.1 Function of bounded variation, Laplace Transform of standard functions such as 1, t^n , e^{at} , sinat, cosat, sinhat, coshat 1.2 Linearity property of Laplace Transform, First Shifting property, Second Shifting property, Change of Scale property of L.T. (without proof) $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_0^t f(u)du\right\}, L\left\{\frac{d^n f(t)}{dt^n}\right\}$ Heaviside Unit step function, Direc Delta function, Periodic functions and their Laplace Transform.	6
2	**Inverse Laplace Transform** **2.1** Linearity property, use of theorems to find inverse Laplace Transform, Partial fractions method and convolution theorem. **2.2** Applications to solve initial and boundary value problems involving ordinary differential equations with one dependent variable.	6
3	**Complex variables:** **3.1** Functions of complex variable, analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), Cauchy-Riemann equations in polar coordinates. **3.2** Milne- Thomson method to determine analytic function $f(z)$ when it's real or imaginary or its combination is given. Harmonic function, orthogonal trajectories. **3.3** Mapping: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations such as Rotation and magnification, invertion and reflection, translation.	10

4	**Complex Integral** **4.1** Line integral of a function of a complex variable, Cauchy's theorem for analytic function, Cauchy's Goursat theorem (without proof), properties of line integral, Cauchy's integral formula and deductions. **4.2** Singularities and poles: **4.3** Taylor's and Laurent's series development (without proof) **4.4** Residue at isolated singularity and its evaluation. **4.5** Residue theorem, application to evaluate real integral of type $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$, and $\int_{-\infty}^{\infty} f(x)dx$	**10**
5	**Fourier Series** **5.1** Orthogonal and orthonormal functions, Expressions of a function in a series of orthogonal functions. Dirichlet's conditions. Fourier series of periodic function with period 2π & $2l$. **5.2** Dirichlet's theorem(only statement), even and odd functions, Half range sine and cosine series, Parsvel's identities (without proof) **5.3** Complex form of Fourier series.	**10**
6	**Partial Differential Equations** **6.1** Numerical Solution of Partial differential equations using Bender-Schmidt Explicit Method, Implicit method(Crank- Nicolson method) Successive over relaxation method. **6.2** Partial differential equations governing transverse vibrations of an elastic string its solution using Fourier series. **6.3** Heat equation, steady-state configuration for heat flow. **6.4** Two and Three dimensional Laplace equations.	**10**

Theory Examination:

1. Question paper will comprise of total 6 questions, each of 20 Marks.
2. Only 4 questions need to be solved.
3. Question 1 will be compulsory and based on maximum part of the syllabus.
4. Remaining questions will be mixed in nature (for example suppose Q.2 has part (a) From module 3 then part (b) shall be from any module other than module 3)

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

References:

1. Elements of Applied mathematics, P N & J N Wartikar, Pune VidyarthiGruhaPrakashan
2. Higher Engineering Mathematics, Dr B. S. Grewal, Khanna Publication
3. Advanced Engineering Mathematics, E Kreyszing, Wiley Eastern Limited
4. Integral Transforms and their Engineering Applications, Dr B. B. Singh, Synergy Knowledgeware, Mumbai
5. Complex Variables: Churchill, Mc-Graw Hill
6. Numerical Methods, Kandasamy, S. Chand & CO.

CLASS: SE (Mechatronics)	Subject Code: MTC302		Semester:-III
SUBJECT: **Thermodynamics and Heat Transfer**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisite:

1. FEC102 Applied Physics-I
2. FEC202 Applied Physics-II

Objectives:

1. Study of basic concepts and laws of thermodynamics.
2. Study of modes of heat transfer and governing laws.
3. Study and analysis of Boilers, turbines and heat exchangers

Outcomes: Learner will be able to…

1. Demonstrate understanding of basic concepts of thermodynamics
2. Analyze basic power cycles.
3. Identify & explain the three modes of heat transfer (conduction, convection and radiation).
4. Develop mathematical model for each mode of heat transfer
5. Demonstrate and explain mechanism of boiling and condensation
6. Design and analyze different heat exchangers

Module	Detailed Contents	Hrs.
01	**Introduction and Basic Concepts:** Application areas of thermodynamics, Systems and Control volumes, Properties of system, Continuum, State and equilibrium, Processes and cycles, Temperature and Zeroth law of thermodynamics, Heat and thermodynamic concept of work. **First Law of Thermodynamics:** Statement, Heat and work calculations, Application of first law to non-flow and flow systems, steady flow energy equation as applied to boiler, condenser, nozzle and turbine. **Second Law of Thermodynamics:** Statements and their equivalence, thermal energy reservoirs, concept of heat engine, refrigerator, heat pump and perpetual motion machines, Carnot cycle and principles. **Entropy:** Concept of entropy, Temperature- entropy plot, Clausius inequality, Principle of Increase of entropy, entropy balance.	09
02	**Boilers** Fire tube and Water tube boiler, Low pressure and high pressure boilers, once through boiler, examples, and important features of HP boilers, Mountings and accessories, Layout of a modern HP boiler, Boiler performance, Boiler efficiency. Properties of steam like dryness fraction; enthalpy; internal energy and entropy, Steam table and Mollier Diagram. **Steam Turbines** Impulse turbines, Reaction turbines, velocity diagram, degree of reaction, compounding of steam turbines, Parson's turbine, condition for maximum efficiency.	09

03	**Internal Combustion Engines** Air standard cycles, Carnot, Otto, diesel, dual cycles and their comparison, Two stroke and Four stroke engines, CI and SI engines, Environmental and pollution control issues and remedies **Gas Turbines** Ideal and actual Brayton cycle, open and closed cycle gas turbine, Applications of gas turbine in aviation and power generation,	09
04	**Heat Transfer** Typical heat transfer situations, Modes of heat transfer **Conduction** Fourier's law of heat conduction, thermal conductivity, differential equation of heat conduction with heat generation in unsteady state in the Cartesian coordinate system, Steady heat conduction in plane walls, composite walls, Concept of thermal resistance and thermal resistance network, Heat conduction in cylinders and spheres, (Derivation NOT INCLUDED for Cylindrical as well as Spherical coordinate systems), Critical thickness/radius of insulation and its importance. **Transient Heat Conduction** Lumped system analysis, One dimensional transient problems analytical solutions	09
05	**Convection** Physical mechanism of convection, Natural and Forced convection, Laminar flow heat transfer in circular pipe, constant heat flux and constant wall temperature, Turbulent flow heat transfer in circular pipes, Pipes of other cross sections, Heat transfer in laminar and turbulent flow over a flat plate, Principles of dimensional analysis and its application in convective heat transfer, Physical significance of various dimensionless numbers useful in natural and forced convection **Radiation** Basic laws of radiation (Plank's law, Kirchoff's law, Stefan-Boltzman law, Wien's displacement law, Lambert's cosine law), Radiation exchange between black surfaces, Shape factor, Radiation exchange between gray surfaces, Radiation shield and the radiation effect	09
06	**Boiling and Condensation** Pool boiling, Flow boiling, Film condensation, Drop wise condensation **Heat Exchangers** Types of heat exchangers, Overall heat transfer coefficient, Analysis of heat exchangers, LMTD method, Effectiveness-NTU method	07

Internal Assessment:
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

References:

1. Introduction to Thermodynamics and Heat Transfer, Yunus Cengel, 2nd ed, McGraw-Hill
2. Fundamentals of Thermodynamics, Sonntag, Borgnakke, Van Wylen, Wiley India Pvt. Ltd.
3. Applied Thermodynamics, Onkar Singh, 3rd ed, New Age International
4. Basic Engineering Thermodynamics, Rayner Joel, Longman Publishers
5. Basic Engineering Thermodynamics, Zemanski and Van ness, TMH
6. Fundamentals of Heat and Mass Transfer, F. P. Incropera and D. P.DeWitt, Wiley India Pvt. Ltd.
7. Heat Transfer, 9th ed., J P Holman, McGraw Hill
8. Fundamentals of Engineering Heat and Mass Transfer, 4th ed., R C Sachdeva, New Age International
9. Comprehensive Heat Transfer, M M Rathod, Laxmi Publications
10. Principles of Heat Transfer, Srinivasan D, New Age International
11. Heat Transfer, 2nd ed., A F Mills and V Ganesan, PEARSON
12. Principles of Heat Transfer, 6th ed., Frank Kreith, CENGAGE Learning
13. Heat Transfer, S P Sukhatme, University Press
14. Engineering Heat Transfer, N V Suryanarayana, Penram Publication
15. Heat Transfer, Y V C Rao, University Press

CLASS: SE (Mechatronics)	Subject Code: MTC303		Semester:-III
SUBJECT: **Engineering Materials and Metallurgy**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisite:

1. FEC103 Applied Chemistry-I
2. FEC203 Applied Chemistry -II

Objectives:

1. To prepare the students understand basic engineering materials, their properties & selection and applications.
2. To familiarize the students with various types and causes of failure of components in different engineering applications.
3. To acquaint the students with the new concepts of Nano Science and Technology.
4. To prepare the students acquire basic understanding of advanced materials, their functions and properties for technological applications.

Outcomes: Learner will be able to...

1. Distinguish different types of materials and composites used in manufacturing.
2. Select a material for specific applications
3. Read and interpreat Iron-Iron Carbide phase diagram, TTT diagrm and CCT diagram.
4. Demonstrate a deeper understanding of materials in engineering applications.

Modules	Details	Hrs.
01	**1.1 Introduction:** Classification of materials, functional classification and classification based on structure. **1.2 Solidification of Metals:** Formation of solids from liquids of pure metals and alloys. Single crystal and polycrystalline structure. **1.3 Crystal Imperfection:** Definition, classification, Point defects: their formation and effects. Dislocations: Edge and screw dislocations, their significance. Surface defects: Grain boundary, sub-angle grain boundary, stacking fault, and their significance.	**07**
02	**2.1 Fracture:** Definition and types of facture. Brittle fracture and Ductile fracture. Ductility transition. **2.2 Fatigue Failure:** Definition of fatigue and significance of cyclic stress. Mechanism of fatigue. Fatigue testing. Test data presentation. S.N. Curve and its interpretation. Influence of important factors on fatigue. **2.3 Creep:** Definition and significance of creep. Effect of temperature and creep on mechanical behavior of materials. Creep testing and data presentation & analysis. Mechanism and types of creep.	**07**
03	**3.1 Ferrous Metals and Alloys:** The Iron-Iron Carbide Phase Diagram. Classification of Plain Carbon Steels and Cast Irons. Effect of alloying elements in steels. TTT diagram & CCT diagram. Annealing, normalizing, tempering, hardening and surface hardening processes.	**12**

	3.2 Nonferrous Metals and Alloys: Basic treatment only. Important nonferrous materials like aluminium, copper, nickel, tin, zinc and their alloys, properties and applications. **3.3 Powder Metallurgy:** Powder manufacturing methods; Powder Metallurgy Process. Applications such as oil impregnated Bearings and Cemented Carbides. Limitations of Powder Metallurgy.	
04	**4.1 Electronic Materials:** Band structure of solids. Conductivity of metals and alloys. Semiconductors and superconducting materials. Insulators and dielectric properties. Electrostriction, piezoelectricity and ferroelectricity. **4.2 Photonic Materials:** Refraction, reflection, absorption and transmission. Luminescence, Photoconductivity, Lasers, optical fibers in communications. **4.3 Magnetic Materials:** classification of magnetic materials. Diamagnetic, paramagnetic, ferromagnetic, ferrimagnetic and super paramagnetic materials. Metallic and ceramic magnetic materials. Applications of magnetic materials.	**08**
05	**5.1 Ceramics:** Definition, comparative study of structure and properties of Engineering Ceramics with reference to metallic materials. Toughening mechanisms in ceramics. Engineering application of Ceramics. **5.2 Polymers:** Classification of polymers. Thermoplastics, effect of temperature on thermoplastics, mechanical properties of thermoplastics. Thermosetting polymers and elastomers.	**08**
06	**6.1 Composites:** Definition; Classification; Particle-reinforced composites and fibre-reinforced composites. Rule of mixtures; Sandwich structures. Classification of composites on basis of matrix materials. **6.2 Nano-structured Materials:** Definition and Introduction to nano-technology. Unique features of nano-structured materials. Typical applications. **6.3 Modern Engineering Materials:** Smart materials, Shape memory alloys, Chromic materials (Thermo, Photo and Electro), Rheological fluids, Metallic glasses.	**10**

Theory Examination:

1. Question paper will comprise of total 06 questions, each of 20 marks.
2. Only 04 questions need to be solved.
3. Question 01 will be compulsory and based on maximum part of syllabus.
4. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to the number of respective lecture hours as mention in the syllabus.

Internal Assessment:

Assessment consists of two tests out of which; one should be a compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

References:

1. *The Science and Engineering of Materials (6 th Edition)*, by Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, Cengage Learning, Inc., Stamford, USA., (2010)
2. *Materials Science and Engineering: An Itroduction (8th Edition)*, by William D. Callister, Jr. – Adapted by R. Balasubramaniam. Wiley India (P) Ltd., (2010).
3. *Introduction to Physical Metallurgy (2nd Edition)*, by S H Avner, Tata McGraw Hill (1997).
4. *A Text Book of Nanoscience and Nanotechnology*, by Pradeep.T, Tata McGraw Hill, New Delhi, (2012).
5. *Material Science*, by S.L. Kakani, New Age International, (2006).
6. *Electronic Properties of Materials (4th Edition)*, by Rolf.E. Hummel, Springer, New York, (2011).
7. *Photonic Crystals: Theory, Applications, and Fabrication*, by Dennis W Prather, John Wiley & Sons, Hoboken, (2009).

CLASS: SE (Mechatronics)	Subject Code: MTC304		Semester:-III
SUBJECT: **Digital Electronics**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisite:

1. FEC105 Basic Electrical & Electronics Engineering

Objectives:

1. To teach fundamental principles of digital circuit design
2. To impart the knowledge of programmable devices

Outcomes: Learner will be able to..

1. develop a logic and apply it to solve real life problems
2. design combinational and sequential digital logic circuits
3. demonstrate an understanding of logic families TTL and CMOS
4. Use hardware description languages for logic circuit design and program PLDs.

Module	Detailed contents	Hrs.
1.0	**Fundamentals of Digital Design** 1.1 **Logic Gates:** Basic gates, Universal gates, Sum of products and products of sum, minimization with Karnaugh Map (upto four variables) and realization. 1.2 **Logic Families:** Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in), transfer characteristics of TTL NAND, Interfacing CMOS to TTL and TTL to CMOS. 1.3 **Combinational Circuits using basic gates as well as MSI devices:** Half adder, Full adder, Half Subtractor, Full Subtractor, multiplexer, demultiplexer, decoder, Comparator (Multiplexer and demultiplexer gate level upto 4:1). MSI devices IC7483, IC74151, IC74138, IC7485.	**12**
2.0	**Elements of Sequential Logic Design :** 2.1 **Sequential Logic:** Latches and Flip-Flops, Conversion of flip flops (timing considerations and metastability are **not** expected) 2.2 **Counters:** Asynchronous, Synchronous Counters, Up Down Counters, Mod Counters, Ring Counters Shift Registers, Universal Shift Register	**11**
3.0	**Sequential Logic Design:** 3.1 Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques and state assignment, Clocked synchronous state machine design. (*Complex word problems like traffic light controller etc. are not expected*) 3.2 MSI counters (7490, 74163, 74169) and applications, MSI Shift registers (74194) and their applications.	**11**
4.0	**Memories and Programmable Logic Devices:** 4.1 **Classification and characteristics of memory:** SRAM, DRAM, ROM, PROM, EPROM and FLASH memories 4.2 Concepts of PAL and PLA. Architecture of CPLD and FPGA, Xilinx XC 9500 CPLD Series and Xilinx XC 4000 FPGA Series.	**08**

5.0	**Simulation:** 5.1 Functional Simulation, Timing simulation, Logic Synthesis, RTL 5.2 **VHDL:** Data types, Structural Modeling using VHDL, attributes, data flow, behavioral, VHDL implementation of basic combinational and sequential Circuits.	**06**
6.0	**Testability:** Fault Models, Stuck at faults, ATPG, Design for Testability, Boundary Scan Logic, JTAG and Built in self test.	**04**
		52

Internal Assessment (IA):

Assessment consists of two tests out of which; one should be a compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of total 06 questions, each of 20 marks.
2. Only 04 questions need to be solved.
3. Question 01 will be compulsory and based on maximum part of syllabus.
4. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

References:

- William I. Fletcher, 'An Engineering Approach to Digital Design', PHI.
- B. Holdsworth and R. C. Woods, 'Digital Logic Design', Newnes, 4th Edition
- Morris Mano, Digital Design, Pearson Education, Asia 2002.
- John F. Wakerley, Digital Design Principles And Practices, third Edition Updated, Pearson Education, Singapore, 2002
- Anil K. Maini, Digital Electronics, Principles, Devices and Applications, Wiley
- Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with VHDL, McGraw Hill, 2nd Edition

CLASS: SE (Mechatronics)	Subject Code: MTC305		Semester:-III
SUBJECT: **Applied Electrical and Electronics Engineering**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Prerequisite:

1. FEC102 Applied Physics
2. FEC105 Basic Electricity and Electronics

Objectives:

1. Understand working and performance of electrical and electronic devices
2. Applications of electrical and electronic devices.

Outcomes: Learner will be able to...

1. Analyze second order systems in time and frequency domain
2. Illustrate working and performance characteristics of DC Motors
3. Illustrate working and performance characteristics of three phase Induction Motor
4. Implement systems using low power motors like stepper motor, brushless DC Motor and single phase induction motor
5. Illustrate working of Junction Transistors as switch

Module	Detailed contents	Hrs.
1	**Time Domain Analysis of RLC circuits** 1.1 **Time domain analysis of R-L and R-C circuits:** Forced and natural response, time constant, initial and final values 1.2 **Solution using first order equation for standard input signals:** Transient and steady state time response, solution using universal formula 1.3 **Time domain analysis of R-L-C circuits:** Second order forced and natural response and concept of damping	**08**
2	**Frequency domain analysis of RLC circuits** 2.1 S-domain representation, applications of Laplace Transform in solving electrical networks, driving point and transfer function, 2.2 Poles and Zeros, calculation of residues by analytical and graphical method 2.3 Frequency response	**08**
3	**Junction Transistors as Switch** 3.1 **Junction Field Effect Transistor JFET: C**onstruction, pinch off voltage, transfer characteristic, trans-conductance 3.2 **Metal-Oxide Effect Transistor (MOSFET): Working** of MOSFET, threshold voltage and MOSFET as switch 3.3 **BJT**: Regions of operation, normally ON and normally OFF state biasing, working of BJT CE amplifier and BJT as a switch	**10**
4	**DC Motors** 4.1 Construction, principle of working, significance of commutator and brushes in DC machine, classification **EMF equation,** Torque equation, characteristics of DC Motors 4.2 **Starters** for shunt and series motors 4.3 **Speed Control:** basic principle and working of different methods	**08**

5	**Three Phase Induction Motor** 5.1 Construction, working principle of squirrel cage induction motor 5.2 **Equivalent circuit**: Equivalent circuit development, torque speed characteristics, power 5.3 Speed control methods 5.4 **Starting methods:** Classification and working of different methods	**10**
6	**Low Power Motors** 6.1 **Brushless DC Motors:** Unipolar brushless DC motor, Bipolar brushless DC motor, speed control, important features and applications 6.2 **Stepper Motors:** Constructional features, working principle and applications 6.3 **Single phase Induction Motors:** construction, working, starting methods, tor-speed characteristics and applications	**08**
	Total	**52**

Internal Assessment (IA):
Assessment consists of two tests out of which; one should be a compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of total 06 questions, each of 20 marks.
2. Only 04 questions need to be solved.
3. Question 01 will be compulsory and based on maximum part of syllabus.
4. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

References:

1. M E Van Valkenburg, *"Network Analysis"*, Prentice-Hall of India Pvt Ltd, New Delhi
2. Donald A. Neamen, *Electronic Circuit Analysis and Design*, TATA McGraw Hill, 2nd Edition, New Delhi
3. Bimbhra P.S., *Electric Machinery* , Khanna Publisher, New Delhi
4. M. A. Mazadi and J. C. Mazadi, "*The 8051 Microcontroller and Embedded Systems*", Pearson Education, New Delhi
5. John Uffenbeck , "*8086/8088 family: Design Programming and Interfacing*", Pearson Education, New Delhi

CLASS: SE (Mechatronics)	Subject Code: MTL306	Semester:-III
SUBJECT: **Computer Aided Machine Drawing**		Credit: 3
*Theory for entire class to be conducted	*Theory	*02 hours per week
Practical to be conducted for batch of students	Practical	04 hours per week

Pre-requisites:

1. FEC 204 Engineering Drawing

Objectives:

1. To visualize an object and convert it into a drawing.
2. To gain knowledge of conventional representation of various machining and mechanical details as per IS.
3. To become conversant with 2-D and 3-D drafting.

Outcomes: Learner should be able to….

1. Visualize and prepare detail drawing of a given object.
2. Draw details and assembly of mechanical systems.
3. Read and interpret a given machine drawing.
4. Create 2-D and 3-D models using any standard CAD software with manufacturing considerations.

Module	Details	Hrs.	
		Th.	Pract.
1	**1.1 Solid Geometry:** Intersection of surfaces and interpenetration of solids- Intersection of prism or cylinder with prism; cylinder or cone, both solids in simple position only. Primary auxiliary views and auxiliary projections of simple machine parts.	08	--
	1.2 Machine Elements: Preparation of 2-D drawings of standard machine elements (nuts, bolts, keys, cotter, screws, spring etc.)	--	06
	1.3 Conventional representation of assembly of threaded parts in external and sectional views, Types of threads; thread designation, Conventional representation of machine components and materials, Designation of standard	01	--

2	**2.1** Limits fits and tolerances: Dimensioning with tolerances indicating various types of fits in details and assembly drawings, Types of assembly drawings, part drawings, drawings for catalogues and instruction manuals, patent drawings, drawing standards.	04	--
	2.2 Details and assembly drawing: Introduction to the unit assembly drawing, steps involved in preparing assembly drawing from details and vice-versa, Sequence in assembly.	02	--
	2.3 Preparation of details and assembly drawings of *any two* from: Clapper block, Single tool post, Lathe and Milling tail stock.	--	06
	2.4 Cotter, Knuckle joint, Keys and Couplings: keys-sunk, parallel woodruff, saddle, feather etc. Coupling: simple, muff, flanged.	03	--
3	**3.1 Preparation of details and assembly drawings of Bearings:** Simple, solid, Bushed bearing. I.S. conventional representation of ball and roller bearing.	01	06
	3.2 Pedestal bearing, footstep bearing		
4	**4.1** Preparation of details and assembly drawings of pulleys, Pipe joints: Classification of Pulleys, pipe joints	02	--
	4.2 Pulleys: Flat belt, V-belt, rope belt, Fast and loose pulleys.	--	06
	4.3 Pipe joints (any two): Flanged joints, Socket and spigot joint, Gland and stuffing box, expansion joint.	--	06
5	**5.1 Preparation of details and assembly drawings of Valves, I.C. Engine parts:** Types of Valves, introduction to I.C. Engine	02	--
	5.2 Preparation of details and assembly drawings of *(any three):* Air cock; Blow off cock, Steam stop valve, Gate valve, Globe valve, Non return Valve, I.C. Engine parts: Piston, Connecting rod, Cross head, Crankshaft,	--	08
6	**6.1 Preparation of details and assembly drawings of Jigs and Fixtures:** Introduction to Jigs and fixtures.	01	--
	6.2 Jigs and Fixtures (*any two from each*)	--	06
	6.3 Reverse Engineering of a physical model: disassembling of any physical model having not less than five parts, sketch the minimum views required for each component, measure all the required dimensions of each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions.	--	06

Term work:

A. Minimum two questions from theory part of each module should be solved as a home work in A-3 size sketch book.

B. A-3 size Printouts/plots of the problems solved in practical class from the practical part of each module

Problems from practical parts of each module should be solved using any standard CAD packages like IDEAS, PRO-E, CATIA, Solid Works, Inventor etc.

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

Home work sketch book ……. 20 marks
Printouts/Plots ……. 20 marks
Attendance (Theory and practical's) ……. 10 marks

Practical/Oral examination:

1. Practical examination duration is **three hours**, based on Part-B of the Term work, and should contain two sessions as follows:

   Session-I: Preparation of 3-D models of parts, assembling parts and preparing views of assembly from given 2-D detailed drawing.

   Session-II: Preparation of minimum five detailed 3-D part drawings from given 2-D assembly drawing.
   Oral examination should also be conducted to check the knowledge of conventional and CAD drawing.

2. Questions provided for practical examination should contain minimum five and not more than ten parts.

3. The distribution of marks for practical examination shall be as follows:

Session-I	…… 20marks
Session-II	…… 20marks
Oral	…….10 marks

4. Evaluation of practical examination to be done based on the printout of students work

5. Students work along with evaluation report to be preserved till the next examination

References:

1. Machine Drawingby N.D. Bhatt.
2. A text book of Machine Drawing byLaxminarayan&M.L.Mathur.(Jain brothers Delhi).
3. Machine DrawingbyKamat&Rao.
4. Machine DrawingbyM.B.Shah
5. A text book of Machine Drawing by R.B.Gupta(Satyaprakashan, Tech. Publication)
6. Machine Drawing by K.I.Narayana, P.Kannaiah, K.Venkata Reddy.
7. Machine Drawing by Sidheshwar and Kanheya
8. Autodesk Inventor 2011 for Engineers and Designers by ShamTickoo,SurinderRaina (dreamtech Press).
9. Engineering Drawing by P J Shah
10. Engineering Drawing by N D Bhatt

CLASS: SE (Mechatronics)	Subject Code: MTL307	Semester:-III
SUBJECT: **Object Oriented Programming Laboratory**		Credit: 2
*Theory for entire class to be conducted	Theory	--
Practical to be conducted for batch of students	Practical	02 hours Theroy for entire clss per week + 02 hours practical per batch per week

Pre-requisites:

1. FEC 205 Structured Programming Approach

Objectives:

1. To study the concepts of Object oriented programming.
2. To study solving of the real world problem using top down approach.
3. To study Java programming constructs.

Outcomes: Learner will be able to...

1. Solve basic computational problems using Java programming constructs like if-else, control structures, array and strings.
2. Model real world scenario using class diagram.
3. Exhibit communication between two objects.
4. Implement relationships between classes.
5. Demonstrate programs on exceptions, multithreading.

Module	Detailed Contents	Th. Hours
1	**Introduction to Object Oriented Programming** 1.1 Principle of Object Oriented Programming 1.2 Differences and similarity between C++ and Java 1.3 Advantages of object oriented programming	**04**
2	**Java Fundamentals** 2.1 Features of Java 2.2 Introduction to Java Environment ,JDK, 2.3 Structure of a Java Program 2.4 Looping and Methods 2.5 Developing a simple Java Program	**06**
3	**Java classes and objects** 3.1 Arrays, Vectors ,Strings and Wrapper classes 3.2 Constructor and Finalize 3.3 Parameterized Methods and classes 3.4 Exception Handling 3.5 I/O Processor	**08**
4	**Inheritance** 4.1 Understanding Inheritance 4.2 Forms of Inheritance 4.3 Super and Final Key words 4.4 Abstract classes and Interfaces 4.5 Multithreading and Packaging	**08**

Term Work:

Term work shall consist of

1. Minimum two assignments covering the entire syllabus.
2. Minimum 10 experiments and one mini project (in a group of maximum three) covering entire syllabus should be set to have well predefined inference and conclusion.

Term Work Evaluation: 50 Marks (Total marks) = 30 Marks (Experiment) +10 Marks (mini project) +10 Marks (Attendance)

The practical and oral examination will be based on entire syllabus.

Practical's:

All the programs and mini project should be implemented in Java under Windows, Linux or Ubuntu environment.

References:

1. E Balgurusamy, *"Programming with JAVA",* Tata McGraw Hill
2. G. T. Thampi ,"*Object Oriented Programming in Java*", Dream Tech Press
3. Herbert Schildt, *"The Complete Reference JAVA",* Tata McGraw Hill

CLASS: SE (Mechatronics)	Subject Code: MTL308	Semester:-III
SUBJECT: **Applied Electronics Laboratory-I**		Credit: 1
Practical to be conducted for batch of students	Practical	Slot of 02 hours per week

Prerequisite:

1. FEC102 Applied Physics
2. FEC105 Basic Electricity and Electronics

Objectives:

1. Characterization of electrical and electronics circuits
2. Characterization of electrical and electronics actuators

Outcomes: Learner will be able to..

1. analyze second order systems in time and frequency domain
2. characterize TTL family
3. characterize MOS family
4. Implement combinational and sequential circuits using MSI devices.

List of experiments:

1. Time domain response of RC circuit
2. Time domain response of R-L-C series circuit: under, over and critically damped. This can be studied by writing a simple programme using any software tool. Plot time domain response and study effect of change in values of R-L-C
3. Write a simple programme for the transfer function of any R-L-C circuit. Plot frequency domain response and study effect of change in values of R-L-C
4. Speed control of DC shunt and series motor
5. Plot torque speed characteristics of DC shunt motor
6. Speed control of three phase Induction Motor
7. Stepper Motor control
8. Starting of capacitor start/run single phase Induction Motor
9. BJT as electronic ON/OFF switch
10. JFET as electronic ON/OFF switch
11. MOSFET as electronic ON/OFF switch
12. Developing ON/OFF control for Stepper Motor
13. Developing ON/OF control for permanent magnet DC motor

Term Work:

Term work shall consist of minimum 10 experiments and should be set to have well predefined inference and conclusion.
Term Work Evaluation: 25 Marks (Total marks) = 20 Marks (Experiment) +05 Marks (Attendance)

Practical / Oral Examination:

Practical examination of 2 hours duration based on any one of the experiments mentioned in the list above.

The distribution of marks for oral-practical examination shall be as follows:

Practical Examination …… 15 marks
Oral …… 10 Marks

1. Evaluation of practical examination to be done based on the performance of design task.
2. Students work along with evaluation report to be preserved till the next examination.

CLASS: SE (Mechatronics)	Subject Code: MTL309	Semester:-III
SUBJECT: **Engineering Materials and Metallurgy Laboratory**		Credit: 1
Practical to be conducted for batch of students	Practical	Slot of 02 hours per week

Pre-requisites:

1. FEC103 Applied Chemistry-I
2. FEC202 Applied Physics –II
3. FEC203 Applied Chemistry –II

Objectives:

1. To prepare the students understand basic engineering materials, their properties & selection and applications.
2. To prepare the students acquire basic understanding of advanced materials, their functions and properties for technological applications.

Outcomes: Learner will be able to...

1. Distinguish different types of materials and composites used in Manufacturing.
2. Demonstrate a deeper understanding of heat treatment processes for engineering applications.
3. perform non-destructive technique (NDT)

List of Experiments:

1. Preparation of specimen (minimum two metals/alloys) for microscopic examination.
2. Heat treatment process (Annealing, Normalizing and Hardening).
3. Jominy end Quench test for hardenability.
4. NDT (at least two).

Term Work:

Term work shall consist of

1. Assignments: On topics drawn from syllabus.
2. Factory report: Preparation of equipment, process, quality control and failure analysis of engineering components reports after visit to important industrial plants.
3. All experiments mentioned in the list of experiments shall be performed.

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

• Laboratory work (assignments, Practicals):	10 Marks.
Report on Factory visit:	10 Marks
• Attendance (Practicals):	05 Marks.
TOTAL:	**25 marks**

CLASS: SE (Mechatronics)	Subject Code: MTC401		Semester:-IV
SUBJECT: **Applied Mathematics IV**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisites:

1. FEC101 Applied Mathematics-I
2. FEC201 Applied Mathematics-II

Objectives:

1. To inculcate an ability to relate engineering problems to mathematical context.
2. To provide a s o l i d foundation in mathematical fundamentals required to solve engineering problem.
3. To study the basic principles of Vector analyses, statistics and probability and complex integration.
4. To prepare students for competitive exams.

Outcomes: Learner will be able to ….

1. Use matrix algebra with its specific rules to solve the system of linear equations.
2. Understand and apply the concept of probability distribution and sampling theory to engineering problems.
3. Apply principles of vector differential and integral calculus to the analysis of engineering problems.
4. Identify, formulate and solve engineering problems.

Module	Details	Hrs
1	**Matrices** 1.1 Brief revision of vectors over a real field, inner product, norm, Linear Dependance and Independence and orthogonality of vectors. 1.2 Characteristic polynomial, characteristic equation, characteristic roots and characteristic vectors of a square matrix, properties of characteristic roots and vectors of different types of matrices such as orthogonal matrix, Hermitian matrix, Skew-Hermitian matrix, Cayley Hamilton theorem (without proof) Functions of a square matrix, Minimal polynomial and Derogatory matrix.	**09**
2	**Vector calculus** 2.1 Brief revision of Scalar and vector point functions, Gradient, Divergence and curl. 2.2 Line integrals, Surface integrals, Volume integrals. Green's theorem (without proof) for plane regions and properties of line integrals, Stokes theorem (without proof), Gauss divergence theorem (without proof) related identities and deductions. (No verification problems on Stoke's Theorem and Gauss Divergence Theorem)	**11**

3	**Non Linear Programming** 3.1 Unconstrained optimization, problems with equality constraints Lagranges Multiplier method. 3.2 Problem with inequality constraints Kuhn-Tucker conditions.	**06**
4	**Probability Distributions** 4.1 Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expected value, Variance. 4.2 Probability Distributions: Binomial, Poisson and Normal Distributions for detailed study.	**10**
5	**Sampling Theory** 5.1 Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small samples. 5.2 Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. 5.3 Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between samples means and population means, Test for significance of the difference between the means of two Samples, paired t-test. 5.4 Analysis of Variance(F-Test): One way classification, Two-way classification(short-cut method) 5.5 Chi-square distribution and its properties, Test of the Goodness of fit and Yate's correction.	**10**
6	**Correlation and Regression** 6.1 Correlation, Co-variance, Karl Pearson Coefficient of Correlation & Spearman's Rank Correlation Coefficient (non-repeated & repeated ranks) 6.2 Regression Coefficients & lines of regression	**06**

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of total 6 questions, each of 20 Marks.
2. Only 4 questions need to be solved.
3. Question 1 will be compulsory and based on maximum part of the syllabus. Remaining questions will be mixed in nature (for example suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

References:

1. Fundamentals of Mathematicals Statistics, S C Gupta & V K Kapoor, S. Chand & Co
2. Higher Engineering Mathematics, Dr B. S. Grewal, Khanna Publication
3. Elements of Applied mathematics, P N & J N Wartikar, Pune VidyarthiGruhaPrakashan
4. Advanced Engineering Mathematics, E Kreyszing, Wiley Eastern Limited
5. Operations Research, S.D. Sharma, S. Chand & CO.
6. Vector Analysis by Murray R. Spiegel, Shaum Series
7. Operations Research, Kantiswarup, Manmohan, P K Gupta, S. Chand & CO.

CLASS: SE (Mechatronics)	Subject Code: MTC402		Semester:-IV
SUBJECT: **Kinematics of Machinery**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisites:

1. FEC104 Engineering Mechanics

Objectives:

1. To provide basic concepts of kinematics of machine elements.
2. To understand velocity and acceleration analysis of mechanisms.
3. To study basics of power transmission by belts, chains, gears.
4. To analyse cam and follower mechanisms.

Outcomes: Learner should be able to…

1. Define various components of mechanisms.
2. Construct/Compose mechanisms to provide specific motion.
3. Draw velocity and acceleration diagrams.
4. Select appropriate power transmission mechanism.
5. Construct cam profile for the specific follower motion.

Sr. no.	Details	Hrs
1	1.1 Kinetics of Rigid Bodies D'Alemberts Principle, Application of motion of bars, cylinders and spheres only. Kinetics of Rigid Bodies: Kinetic energy in translating motion, Rotation about fixed axis and in general plane motion. **1.2 Basic Kinematics:** Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach crieterion, Grubler's criterio Four bar chain and its inversions, Double slider crank chain and its inversions.	07
2	**Mechanisms:** Straight line generating Mechanisms: Exact Straight Line Generating Mechanisms –Peaucellier approximate Straight Line Generating Mechanisms – Watt, Grasshopper and Tchebicheff's. Compliant mechanisms, Flexure based straight line mechanism. Offset slider crank mechanisms, Pantograph, Overview of mechanisms used in mechatronics systems: image scanner, 3D printer.	08
3	**Velocity & Acceleration analysis of Mechanisms** 3.1 Velocity Analysis of mechanisms (mechanisms up to 6 links). Velocity analysis by instantaneous center of rotation method (Graphical approach) Velocity analysis by relative velocity method (Graphical approach) Analysis is extended to find rubbing velocities at joints, mechanical advantage (Graphical approach). Velocity analysis of low	09

	degree complexity mechanisms (Graphical approach). Auxiliary point method 3.2 Velocity and Acceleration analysis of mechanism. Velocity and Acceleration –analysis by relative method (mechanisms up to 6 link) including pairs involving Coriolis acceleration (Graphical Approach).	
4	**Synthesis of Mechanisms and linkages**: Classification of Synthesis Problem, precision points for function Generation, Graphical synthesis of four bar mechanism, Three position synthesis, Four point synthesis, coupler-curve synthesis, Graphical synthesis of slider crank mechanism, Least square technique, Synthesis of four bar mechanism for body guidance.	10
5	**Belts and Chains** **5.1** Belt –Types of belts, velocity ratio, slip & creep, length of belt for open & cross system. Law of belting, Dynamic analysis- driving tensions, centrifugal tension, initial tension, condition of maximum power transmission. **5.2** Chains –types of chains, chordal action, variation in velocity ratio, Length of chain. **5.3 Gears** Law of gearing, Involute and Cycloid gear tooth profile, Construction of Involute profile. Path of contact, arc of contact, contact ratio for involutes and cycloidal tooth profile, Interference in involutes gears. Critical Numbers of teeth for interference free motion. Static force analysis in gears- spur, helical, worm & worm wheel. **5.4 Gear Trains** Kinematics and dynamic analysis of - simple gear trains, Module compound gear trains, reverted gear trains, epicyclic gear trains with spur or bevel gear combination.	10
6	**Cams and Followers** Cam and its Classifications. Followers and its Classification. Motion analysis and plotting of displacement-time, velocity-time, acceleration- time, jerk-time graphs for uniform velocity. UARM, SHM. Motion analysis of simple cams –R-R cam, D-R-R and D-R-D-R cam operating radial translating follower. Layout of cam profiles.	08

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory examinations:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

References:

1. Theory or Mechanisms and Machines by Amitabh Ghosh and A. Kumar Mallik.
2. Theory of Machines and Mechanism by John Uiker, Garden Pennock& Late. J. F. shigley
3. Theory of Machines –P. L. Ballaney
4. Theory of Machines by S. S. Rattan
5. Kinematics of Machines by R T Hinckle (Prentice Hall Inc.)
6. Kinematics By V.M. Fairs (McGraw Hill)
7. Mechanism Design: Analysis and Synthesis Vol. I by A. Erdman and G.N. Sander (Prentice Hall)
8. Kinematics and Dynamics of Planer Mechanisms by Jeremy Hirsihham (McGraw Hill).

CLASS: SE (Mechatronics)	Subject Code: MTC403		Semester:-IV
SUBJECT: **Fluid Mechanics and Machinery**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisites:

1. FEC104 Engineering Mechanics

Objectives:

1. To study the properties of the fluids.
2. To study the dynamics of fluids.
3. To study the transport of mass, momentum and energy.
4. To study the applications of the conservation laws to flow though pipes and hydraulics machines.

Outcomes: Learner will be able to…

1. Illustrate the physical properties and characteristic behavior of fluids.
2. Illustrate the principle and applications of continuity equation.
3. Learn about the Euler's equations along the streamlines.
4. Apply the principles of turbulent Vs laminar flow to flow systems
5. Apply the concepts of friction and determine friction factors.
6. Illustrate dimensional analysis for model and similitude of hydraulic machines.
7. Illustrate the working principle of hydraulic turbines.
8. Illustrate the working principle of hydraulic pump.

Module	Details	Hrs
01	**INTRODUCTION:** Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Classification of fluids - Properties of fluids. Centre of pressure - Plane and curved surfaces. Buoyancy and stability of floating bodies.	**9**
02	**FLUID KINEMATICS AND FLUID DYNAMICS:** Fluid kinematics: stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform, non uniform, laminar, turbulent, rotational, and irrotational flows-equation of continuity for one dimensional flow. Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, Bernoulli's equation - applications - Venturi meter – Orifice meter Pitot tube. Momentum equation and its application on force on pipe bend. Applications of momentum equations.	8
03	**INCOMPRESSIBLE FLUID FLOW:** Viscous flow - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow though circular conduits and circular annuli. Boundary layer concepts. Boundary layer thickness. Hydraulic and energy gradient. Darcy – Weibach equation. Friction factor and Moody diagram. Commercial pipes. Minor losses. Flow though pipes in series and in parallel.	**9**

04	**DIMENSIONAL ANALYSIS:** Dimension and units: Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude. Applications of dimensionless parameters. Model analysis Dimensionless number and their significance, model laws, Reynolod's model law, Fraude's model law, Euler's model law, Weber's model law, Mach's Model law, Type of models, scale effect in model, limitation of hydraulic similitude.	**8**
05	**HYDRAULIC TURBINES:** Hydro turbines: Definition and classification, turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine - working proportions, work done, efficiencies, hydraulic design –draft tube- theory- functions and efficiency.	**9**
06	**HYDRALUIC PUMPS**: Pumps: definition and classifications - Centrifugal pump; classifications, working principle, velocity triangles, Work done - Reciprocating pump: classification, working principle, Basic principles of indicator diagram. Performance parameters and characteristics of pumps and turbines; Positive displacement pumps.	**9**

Internal Assessment:
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

References:

1. Frank M. White, 1999, Fluid Mechanics, 4e, McGraw-Hill.
2. Streeter V.L., and Wylie, E.B., "Fluid Mechanics",4th Edtion, McGraw-Hill, 1983.
3. Babu.V "Fundamentals of Incompressible Flow", CRC press, First Edition, 2010.
4. White F.M., "Fluid Mechanics", 5th Edition, Tata McGraw-Hill, New Delhi, 2003.
5. Som S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", 2nd Edition, Tata McGraw-Hill, 2004.
6. Vijay Gupta, Santhosh Kumar Gupta, "Fluid Mechanics and it applications", New Age International Publishers, 2nd Edition, 2011.
7. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995.
8. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.

CLASS: SE (Mechatronics)	Subject Code: MTC404		Semester:-IV
SUBJECT: **Strength of Material**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisites:

1. FEC104 Engineering Mechanics
2. MTC 303 Engineering Materials and Metallurgy

Objectives:

1. To gain knowledge of different types of stresses, strain and deformation induced in the mechanical components due to external loads.
2. To study the distribution of various stresses in the mechanical elements such as beams, shafts etc.
3. To study Effect of component dimensions and shape on stresses and deformations.

Outcomes: Learner will be able to ….

1. Demonstrate fundamental knowledge about various types of loading and stresses induced.
2. Draw SFD and BMD for different types of loads and support conditions.
3. Compute and analyze stresses induced in basic mechanical components.
4. Analyze buckling and bending phenomenon in columns and beams respectively.

Module	Details	Hrs
1	**Moment of Inertia:** Mass Moment of Inertia , Area Moment of Inertia, Parallel Axis theorem, Polar Moment of Inertia, Principal axes, Principal moment of inertia. **Stress and Strain:** Definition, Stress- strain, uni-axial, bi-axial and tri-axial stresses, tensile & compressive stresses, shear stress-Elastic limit, Hooke's Law. **Elastic Constants:** Poission's Ratio, Modulus of elasticity, Modulus of rigidity, Bulk modulus, Yield stress, Ultimate stress. State of simple shear, relation between elastic constants, Volumetric strain, Volumetric strain for tri-axial loading, Deformation due to self-weight, Stresses in bars of varying sections, composite sections. Thermal Stress.	7
2	**Stresses Analysis:** General case of two-dimensional stress, Principal Stresses, Directions of Principal Stresses; Principal Planes, Shearing Stresses on Principal Planes, Maximum Shearing Stresses, Normal Stresses on Planes of Maximum Shearing Stress, Mohr's Circle, Determination of Principal Stresses by Mohr's Circle, Determination of Stresses on Arbitrary plane by Mohr's Circle. Principal Stresses for a General State of Stress, Mohr's Circle for General State of stress.	9

3	**Shear Force and Bending Moment in Beams:** Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading, relationship between rates of loading, shear force and bending moment.	9
4	**Stresses in Beams:** Theory of pure Bending, Assumptions, Flexural formula for straight beams, moment of resistance, bending stress distribution, Section moduli for different sections, beams for uniform strength, Flitched beams. **Direct & Bending Stresses**: Core of Section, Chimneys subjected to wind pressure **Shear Stress in Beams:** Distribution of shear stress, across plane sections used commonly for structural purposes, shear connectors.	9
5	**Torsion:** Torsion of circular shafts-solid and hollow, stresses in shafts when transmitting power, shafts in series and parallel. **Strain Energy:** Resilience, proof Resilience, strain energy stored in the member due to gradually applies load, suddenly applied load, impact load. Strain energy stored due to Shear, Bending and Torsion.	9
6	**Deflection of Beams:** Deflection of Cantilever, simply supported and over hanging beams using double integration and Macaulay's Method for different type of loadings. **Thin Cylindrical and Spherical Shells:** Cylinders and Spheres due to internal pressure. Cylindrical Shell with hemispherical end.	9

Theory Examination:

1. Question paper will comprise of total 6 questions, each of 20 Marks.
2. Only 4 questions need to be solved.
3. Question 1 will be compulsory and based on maximum part of the syllabus.
4. Remaining questions will be mixed in nature (for example suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

References:

1. Strength of Materials, Subramanyam, Oxford University Press, Edition 2005
2. Mechanics of Materials, B.C Punmia Ashok Jain, Arun Jain, Lakshmi Publications, NewDelhi.
3. Strength of Materials, Basavarajaiah and MahadevappaKhanna Publishers, New Delhi.
4. Strength of Materials, Singer Harper and Row Publications
5. Elements of Strength of Materials, Timoshenko and Young Affliated East-West Press.
6. Mechanics of Materials, James M. Gere (5th Edition), Thomson Learning
7. Strength of Materials—S. Ramamrutham, DhanpatRai Pvt. Ltd.
8. Mechanics of Materials—S. S. Rattan, TMH Pvt. Ltd.
9. Mechanics of Structures—S. B. Junnarkar, Charotar Publication.
10. Strength of Materials—W. Nash, Schaum's Outline Series, McGraw Hill Publication.

CLASS: SE (Mechatronics)	Subject Code: MTC405	Semester:-IV
SUBJECT: **Application of Integrated Circuits**		Credit-4

Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisite:

1. MTC304 Digital Electronics
2. MTC305 Applied Electrical and Electronics Engineering

Objectives:

1. To teach fundamental principles of standard linear integrated circuits.
2. To develop a overall approach for students from selection of integrated circuit, study its specification, the functionality, design and practical applications

Outcomes: Learner will be able to..

1. Demonstrate an understanding of fundamentals of integrated circuits.
2. Analyze the various applications and circuits based on particular linear integrated circuit.
3. Select and use an appropriate integrated circuit to build a given application.
4. Design an application with the use of integrated circuit

Module	Topics	Hrs
1	**Fundamentals of Operational Amplifier** 1.1 Ideal Op Amp, characteristics of op-amp, op-amp parameters, high frequency effects on op-amp gain and phase, slew rate limitation, practical determination of op-amp parameters, single supply versus dual supply op-amp 1.2 Operational amplifier open loop and closed loop configurations, Inverting and non-inverting amplifier	06
2	**Linear Applications of Operational Amplifier** 2.1 **Amplifiers:** Adder, subtractor, integrator, differentiator, current amplifier, difference amplifier, instrumentation amplifier and application of Op-Amp in Transducer Measurement System with detail design Procedure. 2.2 **Converters:** Current to voltage converters, voltage to current converters 2.3 **Active Filters:** First order filters, Second order active finite and infinite gain low pass, high pass, band pass and band reject filters. 2.4 **Sine Wave Oscillators:** RC phase shift oscillator and Wien bridge oscillator	12
3	**Non-Linear Applications of Operational Amplifier** 3.1 **Comparators:** Inverting comparator, non-inverting comparator, zero crossing detector, window detector and level detector. 3.2 **Schmitt Triggers:** Inverting and non-inverting Schmitt trigger 3.3 **Waveform Generators:** Square wave generator and triangular wave generator with duty cycle modulation 3.4 **Precision Rectifiers:** Half wave and full wave precision rectifiers and their applications. 3.5 Peak Detectors, Sample & Hold Circuits, voltage to frequency converter, frequency to voltage converter, logarithmic converters and antilog converters	12

4	**Data Converters** 4.1 **Analog to Digital**: Performance parameters of ADC, Single Ramp ADC, ADC using DAC, Dual Slope ADC, Successive Approximation ADC, Flash ADC, ADC0808/0809 and its interfacing 4.2 **Digital to Analog**: Performance parameters of DAC, Binary weighted register DAC, R/2R ladder DAC, Inverted R/2R ladder DAC, DAC0808 and its interfacing	06
5	**Special Purpose Integrated Circuits** 5.1 Functional block diagram, working, design and applications of Timer 555. 5.2 Functional block diagram, working and applications of VCO 566, PLL 565, multiplier 534, waveform generator XR 2206, power amplifier LM380.	08
6	**Voltage Regulators** 6.1 Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM 317, LM 337) voltage regulators. 6.2 Functional block diagram, working and design of general purpose 723 (LVLC, LVHC, HVLC and HVHC) with current limit and current fold-back protection, Switching regulator topologies, Functional block diagram and working of LT1070 monolithic switching regulator.	08
	Total	52

Internal Assessment (IA):

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory 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 preferably objective type and based on entire syllabus.
4. Remaining questions will be mixed in nature (for example suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

References:

1. Sergio Franco, "*Design with operational amplifiers and analog integrated circuits*", Tata McGraw Hill, 3rd Edition.
2. William D. Stanley, "*Operational Amplifiers with Linear Integrated Circuits* ", Pearson, 4th Edition
3. D. Roy Choudhury and S. B. Jain, "*Linear Integrated Circuits*", New Age International Publishers, 4th Edition.
4. David A. Bell, "*Operation Amplifiers and Linear Integrated Circuits*", Oxford University Press, Indian Edition.
5. Ramakant A. Gayakwad, "*Op-Amps and Linear Integrated Circuits*", Pearson Prentice Hall, 4th Edition.
6. R. P. Jain, "*Modern Digital Electronics*," Tata McGraw Hill, 3rd Edition.
7. Ron Mancini, "*Op Amps for Everyone*", Newnes, 2nd Edition.
8. J. Millman and A. Grabel, "*Microelectronics*", Tata McGraw Hill, 2nd Edition.
9. R. F. Coughlin and F. F. Driscoll, "*Operation Amplifiers and Linear Integrated Circuits*", Prentice Hall, 6th Edition.
10. J. G. Graeme, G. E. Tobey and L. P. Huelsman, "*Operational Amplifiers- Design & Applications*", NewYork: McGraw-Hill, Burr-Brown Research Corporation.

CLASS: SE (Mechatronics)	Subject Code: MTC406		Semester:-IV
SUBJECT: **Signals and Systems**			Credit-4
Periods per week: 1Period of 60 min.	Lecture	4	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	80
	Internal Assessment		20
	TOTAL		**100**

Pre-requisite:

1. MTC305: Applied Electrical and Electronics Engineering

Objectives:

1. To introduce students to the idea of signal and system analysis and characterization in time and frequency domain.
2. To provide foundation to numerous other courses that deal with signal and system concepts directly or indirectly.

Outcomes: Learner will be able to...

1. Classify various types of signals and systems.
2. Analyze continuous time systems intime domain and Laplace, z, and frequency domains.
3. Explain and apply the properties Laplace transform/z-transform/Fourier series/transform in solving numerical problems.
4. Demonstrate their written and oral communication skills for this subject.

Module	Details	Hrs.
1.0	**Introduction:** 1.1 **Signals and systems**: Examples of signals & systems as seen in everyday life, and in various branches of engineering: electrical, mechanical, hydraulic, thermal, and biomedical. Extracting the common essence and requirements of signal and system analysis from these examples. 1.2 **Continuous time signals**: elementary signals, exponential, sine, step, impulse, ramp, rectangular, triangular and operations on signals 1.3 **Classification of signals:** Continuous and discrete time, deterministic and non-deterministic, periodic and aperiodic, symmetric (even) and asymmetric (odd), energy and power, causal and anti-causal signals.	**06**
2.0	**Time domain analysis of Continuous Time Systems** 2.1 **Classification of systems:** Static and dynamic, time variant and time invariant, linear and nonlinear, causal and non-causal, stable and unstable systems. 2.2 **Linear Time Invariant (LTI) systems:** Representation of systems using differential equation, Impulse, step and exponential response, system stability, examples on applications of LTI systems, convolution, impulse response of interconnected systems, auto-correlation, cross correlation and properties of correlation	**12**
3.0	**Laplace Transform** 3.1 **Overview of Laplace Transform:** Laplace Transform and properties, relation between continuous time Fourier Transform and Laplace Transform, unilateral Laplace Transform. 3.2 **Analysis of continuous time LTI systems using Laplace Transform:** Transfer Function, causality and stability of systems, solution of differential equation using Laplace Transform.	**06**
4.0	***z* – Transform** 4.1 z-Transform of finite and infinite duration sequences, relation between discrete time Fourier Transform and z-Transform, properties, Inverse *z*-	**08**

	Transform, one sided *z*– Transform. 4.2 **Analysis of discrete time LTI systems using z-Transform**: Transfer Function, causality and stability of systems, frequency response, relation between Laplace Transform and *z*–Transform.	
5.0	**Fourier series of continuous and discrete time signals** 5.1 **Review of Fourier series:** trigonometric and exponential Fourier series representation of signals, magnitude and phase spectra, power spectral density and bandwidth. Gibbs phenomenon. 5.2 **Properties of Fourier Series:** Linearity, time shifting, time reversal, frequency shifting, time scaling, differentiation, symmetry. Parsevel's relation. Examples based on properties, analogy between Continuous Time Fourier Series (CTFS) and Discrete Time Fourier Series (DTFS).	**10**
6.0	**Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT)** 6.1 **Fourier Transform:** Fourier Transform and Inverse Fourier Transform on periodic and non-periodic signals, limitations of Fourier Transform and need for Laplace and *z*-Transform 6.2 **Properties of Fourier Transform:** Linearity, time shifting, time reversal, frequency shifting, time and frequency scaling, modulation, convolution in time domain, differentiation in time domain, differentiation in frequency domain, symmetry. Parsevel's relation. Energy, power spectral density and bandwidth. Definition and problems on DTFT	**10**
	Total	**52**

Internal Assessment (IA):

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory 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 questions will be mixed in nature (for example suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

References:

1. Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, Signals and Systems, PrenticeHall of India, Second Edition, 2002
2. B.P. Lathi, Principles of Linear Systems and Signals, Oxford, Second Edition, 2010.
3. Simon Haykin and Barry Van Veen, Signals and Sytems, John Wiley and Sons, Second Edition, 2004.
4. Hwei. P Hsu, Signals and Systems, Tata McGraw Hill, Third edition, 2010.
5. NagoorKani, Signals and Systems, Tata McGraw Hill, Third Edition, 2011.
6. Chi-Tsong Chen, Signals and Systems, Oxford Indian Edition, Third Edition 2012.
7. Luis F. Chaparro, Signals and Systems Using MATLAB, Academic Press, 2011.
8. Michael J Roberts, Fundamentals of Signals and systems, Tata McGraw Hill, special Indian Economy edition, 2009.
9. Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, Signals and Systems, Pearson Education, Fourth Edition 2009.

.

CLASS: SE (Mechatronics)	Subject Code: MTL407	Semester:-IV
SUBJECT: **Applied Electronics Laboratory-II**		Credit: 1
Practical to be conducted for batch of students	Practical	02 hours per week

Pre-requisite:

1. MTL308: Applied Electronics Laboratory-I

Objectives:

1. Study of electronic amplifier
2. Study of interfacing
3. Time domain analysis of systems

Outcomes: Learner will be able to...

1. Characterize op-amp
2. do interfacing
3. do time domain characterization of the systems

List of Experiments:

1. Experiment on op amp parameters
2. Experiment on design of application using op amp
3. Experiment on implementation of op amp application e.g. oscillator
4. Experiment on nonlinear application (e.g. comparator or peak detector) of op amp
5. Experiment on ADC and DAC interfacing
6. Experiment on IC 555
7. Experiment on voltage regulator
8. Simulation experiment based on time domain analysis of continuous time systems
9. Simulation experiment on Laplace/z-Transform
10. Simulation experiment on CTFT and DTFT

Term Work:

Term work shall consist of performance of above mentioned 10 experiments with well predefined inference and conclusion.

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

Term Work Evaluation: 25 Marks (Total marks) = 20 Marks (Experiment) + 05 Marks (Attendance)

Practical exam (15 marks) will be on any one of the experiments from the list and oral exam (10 marks) will be based on the entire syllabus of the laboratory.

CLASS: SE (Mechatronics)	Subject Code: MTL408	Semester:-IV
SUBJECT: **Electrical and Electronics Workshop**		Credit: 1
Practical to be conducted for batch of students	Practical	02 hours per week

Pre-requisite:

1. MTL308: Applied Electronics Laboratory-I

Objectives:

1. To inculcate skill for electrical engineering works
2. To inculcate skill for electronics engineering works

Outcome: Learner will be able to...

1. demonstrate PCB design and soldering skills
2. demonstrate computer assembly skills
3. demonstrate skills in handling electrical components

Syllabus:

The primary objective is to encourage students to design and implement innovative ideas by development of engineering skills. This will give them in depth practical knowledge from design to the final verification stage. Documentation is important for any activity and students are expected to document their work properly.

Part A:

1. Soldering Techniques and PCB Design
2. Computer hardware
3. Various electrical components (relays, fuses, transformers, motors etc.)
4. Electrical wiring

Part B:

Mini Project: Design and implementation of any real life application preferably based on syllabus of ETC405 (Application of Integrated Circuits). Each student should separately design PCB, solder and test the different circuit.

Term Work:

Four hands on exercises from Part A should be set to have well predefined inference and conclusion.

Few computation/simulation based experiments are encouraged.

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

Term Work Evaluation: 50 Marks (Total marks) = 20 Marks (Part A: Experiment) +20 Marks (Part B: mini project) +10 Marks (Attendance)

Practical and Oral exam will be based on Part A and Part B.

CLASS: SE (Mechatronics)	Subject Code: MTL409	Semester:-IV
SUBJECT: **Strength of Materials Laboratory**		Credit: 1
Practical to be conducted for batch of students	Practical	Slot of 02 hours per week

Pre-requisites:

1. FEC104 Engineering Mechanics
2. MTC 303 Engineering Materials and Metallurgy

Objectives:

1. To gain knowledge of different types of stresses, strain and deformation induced in the mechanical components due to external loads.
2. To study the distribution of various stresses in the mechanical elements such as beams, shafts etc.
3. To study effect of component dimensions and shape on stresses and deformations.

Outcomes: Learner should be able to ….

1. Perform tension test.
2. perform hardness test
3. perform torsion test
4. perform impact test
5. perform flexural test

Term Work:

List of Experiment:

1. Tension test on mild steel bar (stress - strain behavior, modulus determination)
2. Test on-tor-steel bar
3. Torsion test on mild steel bar/cast iron bar
4. Brinell hardness test
5. Rockwell hardness test
6. Izod impact test / Charpy test
7. Flexural test on beam (central point load)
8. Flexural test on beam (two point load)

Distribution of marks for Term work shall be as follows:

Laboratory work (experiments/assignments): 20 marks

Attendance (Theory and practical's): 05 marks

Practical and Oral Examination:

Practical examination of 2 hours duration based on any one of the experiments mentioned in the list above.

Marks distribution: 25 Marks (Total marks) = 15 Marks (Practical) + 10 Marks (Oral)