B. Tech.

MECHANICAL AND MECHATRONICS ENGINEERING (ADDITIVE MANUFACTURING)

FIRST SEMESTER

Sr. No.	Course Code	Department	Title	Contact Hours				Credits
				L	T	P	Total	
1.	MA102	MATHS	Engineering Mathematics - 1	3	1	-	4	4
2.	PH101	PHY	Engineering Physics-1	3	1	-	4	4
3.	HS101	HSS	English	2	1	-	3	3
4.	CS101	CSE	Computer Programming	3	1	-	4	4
5.	PH201	PHY	Engineering Physics Lab-1	-	-	2	2	1
6.	CS201	CSE	Computer Programming Lab	-	-	4	4	2
7.	ME201	ME	Workshop Practices	-	-	3	3	1.5
8.		HSS	Value Added Course-1	2	-	-	2	-
			TOTAL				24	19.5

SECOND SEMESTER

Sr. No.	Course Code	Department	Title	Contact Hours				Credits
				L	T	P	Total	
1.	HS104	HSS	Life Skills and Effective Communication	1	1	-	2	2
2.	MA103	Maths	Engineering Mathematics-2	3	1	-	4	4
3.	CH101	Chemistry	Engineering Chemistry	3	1	-	4	4
4.	EC102	ECE	Basic Electrical and Electronics	3	1	-	4	4
5.	ME101	ME	Engineering Mechanics	3	1	-	4	4
6.	CH201	Chemistry	Engineering Chemistry Lab	-	-	2	2	1

7.	EC202	ECE	Basic Electrical and Electronics Lab	-	-	2	2	1
8.	ME202	ME	Engineering Mechanics Lab	-	-	2	2	1
9.	ME203	ME	Engineering Drawing and Design Lab			3	3	1.5
			TOTAL				27	22.5

THIRD SEMESTER

Sr. No.	Department	Course No.	Title	Contact Hours				Credits
				L	T	P	Total	
			Mathematics-3 (Transforms and Partial Differential Equations, Probability and Statistics)	3	1	-	4	4
1.	MEC	ME102	Basic Thermodynamics	3	1	-	4	4
2.	MEC	ME103	Strength of Materials	3	1	-	4	4
3.	MEC		Manufacturing Technology	3	1	-	4	4
4.	MEC	ME204	Basic Thermodynamics Lab	-	-	2	2	1
5.	MEC	ME205	Strength of Materials Lab	-	-	2	2	1
6.	MEC		Manufacturing Technology Lab	-	-	2	2	1
			Programming for problem solving (Python)	-	-	2	2	1
	HSS		Value Added Course-2	2	-	-	2	-
			TOTAL	14			26	20

FOURTH SEMESTER

Sr. No.	Department	Course No.	Title	Contact Hours				Credits
				L	T	P	Total	
1.	HSS		HSS Elective - 1	2	1	-	3	3
3.	MEC	ME106	Fluid Mechanics	3	1	-	4	4
	MEC	ME105	Theory of Machines	3	1	-	4	4

			Computer Aided Design	3	-	-	3	3
			Theory of Control Systems	3	-	-	3	3
5.	MEC	GE101	Environmental Science	2	-	-	2	2
	MEC	ME207	Theory of Machines Lab	-	-	2	2	1
			Computer Aided Design Lab	-	-	2	2	1
6.	MEC	ME208	Fluid Mechanics Lab	-	-	2	2	1
			TOTAL	16	3	6	25	22

*Students will undergo Summer Training during vacation after IVth Semester (optional).

FIFTH SEMESTER

Sr. No.	Department	Course No.	Title	Contact Hours				Credits
				L	T	P	Total	
1.	HSS		HSS Elective-2	3		-	3	3
4.	MEC		Engineering Materials	3	-	-	3	3
	MEC	ME110	Design of Machine Elements	3	-	-	3	3
			Sensors and Instrumentation	3	-	-	3	3
			Computer Integrated Manufacturing	3	-	-	3	3
5.	MEC	ME213	Minor Project – 1			4	4	2
	MEC	ME20214	Design of Machine Elements Lab	-	-	2	2	1
			Sensors and Instrumentation Lab	-	-	2	2	1
			Computer Integrated Manufacturing Lab	-	-	2	2	1
			Design Thinking Lab	-	-	2	2	1
10	MEC	ME002	Verbal and non-verbal reasoning-1	3	-	-	3	Qualifying
			TOTAL				30	21

SIXTH SEMESTER

Sr. No.	Department	Course No.	Title	Contact Hours				Credits
				L	T	P	Total	
	HSS		HSS Elective - 3	2	1		3	3

			Basics of Additive Manufacturing	3	-	-	3	3
			Micro controller and Applications	3	-	-	3	3
			Digital Signals and Image Processing	3	-	-	3	3
2.	MEC		Discipline Elective – 1	3	-	-	3	3
5.			Value Added Course-II	3	-	-	3	Qualifying
			Basics of Additive Manufacturing Lab	-	-	2	2	1
			Micro controller and Applications Lab	-	-	2	2	1
			Digital Signals and Image Processing Lab	-	-	2	2	1
7.	MEC	ME216	Minor Project-2	-	-	4	4	2
			TOTAL				28	20

Note: Students will undergo 6 weeks Industrial Training during Summer Vacation after 6th Semester (Compulsory).

SEVENTH SEMESTER

Sr. No.	Department	Course No.	Title	Contact Hours				Credits
				L	T	P	Total	
			Robotics Engineering	3	-	-	3	3
			Additive Manufacturing Applications	3	-	-	3	3
1.	MEC		Discipline Elective – 2	3	-	-	3	3
4.			Open Elective - 1	3	-	-	3	3
			Robotics Engineering Lab	-	-	2	2	1
			Additive Manufacturing Applications Lab	-	-	2	2	1
5.	MEC	ME217	Major Project Part-1	-	-	8	8	4
6.	MEC	ME004	Summer Training Viva	-	-	-	-	Qualifying
			TOTAL				24	18

EIGHTH SEMESTER

Sr.	Department	Course No.	Title	Contact Hours	Credits

No.				L	T	P	Total	
			Discipline Elective – 3	3		-	3	3
1.	MEC		Discipline Elective – 4	3			3	3
3.	Engg Branch		Open Elective -2	3		-	3	3
4.	MEC	ME218	Major Project Part-2	-	-	16	16	8
			TOTAL				25	17

Total Credits for B. Tech. –160

List of Discipline Electives

Subject code	Subject name
ME311	Operations Research
ME314	Finite Element Technique
ME330	Optimization Methods in Engineering
ME312	Laser Material Processing
ME317	Statistical Quality Control
ME320	Production and Operation Management
ME306	Engineering Data Analytics
ME331	Supply Chain Management
	Hydraulics and Pneumatics
	Maintenance and Reliability Engineering
	Electrical Machines and Power Systems
	Programmable logic controller
	Embedded System
	Industrial Electronics
	Artificial Intelligence
	Machine Learning
	Data Structure and Algorithm
	Reverse Engineering
	Cyber Security and Computer Network
	Introduction to Blockchain Technologies

HSS Electives:

1. Concept of Financial Management: HS302
2. Knowledge Management: HS303
3. Concept of Digital Marketing: HS304
4. Concept of Marketing Management: HS306
5. Entrepreneurship and Small Business

Value Added Course

1. Human Values and Professional Ethics: HS001
2. Professional communication Practice: HS002
3. Concept of Project Management: HS003
4. Indian Constitution & Traditional Knowledge: HS004
5. Verbal and non-verbal reasoning-1
6. Verbal and non-verbal reasoning-2

Course Name: Engineering Mathematics-I **Course Code: MEMA102**
L-T-P scheme: 3-1-0 **Credits: 4**

Prerequisite: Students should have basic knowledge of Algebra and calculus.

Objective: This course is aimed:

- To introduce the calculus of functions of two variables and applicability of derivatives and integrals of vector functions to Analytical geometry and physical problems.
- To make students aware of the basic mathematical concepts and methods which will help them in learning courses in engineering and Technology.

Learning Outcomes:

Course Outcome	Description
CO1	Understand the rank, eigen values, eigen vectors, diagonalization of matrix; compute inverse of matrix by Caley-Hamilton theorem.
CO2	Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, and solve it by Gauss elimination method.
CO3	Interpret derivatives and integrals of multivariable functions geometrically and physically; implement multivariable calculus tools in engineering, science, optimization, and understand the architecture of surfaces in plane and space etc.
CO4	Know about piecewise continuous functions, Laplace transforms and its properties; use of Laplace transform and inverse transform for solving initial value problems.
CO5	Realize importance of line, surface and volume integrals, Gauss and Stokes theorems and apply the concepts of vector calculus in real life problems.
CO6	Formulate mathematical models in the form of ordinary differential equations and learn various techniques of getting solutions of linear differential equations of second order.

Course Contents:
Unit 1: Algebra of matrices, Determinants, Rank, Gauss elimination method, Eigen values and vectors. Quadratic forms.
Unit 2: Partial differentiation. Taylor's series. Maxima and minima. Jacobians**,** Double integrals,
Unit 3: Differential Equations with constants coefficients.
Unit 4: Gradient, divergence and curl. Line and surface integrals, Normal and tangent to a surface. Gauss and Stokes theorems, Equations to a line, plane, curve and surfaces.
Unit 5: Laplace transforms.

Methodology:

The course will be covered through lectures supported by tutorials. There shall be 3 Lectures per week where the teacher will explain the theory, give some examples supporting the theory and its applications. About 12 Tutorial Sheets covering whole of the syllabus shall be given. Difficulties

and doubts shall be cleared in tutorials. Apart from the discussions on the topics covered in the lectures, assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on mathematics-1 will be available on the JUET server.

Books

1. Erwin Kreyszig: Advanced Engineering Mathematics, Wiley Publishers.
2. Lipshuts, S., Lipsom M.: Linear Algebra, 3rd Ed, Schaum series 2001.
3. B. V. Raman: Higher Engineering Mathematics, McGraw-Hill Publishers.
4. R.K. Jain, S.R.K. Iyenger: Advanced Engineering Mathematics, Narosa Publishing House, New Delhi.
5. Thomas, G.B., Finney, R.L.: Calculus and Analytical Geometry, 9th Ed., Addison Wesley,1996.
6. Grewal, B.S. : Higher Engineering Mathematics, Khanna Publishers Delhi.

Title of Course: Engineering Physics-I **Course Code: PH101**
L-T-P Scheme: 3-1-0 **Course Credits: 4**

Objective: Broadly, the study of Physics improves one's ability to think logically about the problems of science and technology and obtain their solutions. The present course is aimed to offer a broad aspect of those areas of Physics which are specifically required as an essential background to all engineering students for their studies in higher semesters. The course intends to impart sufficient scientific understanding of different phenomena associated with Special relativity, Modern Physics, Statistical physics, atomic physics, and lasers.

Course Outcomes:

Course Outcome	Description
CO1	Describe the limitations of Newton's laws and explain when special relativity become evant, Learn to Apply the principles of Special Relativity to an extended range of oblems involving particle kinematics
CO2	Demonstrate the ability to explain the concepts related to the consequences of Special Relativity, the nature of space-time and related dynamic observables
CO3	Acquired a profound understanding of inadequacy of classical mechanics regarding phenomena related to microscopic level, Become well versed with the experimental developments, historical account and importance of probabilistic interpretation
CO4	Understand the basic quantum mechanical ideas and relevant mathematical framework, approach the solution of one dimensional time independent Schrodinger equation
CO5	Appreciate the importance of applying statistical ideas to explore thermodynamic variables, Developed ability to identify and apply appropriate statistical method for describing the assembly of microscopic particles, comprehend basic properties and working of Laser systems

Course Contents:

Unit-I (Theory of Special Relativity): Frames of reference, Galilean transformation, Michelson Morley Experiment, Postulates of special theory of relativity, time dilation and length contraction, twin paradox, Lorentz transformations, addition of velocities, Relativistic Doppler effect, Mass variation with velocity, Mass-energy relation.

Unit-II (Introduction to Modern Physics):

Quantization of Radiation, Black body radiation, Rayleigh-Jeans law, Planck's law of radiation Wien's law, Stefan's law, Photoelectric effect Compton scattering, Atomic spectra, Bohr model of hydrogen atom, Frank hertz experiment, Matter waves, de Broglie hypothesis, Davisson Germer experiment

Unit III Quantum Mechanics

Wave packets, phase and group velocity, Heisenberg's uncertainty principle, Schrödinger wave equation and its applications to the free particle in a box, potential barrier and Harmonic oscillator

Unit-IV (Statistical Mechanics): Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and their applications.

Unit- VLaser Physics & Applications

Fundamental ideas of stimulated and spontaneous emission, Einstein's coefficients, Principle and working of laser, Different types of lasers (He-Ne Laser, Ruby Laser, Semiconductor Laser), Applications of Lasers

Text Books and References:

1. A. Beiser, Perspectives of Modern Physics, Tata McGraw Hill.
2. J R Taylor, C D Zafiratos, M A Dubson, Modern Physics for Scientist &
1. Engineers, Pearson Education.
2. K Krane, Modern Physics, Wiley India
3. J Bernstein, P M Fishbane, S. Gasiorowicz, Modern Physics, Pearson
4. Education.
5. B. B. Laud, Laser and Non-Linear Optics, New Age International (P) Ltd.
6. R. Resnick, Relativity, New Age.

Title: English **Code: HS101**
L-T-P scheme: 2-1-0 **Credit: 3**
Prerequisite: None
Objective:

1. To enable understanding of basics of communication in Business environment.
2. To provide insight into structural aspect of communication in business.
3. To impart knowledge about communication theory and develop skills in oral and non verbal communication.
4. To improve skills as critical readers, thinkers, listener and writer.

Learning Outcomes:

Course Outcome	**Description**
CO1	Outline the basic concept of verbal/ nonverbal skills to understand the role of effective communication in personal & professional success.
CO2	Describe drawbacks in listening patterns and apply listening techniques for specific needs.
CO3	Develop the understanding to analyze, interpret and effectively summarize a variety of textual content
CO4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus.
CO5	Create effective presentations
CO6	Create professional and technical documents that are clear and adhering to all the necessary convention.

Course Content:

Unit-1: Concept and Nature of Communication : Definition of Communication, Process & Stages of Communication, Barriers to Communication, Channels of Communication.

Unit-2: Listening Skills: The listening process**,** Importance of listening,Purpose and types of listening**,** Hearing and listening, Listening with a purpose, Barriers to listening.

Unit-3: Speaking/Oral Skills: Importance of acquiring oral skills, Visual aids, Body Language, Delivery, Pronunciation, Use of connectives Organization of matter: Metadiscourse features, Textual organization, 7 C'S of effective communication , Improving vocabulary by learning Root words in English, Some foreign words, Reading comprehension, Some important synonyms and antonyms, commonly confused words, Etiquettes & grooming.

Unit-4: Reading Skills: Skimming and Scanning, Intensive and extensive reading, SQ3R Technique

Unit-5: Writing Skills: Business letters, Memo, Circulars, Notices, Report writing, resume writing, Agenda & Minutes writing, Tips on clear writingTranslation- Hindi to English, Translation -English to Hindi.

Unit-6: Introduction to Modern Communication Media: Technology based communication tools, Committee types, Advantages, Conferences, Audio-video conferencing, Barriers and overcoming negative impact.

Unit-7: Public Speaking and Interviewing Strategies: Speech Preparation, Theory of group discussion, Participation in Group discussion, Oral presentation, Power point presentation ,Tips for successful job interview, Do's and don'ts while appearing for interview, Mock interview, Some interview questions, Telephonic interview tips, Resume writing

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3,& Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Teaching Methodology:

The course will be taught with the aid of lectures, handouts, case studies, Task-based language learning, and comprehensive language learning through language lab.

Learning Resources:

Lecture slides and e-books on ENGLISH (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. K.K. Sinha- Business Communication (Galgotia Publications)

Reference Books:

1. R.C. Bhatia- Business Communication (Ane Books Pvt. Ltd.)
2. P.D. Chaturvedi – Business Communication (Pearson Education, 1st Edition 2006).
3. Lesikar RV & Pettit Jr. JD – Basic Business Communication: Theory & Application (Tata Mc Graw Hill, 10th Edition)
4. Wren & Martin, High School English Grammar & Composition – S. Chand & Co. Delhi.
5. Raman Meenakshi & Sharma Sangeeta, Technical Communication-Principles & Practice –O.U.P. New Delhi. 2007.
6. Mitra Barum K., Effective Technical Communication – O.U.P. New Delhi. 2006.
7. Better Your English- a Workbook for 1st year Students- Macmillan India, New Delhi.
8. Raymond Murphy,' Essential English Grammar', Cambridge University Press.

Title: Computer Programming **Code: CS101**
L-T-P scheme:3-1-0 **Credit: 4**

Prerequisite: There is no prerequisite in this course; however, students having any prior experience of programming are desirable.

Objective:

1. To provide exposure to problem-solving through programming.
2. To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

Learning Outcomes:

Course Outcome	Description
CO1	Makes students gain a broad perspective about the uses of computers in engineering industry.
CO2	Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.
CO3	Develops the ability to analyze a problem, develop an algorithm to solve it.
CO4	Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology

	of programming in general.
CO5	Introduces the more advanced features of the C language

Course Content:

Unit-1: Introduction to Programming: Basic computer organization, operating system, editor, compiler, interpreter, loader, linker, program development. Variable naming, basic function naming, indentation, usage and significance of comments for readability and program maintainability. Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory. Constants, Variables and data Types Character Set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of Variables, assigning values to variables, typedef, and Defining symbolic constants. printf & scanf function.

Unit-2:Operators and Expression: Introduction, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operators, Special Operators, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associativity.

Management Input and Output Operators: Introduction, reading a character, writing a character, formatted input, formatted output.

Unit-3: Decision Making B**ranching:** Introduction, Decision making with IF statement, the IF-ELSE statement, nesting of IF-ELSE statement, ELSE-IF ladder, SWITCH statement, ternary operator, and the GOTO statement.

Looping: Introduction, the WHILE statement, the DO statement, The FOR statement, Break and Continue.

Unit-4: Array: Introduction, One-dimensional arrays, Two-dimensional arrays, arrays, Concept of Multidimensional arrays.

Handling of Character strings: Introduction, Declaring and initializing string variables, reading string from terminal, writing string to screen, String, Operations: String Copy, String Compare, String Concatenation and String Length (using predefined functions & without using them), Table of strings.

Unit-5: User-Defined Functions (UDF): Introduction, need for user-defined functions, the form of C function, elements of UDF, return values and their types, Calling a function, category of functions, Nesting of functions, Recursion, Functions with arrays, The scope and Lifetime of variables in functions, multi file program.

Structures and Unions: Introduction, Structure definition, declaring and initializing Structure variables, accessing Structure members, Copying & Comparison of structures, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions.

Unit-6: Pointers: Introduction, understanding pointers, Accessing the address of variable, Declaring and initializing pointers, accessing a variable through its pointer, Pointer expressions, Pointer increments and scale factor, Pointers and arrays, Pointers & character strings, Pointers & Functions, Function returning multiple values, Pointers and structures.

File Management in C and CONSOLE I/O: Introduction, Defining files and its Operations, Error handling during I/O operations, Random access files, Command line arguments. Types of files, File vs. Console, File structure, File attributes, Standard i/o, Formatted i/o, Sample programs.

Teaching Methodology:

This course is introduced to help students understand the discipline of programming. The programming language used to teach this course is C. Starting from the basic computer architecture, the student will slowly be exposed to program designing and later to programming fundamentals. The entire course is broken down into six separate units, from fundamentals of programming to some complex programming structures like pointers. This theory course is well complemented by a laboratory course under the name Software Development Fundamentals Lab in the same semester that helps a student learn with hand-on experience.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 20-30% from coverage till Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage till Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Software Development Fundamentals (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Programming in ANSI C by E. Balguruswamy, Tata Mc-Graw Hill.

[2] Programming With C, Schaum Series.

Reference Books/Material:

[1] The 'C' programming language by Kernighan and Ritchie, Prentice Hall

[2] Computer Programming in 'C' by V. Rajaraman, Prentice Hall

[3] Programming and Problem Solving by M. Sprankle, Pearson Education

[4] How to solve it by Computer by R.G. Dromey, Pearson Education

Web References:

[1] http://www2.its.strath.ac.uk/courses/c/
Notes on C programming by University of Strathclyde Computer Centre. This tutorial was awarded the NetGuide Gold Award during the 1990s.

[2] http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C_%28programming_language%29.html
This site contains notes on C programming from Princeton University, USA.

These are very useful for students who are learning C as their first programming Language.

[3] http://www.stat.cmu.edu/~hseltman/Computer.html

Online reference material on Computers and Programming from Carnegie Mellon University, Pittsburgh, USA

[4] http://projecteuler.net/
Collection of mathematical problems which make you use your programming skills

Title: Engineering Physics Lab-1 **Code: PH201**
L-T-P scheme:0-0-2 **Credit: 1**

Learning Outcomes

Course Outcome	Description
CO1	Demonstrate ability to collect experimental data and understanding the working procedures within the precautionary limits
CO2	Acquired the ability to analyze the experimental data and related errors in a reflective, iterative and responsive way
CO3	Developed understanding of the basic concepts related to Modern Physics, Basic Solid State Physics and Optics
CO4	Acquired a first hand and independent experience of verifying Kirchoff's circuit laws and related concepts e.g. resistivity, measurement of resistance
CO5	Appreciate the importance of the laboratory work culture and ethics that is intended to impart features like regularity, continuity of self evaluation and honesty of reporting the data

List of Experiments

1. To study the variation of magnetic field along the axis of Helmholtz Galvanometer and to determine its reduction factor.
2. To determine the resistance per unit length of a Carey Foster's bridge and to obtain the specific resistance of a given wire.
3. To determine the wavelengths of spectral lines Red, Green and Violet of mercury using plane transmission grating.
4. To determine the specific rotation of cane sugar solution using Bi-quartz polarimeter.
5. To observe Newton's rings and to determine the wavelength of sodium light.
6. To study the CRO and function generator by producing the following waveforms.
   i. 10kHz, 8Vp-p(sine wave, square wave, triangular wave)
   ii. 4kHz, 6Vp-p(sine wave, square wave, triangular wave)
   iii. 10kHz, 8Vpeak(sine wave, square wave, triangular wave)
   iv. 4kHz, 6V_{peak}(sine wave, square wave, triangular wave)
7. To verify the Kirchhoff's current law.
8. To verify the Kirchhoff's voltage law.

Title: Computer Programming Lab **Code: CS201**
L-T-P scheme: 0-0-4 **Credit: 2**

Prerequisite: Experience in programming is desirable.

Objective:

1. To provide exposure to problem-solving through programming.
2. To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
3. To give the student hands-on experience with the concepts.

Learning Outcomes:

Course Outcome	Description
CO1	Makes students gain a broad perspective about the uses of computers in engineering industry.
CO2	Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.
CO3	Develops the ability to analyze a problem, develop an algorithm to solve it.
CO4	Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.
CO5	Introduces the more advanced features of the C language

Course Content:

The following assignments will be carried out in synchronization with the theory classes.

Unit-1: Introduction to programming Environment (Linux commands, editing tools such as vi editor, sample program entry, compilation and execution). Development of programs using multiple arithmetic and logical operators. Programs for Roots of quadratic equation, conversion of units etc.

Unit-II: Programs using simple control statements such as if else, while, do while etc. Making a program for a calculator for example. Extracting the digits of an integer, reversing digits, finding sum of digits etc.

Unit-III: Programs using For loop, switch statement etc. For example, Finding average of numbers, printing multiplication tables etc. Checking for primes, generation of Armstrong numbers. Generation of the Fibonacci sequence, Finding the square root of a number, calculation of factorials, printing various patterns using for loop. The greatest common divisor of two integers, Raising a number to large power.

Unit-IV: Programs using Arrays: declaring and initializing arrays. Program to do simple operations with arrays. Strings – inputting and outputting strings. Using string functions such as strcat, strlen etc. Writing simple programs for strings without using string functions.Finding the maximum number in a set, Array order reversal, Finding maximum number from an array of numbers Removal of duplicates from an ordered array,

Unit-V: Selection/ Bubble/ Insertion sort, create a linked list, traverse a linked list, insert a node and delete a node form the list. Recursion and related examples such as Tower of Hanoi, computing factorial etc. Practice sessions and sessions for missed labs

Units to Lab Mapping:

Unit	**Labs**
I	1, 2, 3
II	4, 5
III	6, 7, 8
IV	9, 10, 11
V	12, 13, 14

Teaching Methodology:

This course is introduced to help students understand the discipline of programming. The programming language used to teach this course is C. Starting from the programming environment setup, the student will slowly be exposed to program designing and later to programming fundamentals. The entire course is broken down into six separate units, from fundamentals of programming to some complex programming structures like pointers. This theory course is well complemented by a laboratory course under the name Software Development Fundamentals Lab in the same semester that helps a student learn with hand-on experience.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	**Based on Lab Exercises: 1-6**
P-2		15 Marks	**Based on Lab Exercises: 7-13**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Software Development Fundamentals Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

1. Programming in ANSI C by E. Balguruswamy, Tata Mc-Graw Hill.
2. Programming With C, Schaum Series.

Reference Books/Material:

1. The ‘C’ programming language by Kernighan and Ritchie, Prentice Hall
2. Computer Programming in ‘C’ by V. Rajaraman, Prentice Hall

3. Programming and Problem Solving by M. Sprankle, Pearson Education
4. How to solve it by Computer by R.G. Dromey, Pearson Education

Web References:

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   a. Notes on C programming by University of Strathclyde Computer Centre. This tutorial was awarded the NetGuide Gold Award during the 1990s.
2. http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C_%28programming_language%29.html
   a. This site contains notes on C programming from Princeton University, USA. These are very useful for students who are learning C as their first programming Language.
3. http://www.stat.cmu.edu/~hseltman/Computer.html
   a. Online reference material on Computers and Programming from Carnegie Mellon University, Pittsburgh, USA
4. http://projecteuler.net/
   a. Collection of mathematical problems which make you use your programming skills

Title: Workshop Practices **Code: ME201**
L-T-P scheme: 0-0-3 **Credit: 1.5**

Prerequisite: Students must have the knowledge of fundamental principles of Physic and Chemistry upto class 12^{th} which helps them to understand the various process of Workshop Lab.

Objective:

1. To demonstrate students, the basic manufacturing processes of Workshop lab: Carpentry, Fitting, Welding, Machining and Casting Processes.
2. To develop effective skills in students to identify the manufacturing process with its applications
3. To be able to perform basic manufacturing processes safely.

Learning Outcomes:

Course Outcome	Description
CO1	Identify the various processes of manufacturing.
CO2	Capable to explain the use of various holding, measuring, marking and
CO3	Prepare a useful job by performing the various processes in proper
CO4	Apply Bernoulli's theorem to analyze the liquid metal velocity in
CO5	Develop the skills to join two metallic specimen using welding
CO6	Work as a team on a project

Course Content:

Carpentry Shop

1. To study about various tools/equipments used in carpentry shop
2. To make Cross lap /T joint as per given specification
3. To make Cross lap /T joint as per given specification

Foundry Shop

1. To study about various tools used in foundry shop.
2. To prepare a green sand mould with the help of a given pattern.
3. To perform permeability test on moulding sand

Machine Shop

1. To study various machine tools such as lathe, milling, shaper, drilling, grinding, EDM drill and cutting tools used by them.
2. To perform turning, step turning and taper turning operations on lathe machine
3. To perform threading operation on the lathe machine

Fitting Shop

1. To study about various tools used in fitting shop.
2. To make a fitting job as per given drawing.

Welding Shop

1. To study various types of welding processes available in the workshop such as Electric arc welding, TIG and MIG welding, gas welding and spot resistance welding,
2. To prepare welding joint by using Electric arc welding/gas welding
3. To prepare welding joint by using Spot Resistance welding

Teaching Methodology:

This Lab course has been introduced to help a student to learn with hand-on experience on machines. The entire course is broken down into fourteen experiments. Experiments are performed different shop wise by taking the proper safety precautions. Workshop lab includes five shops namely: Carpentry, Foundry, Machining, Fitting and Welding. Basic principles of manufacturing processes are applied to prepare a job. Students learn here how to handle the real world problems by using technical skills. The way of experimentation here realizes the students

that they are now moving on an Engineering path. This Lab course will enable a student to learn with hand-on experience.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	Based on Lab Experiments: 1-7
P-2		15 Marks	Based on Lab Experiments: 8-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Laboratory Manual available in Lab. Study material of Workshop Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:

[1] "Workshop Technology Volume- I & II", B.S. Raghuvanshi, Dhanpat Rai & Co.
[2] "Workshop Technology Volume-I & II", Khanna Publisher.

Reference Books:

[1] "Workshop Technology Vol.- 1, 2, 3 & 4", Butterworth-Heinemann.
[2] "Material Science & Engineering", W. D. Callister, John Wiley

Web References:

- https://nptel.ac.in/courses/112/107/112107219/
- https://nptel.ac.in/courses/112/107/112107144/

Value Added Course-I

Course Title: Engineering Mathematics-2 **Code: MA103**
L-T-P scheme: 3-1-0 **Credits: 4**
Prerequisite: Students should have basic knowledge of differential equations and calculus.
Objective: This course is aimed

- To introduce the fundamental ideas of the functions of complex variables and developing a clear understanding of fundamental concepts of Complex Analysis.

- To equip students with the concepts of ordinary and partial differential equations and how to solve them with different methods.

Learning Outcomes:

Course Outcome	This course will enable the students to:
CO1	Understand the concepts of limit, continuity, differentiability, analyticity, singularities, contour integration, Taylor and Laurent's series expansion of function complex variable.
CO2	Learn various techniques of getting solutions of linear ordinary and partial differential equations of second order,
CO3	Visualize complex numbers as points of $\mathbb{R}^2$, two path test for non-existence of limit, orthogonal trajectories, connected domain, conformal mapping.
CO4	Use Laurent series to evaluate complex integrals and classify the singularities of a function, conformal mapping in modeling and solving boundary value problems, power series method to solve linear differential equations.
CO5	Apply Cauchy residue theorem in evaluation of real integrals and separation of variables method in the solution of heat, wave and Laplace equation
CO6	Formulate mathematical models in the form of ordinary and partial differential equations to problems arising in mechanical, chemical and physical disciplines.

Course Content:

Unit-1: Functions of complex variable, analytical functions and Cauchy-Riemann equations, Conformal mapping, Poles and singularities, complex integration, Taylor's and Laurent's series, Cauchy residue theorem, contour integration and their application.

Unit-2: Second order linear differential equations, Convergence of series, convergence tests, solution of D.E. in series, Bessel functions; Legendre and Chebyshev polynomials, Orthogonality.

Unit-3: Second order partial differential equations and classification, one dimensional wave and diffusion equations with their applications. Laplace and Poisson equations. Use of Green's function.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures, assignments and quizzes in the form of questions will also be given for practice.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	

Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on mathematics-2 will be available on the JUET server.

Books

1. Kreyszig, Erwin : Advanced Engineering Mathematics, John Wiley & Sons, Inc.
2. Simmons, G.F. : Differential Equations with Applications, 2nd Ed., McGrawHill, 1991.
3. Brown, J.W., Churchill, R.V. : Complex Variables and Applications, 6th Ed., McGrawHill, 1996.
4. Prasad, C : a) Mathematics for Engineers
   b) Advanced Mathematics for Engineers, Prasad Mudranalaya, 1982.
5. Grewal, B. S. : Higher Engineering Mathematics, Khanna Publishers Delhi.

Title: Engineering Chemistry **Code: CH101**
L-T-P Scheme:3-1-0 **Credit: 4**

Prerequisite: The students must be aware of basic Chemistry upto class 12^{th}. Basic knowledge of chemistry helps them to correlate in various division of Engineering during this course.

Objective:

The purpose behind this course is to make the students familiar with the concepts of the Chemistry and to understand the significance of Chemistry in various field of the Engineering (Chemical, Mechanical and Civil Engineering).

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in still deep interests in learning chemistry; develop broad and balanced knowledge and understanding of key chemical concepts, principles, and theories related to chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of chemistry.
CO2	Describe the real world problems, challenges with application of the Chemistry in various fields of engineering (Chemical, Mechanical and Civil Engineering).
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in chemistry.
CO4	Identify and use of various analytical techniques in the Chemical, Mechanical and Civil

Engineering project management.

CO5 Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in chemistry and related areas or in multidisciplinary areas that involve chemistry and help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

COURSE CONTENT

Unit 1: Alloys

Purpose of making alloys; Types of alloys; Alloy steels; Light alloys; Cast alloys; Copper alloys; Nickel alloys; Nickel iron alloys; Nickel chromium alloys; Super alloys; Lead alloys; Bearing alloys; Modes of formation of alloys; Preparation of alloys; Treatment of alloys.

Unit 2: Corrosion

Types of corrosion; Dry and wet corrosion; Chemical corrosion; Factors promoting corrosion; Galvanic corrosion; Atmospheric corrosion; Open air corrosion; Water corrosion; Pitting corrosion; Inter granular corrosion; Waterline corrosion; Corrosion fatigue; Prevention of corrosion.

Unit 3 : Protective / Metallic Coatings

Coating processes; Hot dipping; Metal cladding; Electroplating; Displacement or immersion plating; Cementation; Metal spraying or metalized coatings; Organic coating.

Unit 4: Adhesives

Introduction; Classification & preparation of adhesives; Animal glue; other protein adhesives; Starch adhesive; Synthetic resin adhesives; Rubber based adhesives; Cellulose and silicate adhesives; Uses of adhesives.

Unit 5: Paints and Pigments

White pigments; white lead; Characteristics of pigments; Zinc oxide; Physical properties of pigments; Characteristics of pigments; Blue pigments; Ultramarine blue; Cobalt blue and iron blue; Red pigments; Red lead; Yellow pigments; Paints; Distempers; Manufacture; Emulsion paint; Varnishes; Lacquers.

Unit 6: Lubricants

Properties of lubricants; Classification of lubricants; Substances used as lubricants; Additives for lubricating oil; Lubricants of mineral origin; Synthetic lubricants; Lubricating greases; Chemical properties of greases; Selection of lubricants.

Teaching Methodology:

This course comprises 3 lectures and 1 tutorial per week. The course content is divided into 42 lectures and 14 tutorials. The lectures will be conducted in both, white board and PowerPoint presentation, modes. At the end of this course student will be able to understand the significance of the basic Chemistry in various field of engineering such as paints, lubricants, adhesives etc.

Evaluation Scheme:

Exams	Marks	Coverage

Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 (70 %) and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] P.C Jain & M. Jain 'Engineering Chemistry'. Dhanpat Rai & Co.(pvt.) Ltd.
[2] Puri Sharma & Pathania " Physical Chemistry" Vishal Publishing Co. 2002
[3] Puri Sharma & Pathania " Inorganic Chemistry" Vishal Publishing Co. 2002

Reference Book:

[1] Shashi Chawala 'Theory and Practical of Engineering Chemistry'. Dhanpat Rai & co.(pvt.) Ltd.
[2] S.S. Dara "A Text book of Engineering Chemistry". S.Chand & Company Ltd. 2008

Title: Basic Electrical and Electronics **Code: EC102**
L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite: Not Applicable

Objective:

1. To learn the basic concepts of electrical engineering.
2. To analyze the various electrical circuit with the help of practical.

Learning Outcomes:

Course Outcome	Description
CO1	Be aware of basic essentials of electrical circuit
CO2	Apply theorems for finding the solutions of network problems
CO3	Analysis the behavior of direct current transients
CO4	Realize the performance of two port network parameters
CO5	Be familiar with the role of alternating current in home and industry

CO6	Evaluate the performance of various alternating current circuits

Course Content:

Unit I: Basic Electrical Circuit: Electromotive Force , Terminal Voltage; Resistance (R), Inductance (L) and Capacitance (C) from (i) Circuit, (ii) Energy, and (iii) Geometrical Points of View; Voltage Divider, Current Divider; Star-Delta Transformation; Voltage Source and Current Source, Source Transformation, Combination of Sources; Controlled (Dependent) Sources.

Unit II: Network Analysis and Network Theorems: Kichhoff's Circuit Law (KCL), Kichhoff's Voltage Law (KVL), Loop-Current Analysis, Mesh Analysis, Node-Voltage Analysis, Choices of Method of Analysis. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Millman's Theorem, Reciprocity Theorem.

Unit III: DC Transients: Simple RL Circuit, Time Constant, Decay and Growth of Current; Simple RC Circuit, Discharging of a Capacitor, Charging of a Capacitor.

Unit IV: Two Port Networks: Impedance parameters, Admittance parameters, Hybrid parameters, Equivalent circuits of all the parameters, Symmetry and Reciprocity conditions.

Unit V: Alternating Voltage and Current: Physical Model for a Sinusoid, Phase and Phase Difference; Average Value, Effective Value, Form Factor and Peak Factor; Concept of Phasors, Addition of Phasors Using Complex Numbers; Non sinusoidal Waveforms; Power and Power Factor; Behaviour of *R*, *L* and *C* in AC Circuits.

Unit VI: AC Circuits: Series RL Circuit, Complex Impedance; Series RC Circuit, Complex Power; Parallel RL Circuit; Parallel RC Circuit; Series RLC Circuit and its Phasor Diagram; Parallel RLC Circuit and its Phasor Diagram, Q factor, Resonance in series parallel RLC circuits.

Teaching Methodology:

This course is introduced to help students for understanding the basic concept of electricl engineering. Initially an overview of basic terminology of electrical circuit along with various component needed for circuits will be discussed briefly. In the first part, Direct Current (DC) related issued are elaborated through various theorems. Later on DC transient is evaluated on various circuits. In the second part, Alternating Current (AC) is described by different parameters and phasor diagrams. At the end, ac circuits and resonance condition has been evaluated.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15	Based on Unit-1 & Unit-2
Test-2	25	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10	Based on all Units
Tutorials	5	Based on all Units
Quiz	5	Based on all Units
Attendance	5	Based on attendance in the theory classes
Total	**100**	

Learning Resources:

Tutorials and lecture slides on theory course will be added from time to time and a digital copy of study material will be available on the JUET server.

Text Books:

[1] "Basic Electrical Engineering", D.C. Kulshreshtha, McGraw Hill Education, 2009.
[2] "Engineering Circuit Analysis", W.H. Hayt, J. E. Kemerlay and S.M. Durbin, 6th edition, McGraw Hill, 2006.
[3] "Introduction to Electric Circuits", R.C. Dorf & J.A. Svoboda, John Wiley, 2004.

Reference Books:

1. "Network Analysis", V. Valkenburg, Prentice-Hall India Ltd., 2001.
2. "Basic Electrical Engineering", A. Chakrabarti, S. Nath, C. K.Chanda, Tata McGraw Hill Publishing Co, 2008.
3. "Principles of Electrical Engineering", V. D. Toro, Prentice Hall of India.

Web References:

[1] https://www.rapidtables.com/electric/index.html
[2] https://library.automationdirect.com/basic-electrical-theory/

Journals References:

[1] International Journal of Circuit Theory and Application Wiley publication
[2] International Journal of Circuits and Electronics

Title: Engineering Mechanics **Code: ME101**
L-T-P scheme: 3-1-0 **Credit: 4**
Prerequisite: Students must have already studied courses, "Basic Mathematics" and "Physics"
Objective:

4. Enable students to apply their knowledge of mathematics, science, and engineering in order to expand this knowledge into the vast area of "Rigid Body Mechanics".
5. To enhance students' ability to design by framing the solution of open ended problems.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the various laws of mechanics
CO2	Describe the equivalent force systems
CO3	Develop the equations of equilibrium for various force systems
CO4	Identify and use various methods for analyzing the forces in machines and structures
CO5	Apply concepts of kinematics and kinetics of particles to analyze practical problems.
CO6	Demonstrate and deployment basic knowledge of engineering mechanics for solving real-world problems

Course Content:

Unit-1: Introduction: Idealization of mechanics, Concept of rigid body, External forces (body forces & surface forces), Laws of mechanics.

Unit-2:Force Systems and Equilibrium: Introduction to vector, Statically equivalent force systems (planar and spatial), Free body diagram, Equations of equilibrium and their applications to various system of forces, Variational mechanics.

Unit-3: Structures and Machines: Plane trusses, Space trusses, Method of joints, Method of section, Graphical method, Frames and machines.

Unit-4: Distributed Forces and Moment of Inertia: Centroid of composite figures, Area moment of inertia, Mass moment of inertia, Principal axes and principal moment of inertia.

Unit-5:Friction: Introduction of friction, Laws of friction, Wedge, Screw, Belt, and Rolling friction.

Unit-6:Beams: Different support & loading conditions of Beam, Shear force diagram (SFD), Bending moment diagram (BMD).

Unit-7:Kinematics and Kinetics of Rigid Bodies: Velocity and acceleration, Rotation of rigid bodies, Rolling motion, Plane motion of rigid bodies, Effective forces on a rigid body, D'Alembert's principle, Force, Mass and Acceleration, Work and energy, Impulse and momentum.

Teaching Methodology:

This course is introduced to help students in applying their knowledge of mathematics, science and engineering in order to explore the vast area of rigid body mechanics and to enhance students' ability to design machines and mechanisms by framing the solution of open ended problems. The entire course is divided into seven separate units: Introduction, Force Systems and Equilibrium, Structures and Machines, Distributed Forces and Moment of Inertia, Friction, Beams and Kinematics and Kinetics of Rigid Bodies. These sections have been framed to impart a systematic understanding of the basic laws of forces, static and dynamic equilibrium conditions and finally implement these laws to solve the real-world problems. This theory course is well complemented by a laboratory course under the name Engineering Mechanics Lab in the same semester. This Lab course will enable a student to learn with hand-on experience.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2 and Unit-3
Test-2	25 Marks	Based on Unit-4, Unit-5, Unit-6 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Engineering Mechanics (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Engineering Mechanics Vol. I-Statics, by J. L. Meriam and L.G. Kraige, John Wiley & Sons Inc. 6th Edition.

[2] Engineering Mechanics Vol. II-Dynamics, by J. L. Meriam and L.G. Kraige, John Wiley & Sons Inc. 6th Edition.

Reference Books/Material:

[1] Engineering Mechanics: Statics and Dynamics, Hibbeler, R.C. (2007), Pearson Prentice Hall, Upper Saddle River, NJ, 13th Edition.

[2] Engineering Mechanics, S.Timoshenko, D.H.Young, McGraw Hill Book Co.

Web References:

- https://nptel.ac.in/courses/112103109/
- https://ocw.mit.edu/courses/mechanical-engineering/2-003sc-engineering-dynamics-fall-2011/
- https://freevideolectures.com/course/2264/engineering-mechanics
- https://www.coursera.org/learn/engineering-mechanics-statics-2

Journals References:

- Journal of Engineering Mechanics - ASCE
- Mechanical Engineering & Mechanics, Springer
- International Journal for Theoretical and Applied Mechanics, Association for Engineering Mechanics
- Probabilistic Engineering Mechanics, Elsevier
- International Journal of Mechanics and Materials in Design, Springer
- Journal of Engineering Mechanics and Machinery, Clausius Scientific Press

Title: Engineering Chemistry Lab **Code: CH201**
L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: The students must be aware of basic Chemistry Experiment upto class 12^{th}. Basic knowledge of chemistry helps them to correlate in various division of Engineering during this lab.

Objective:

The purpose behind this course is to make the students familiar with the concepts of the Chemistry Experiment and to understand the significance of Chemistry in various field of the Engineering (Chemical, Mechanical and Civil Engineering).

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in still deep interests in learning chemistry; develop broad and balanced knowledge and understanding of key chemical concepts, principles, and theories related to chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of chemistry.
CO2	Describe the real world problems, challenges with application of the Chemistry in various fields of engineering (Chemical, Mechanical and Civil Engineering).
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in chemistry.
CO4	Identify and use of various analytical techniques in the Chemical, Mechanical and Civil Engineering project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in chemistry and related areas or in multidisciplinary areas that involve chemistry and help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

LIST OF EXPERIMENT

1. To determine the dissolve oxygen (DO) in the given water samples.
2. To determine the pH and conductivity of the given water samples.
3. To determine the relative viscosity of given unknown liquids.
4. To determine the relative surface tension of the given unknown liquid.
5. To determine the equivalence point by using pH metric titration of strong acid and weak base.
6. To determine the alkalinity of a given water sample.
7. Determination of total hardness of water by complexmetric titration using EDTA.
8. To find out the strength of unknown solution of oxalic acid & sodium hydroxide with the help of N/20 oxalic acid solution by double titration.
9. Confirmation of hetro-elements e.g. N, S, Cl, Br and I by Lassaigne's test.
10. Detection of functional groups e.g. aldehyde, alcohol, carboxylic and ketone in the given organic compound.
11. To prepare urea formaldehyde resin by condensation reaction. (Bakelite).
12. Evaluation of physical properties of oils e.g. saponification value and acid value.
13. Separation of pigments/colored ions by paper/column chromatography.
14. Separation of parameter by using TLC.

Teaching Methodology:

This course planned in 14 lab experiment and each experiment having 2 hours practical exposure in Chemistry lab. Their continuous evaluation will be performed in each week and weightage given during finalizing of the grade sheet. At the end of this course student will be able to: Understand the significance of the basic Chemistry in various field of engineering.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-7
P-2		15 Marks	Based on Lab Exercises: 8-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		100 Marks	

Learning Resources:
Study material of Web Technology Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book

1. Organic Chemistry Lab Technique, Lisa Nichols Publisher, by Lisa Nichols, Butte Community College.
2. Practical Chemistry Labs, by Leonard Saland, **Manufacturer:** Walch Education 015116

Reference Book

1. Green Chemistry, by Sally A. Henrie, CRC Press Published March 18, 2015.
2. Drinking Water Chemistry: A Laboratory Manual by Barbara Hauser, CRC Press Published August 21, 2001.

Title: Basic Electrical and Electronics Lab **Code: EC202**
L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Not applicable

Objective:

3. To analyze the various dc network theorem.
4. To learn the ac fundamental concepts.

Learning Outcomes: In reference to Electrical Circuit Analysis (18B11EC212), the students will be able to:

Course Outcome	Description
CO1	Be aware of basic laws of electrical circuit
CO2	Apply theorems for finding the solutions of network problems
CO3	Calculate the power from electrical circuits
CO4	Analysis the behavior of direct current transients
CO5	Realize the performance of two port network parameters
CO6	Evaluate the performance of various alternating current circuits

Course Content:

Unit-1; Lab exercises based on basic law's of electrical circuits
Unit-2; Lab exercises based on various dc theorems such as superposition, Thevenin's
Unit-3; Lab exercises based on power calculation with the help of maximum power transfer
Unit-4; Lab exercises based on transient analysis of electrical circuits
Unit-5; Lab exercises based on different two-port network
Unit-6; Lab exercises based on ac fundamental circuits

Teaching Methodology:

This lab course is introduced to help students for understanding the basic concept of electrical engineering. Initially an overview of basic terminology of electrical circuit along with various component needed for circuits will be discussed briefly. In the first part, Direct Current (DC) related issued are elaborated through various theorems. Later on DC transient is evaluated on various circuits. In the second part, Alternating Current (AC) is described by different parameters and phasor diagrams. At the end, ac circuits and resonance condition has been evaluated.

Evaluation Scheme:

Exams	Marks		Coverage
P-1	15 Marks		**Based on Lab Exercises: 1-7**
P-2	15 Marks		**Based on Lab Exercises: 8-14**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Electrical Circuit Analysis Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:

[4] "Basic Electrical Engineering", D.C. Kulshreshtha, McGraw Hill Education, 2009.
[5] "Engineering Circuit Analysis", W.H. Hayt, J. E. Kemerlay and S.M. Durbin, 6th edition, McGraw Hill, 2006.
[6] "Introduction to Electric Circuits", R.C. Dorf & J.A. Svoboda, John Wiley, 2004.

Reference Books:

4. "Network Analysis", V. Valkenburg, Prentice-Hall India Ltd., 2001.
5. "Basic Electrical Engineering", A. Chakrabarti, S. Nath, C. K.Chanda, Tata McGraw Hill Publishing Co, 2008.
6. "Principles of Electrical Engineering", V. D. Toro, Prentice Hall of India.

Web References:

[3] https://www.rapidtables.com/electric/index.html
[4] https://library.automationdirect.com/basic-electrical-theory/

Journals References:

[3] International Journal of Circuit Theory and Application Wiley publication
[4] International Journal of Circuits and Electronics

Title: Engineering Mechanics Lab **Code:ME202**
L-T-P scheme: 0-0-2 **Credit: 1**
Prerequisite: Students must have already studied the course, "Engineering Mechanics"
Objective:

1. To demonstrate students, the basic principles of Engineering Mechanics: Statics and Dynamics.
2. To develop effective skills in students to observe experimental data and to analyze the results.

Learning Outcomes:

Course Outcome	Description
CO1	Verify the various laws of mechanics
CO2	Determine mechanical advantage, velocity ratio and efficiency of various lifting machines
CO3	Evaluate co-efficient of friction between two mating surfaces
CO4	Estimate the forces in machines and structures
CO5	Apply concepts of kinematics and kinetics of particles to analyze practical problems.
CO6	Work as a team on a project

Course Content:

Experiment-1: To verify the triangle law of forces

Experiment-2: To verify the parallelogram law of forces

Experiment-3: To verify the polygon law of forces

Experiment-4: To verify Lami's theorem

Experiment-5: To determine the co-efficient of friction between wood and other surfaces

Experiment-6: To find the moment of inertia of flywheel

Experiment-7: To determine the mechanical advantage, velocity ratio and efficiency of a screw jack

Experiment-8: To determine the mechanical advantage, velocity ratio and efficiency of Worm and Wheel

Experiment-9: To determine the mechanical advantage, velocity ratio and efficiency of the Winch Crab

Experiment-10: To find the forces in a member of a Triangular Truss

Experiment-11: To find the forces in a member of a Warren Truss

Experiment-12: To find the forces in a member of a Pratt Truss

Experiment-13: To find the forces in a member of a Joint Roof Truss

Teaching Methodology:

This Lab course has been introduced to help a student to learn with hand-on experience on machines. The entire course is broken down into thirteen experiments. Each experiment includes engineering mechanics principles applied to various machines in order to help a student gain more experience as Mechanical Engineer. This lab course is well complemented by a theory course under the name Engineering Mechanics in the same semester in order to enable the student to get acquainted, learn and discuss the technical details of the underlying principles of mechanics and mechanisms in machines and structures. This Lab course will enable a student to learn with hand-on experience.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	**Based on Lab Exercises: 1-7**
P-2		15 Marks	**Based on Lab Exercises: 8-13**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Laboratory Manual available in Lab. Study material of Engineering Mechanics Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Engineering Mechanics Vol. I-Statics, by J. L. Meriam and L.G. Kraige, John Wiley & Sons Inc. 6th Edition.

[2] Engineering Mechanics Vol. II-Dynamics, by J. L. Meriam and L.G. Kraige, John Wiley & Sons Inc. 6th Edition.

Reference Books/Material:

[1] Engineering Mechanics: Statics and Dynamics, Hibbeler, R.C. (2007), Pearson Prentice Hall, Upper Saddle River, NJ, 13th Edition.

[2] Engineering Mechanics, S.Timoshenko, D.H.Young, McGraw Hill Book Co.

Web References:

[1] https://nptel.ac.in/courses/112103109/

[2] https://ocw.mit.edu/courses/mechanical-engineering/2-003sc-engineering-dynamics-fall-2011/

[3] https://freevideolectures.com/course/2264/engineering-mechanics

[4] https://www.coursera.org/learn/engineering-mechanics-statics-2

Journals References:

[1] Journal of Engineering Mechanics - ASCE

[2] Mechanical Engineering & Mechanics, Springer

[3] International Journal for Theoretical and Applied Mechanics, Association for Engineering Mechanics

[4] Probabilistic Engineering Mechanics, Elsevier

[5] International Journal of Mechanics and Materials in Design, Springer

[6] Journal of Engineering Mechanics and Machinery, Clausius Scientific Press

Title: Engineering Drawing & Design Lab **Code:ME203**

Course Outcome	Description
CO1	Outline the objectives of scale and develop the imagination and mental visualization capabilities for correlating the geometrical details of objects.
CO2	To develop the constructional ability for a different curve.
CO3	ToDescribe BIS rules for orthogonal projection andunderstand the fundamental concept of orthogonal projection for point, line, plane and solids.
CO4	Understand and apply orthogonal projection for solids, section and intersection of solid objects/structures
CO5	To apply the skill of development of surfaces of three dimensional objects for evaluation of black size of the components.

L-T-P scheme: 0-0-3 **Credits: 1.5**

OBJECTIVE

[1] Enables students to learn the concepts of graphic communication, their role in sanitary construction.

[2] Make familiar with different drawing equipment, technical standards and procedures for construction of geometric figures.

[3] Equipped with the skill that enables them to convert pictorial to orthogonal representations.

CO6	Demonstrate computer aided drafting tools and techniques using CAD software's

Course Content:

Unit-1: Study and construction of lines, lettering, dimensioning, plane scales, diagonal scales, construction of different methods used for the construction of conic curves.
Unit-2: Study and construction of geometrical construction, cycloidal curves, involutes and helix etc.
Unit-3: Orthogonal projection of point in all possible positions, Study and construction of projection of line and its applications (inclined to both planes), and projection of planes (inclined to both planes).

Unit-4: Study and construction of projection of solids (right circular cone, prism, pyramid and cylinders), and true shape of sections,
Unit-5: Study and construction of oblique projection and development of surface, isometric view using orthogonal projection on isometric scales.

Unit-6: Introduction to basic and editing command of CAD software, 2-D drafting, surface modeling, and 3-D geometrical model.

Teaching Methodology:
This course is introduced to build the imagination and established the correlation between the real object and engineering drawing and CAD developed by the design engineers and the requirement of the production engineers of the different units.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	**Based on Lab Exercises: 1-7**
P-2		15 Marks	**Based on Lab Exercises: 8-14**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
The study material of engineering drawing & design lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

1. Bhatt, N.D., Engineering Drawing,

Reference Books:

2. Gill, PS, A Text Book of Engineering Drawing (Geometrical Drawing)
3. Dhananjay A J, Engineering Drawing with an introduction to Auto CAD, Mc Graw Hill

Title: Basic Thermodynamics **Code:ME102**
L-T-P scheme:3-1-0 **Credit: 4**

Prerequisite: Students must have already studied courses, "*Partial Differential Equations*".

Objective:

1. To learn Basic principles and equations of fluid mechanics so that intuitive understanding of subject can be developed.
2. He will study numerous and diverse real-world engineering examples, so that his understanding of fluid mechanics principles strengthens more.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the concepts of system (open and closed), thermodynamic properties and equilibrium, work and heat.
CO2	Apply the laws of thermodynamics real life problems like refrigeration, engines, compressors, turbines, nozzles etc.
CO3	Understand the properties of pure substances and can evaluate Rankine cycle.
CO4	Describe the concept of available energy along with the development of Maxwell's and thermodynamic relations of gas mixtures.
CO5	Identify air standard cycles applied in real engines.
CO6	Describe the basic concept of Heat transfer & VCS and solve real life problem

Course Content:

Unit-1:BASIC CONCEPTS: Macroscopic and microscopic approaches, Property, Equilibrium, State, Process, Quasi-static processes, Cycle, Laws of thermodynamics, Steady and unsteady flow processes.

Unit-2: FIRST LAW OF THERMODYNAMICS: Energy and its forms, Energy and first law of thermodynamics, Boundary work, Work done in different processes, Specific heat, Internal energy and enthalpy, PMMI, Steady flow energy equation, First law applied to non- flow process, flow process (steady and unsteady).

Unit-3:SECOND LAW OF THERMODYNAMICS AND EXERGY: Limitations of first law, Thermal reservoir, Heat source and heat sink, Heat engine, Refrigerator and heat pump, Kelvin - Planck and Clausius Statements and their equivalence, Carnot's theorem, Carnot's cycle,

Entropy, Entropy change for ideal gas, T-S diagrams, Availability and irreversibility, Loss of available energy, Dead state of a system, Availability of a non-flow and steady flow system, Helmholtz and Gibb's functions.

Unit-4: PURE SUBSTANCE, AIR-STANDARD CYCLES & THERMODYNAMICS RELATIONS : Phase and phase transformation, Saturated and superheat steam, Solid – liquid – vapour equilibrium, T-V, P-V and P-T Plots during steam formation, Property changes during steam processes, Throttling and measurement of dryness fraction of steam, Two stroke and four stroke engines, Otto cycle, Diesel cycle, Brayton cycle, PVT relationship, Mixture of ideal gases, Properties of mixture of ideal gases, T-ds relations, Maxwell equations, Joule-Thomson coefficient, Clapeyron equation.

Unit-5: BASIC HEAT TRANSFER MECHANISM: Definition of Heat Transfer, Modes of heat flow, Combined heat transfer system and law of energy conservation, Steady state heat conduction through a plane wall, cylinder and sphere, Conduction with heat generation, Basic mechanism of convection (free and forced), The Stephen-Boltzmann law, The black body radiation.

Unit-6: **REFRIGERATION AND REFRIGERANTS:** Refrigeration & air conditioning, Refrigerants and their Classification, Carnot refrigeration cycle, Brayton refrigeration or the Bell Coleman air refrigeration cycle, Simple vapour compression (VC) refrigeration systems-Limitations of reversed carnot cycle with vapour as the refrigerant, Analysis of VC cycle, Effects of operating conditions on COP.

Teaching Methodology: This course is one of the foundation course in the Mechanical discipline. The knowledge gained in this course will help the student to understand not only the industrial processes but, they will also be able to do some small applied research. The course is divided into six units which have to be followed one after the other i.e. no unit should be skipped. This course has to discussed in great depth as, it covers a very large part of GATE and ESE examinations syllabus. After every broader topic an assignment will be given to students which has to submitted in due time. In tutorials the students will work collectively to understand the concepts with the help of practical problems.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	

Total	100 Marks

Learning Resources:

Tutorials and assignments on Basic Thermodynamics (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1]"Engineering Thermodynamics", P. K. Nag , Tata McGraw Hill.
[2]"Refrigeration and Air conditioning", C. P. Arora, Tata McGraw Hill.
[3]"Fundamentals of Heat and Mass transfer", P. F. Incropera and D. P. DeWitt, Wiley

Reference Books/Material:

[1] "Introduction to Thermodynamics", D. C. Spanner, Academic Press
[2] "Principle of Engineering Thermodynamics", Moran, Shapiro, Boettner, Bailey, whiley.
[3] "Heat Transfer", P. S. Ghoshdastidar, Oxford.
[4] "Engineering thermodynamics", E. Fermi, Dover book
[5] "Engineering Thermodynamics", Y. A. Cengel, Cimbala, Tata McGraw Hill.

Web References:

- pdumka.blogspot.com/
- www.youtube.com/channel/UCgY8X2rJciN3DvIHp0ysNKg

Title: Strength of materials **Code: ME103**
L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have already studied courses, "Engineering Mechanics".

Objective:

1. To learn and be able to analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
2. To learn and be able to perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts.

Learning Outcomes:

Course Outcome	Description
CO1	Understand statically determinate and indeterminate problems.
CO2	Determine the resistance and deformation in structural members subjected to various loading.

CO3	Apply knowledge of materials and structural elements to the analysis of simple structures.
CO4	Undertake problem identification, formulation and solution using a range of analytical methods.
CO5	Evaluate principal stresses, strains and apply the concept of failure theories for design.
CO6	Analyze and design thin, thick cylinders and springs.

Course Content:

Unit-1: Simple Stresses & Strains: Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

Unit-2: Shear Force and Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

Unit-3: Bending and shear stress in beams: Bending of beams with symmetric cross-section, shearing stress variation in beam cross-section (shear centre and plastic analysis not to be discussed)

Unit-4: Torsion of shafts: Torsion of solid and hollow circular shafts and thin-walled tubes (plastic analysis and rectangular shafts not to be discussed), shaft in series and parallel.

Unit-5: Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain. Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures.

Unit-6: Deflection of beams: Deflection of beams, deflection by Double Integration, Macaulay's method, Moment area method, Castigliano's theorem.

Unit-7: Columns and Struts: Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipment's and machines.

Unit-8: Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Unit-9: Principal stresses and strains: Analysis of biaxial state of stress with and without shear stress. Mohr's circle.

Teaching methodology:

The aim of introducing this course is to give aexposure to the students on the important and fundamental concept in the extensive area of Materials and its behavior under different loading

conditions. The concepts, ideas and techniques developed in SOM are indispensable in machine and structural design. The main focus of this course is to introduce fundamental concepts in SOM with special emphasis on practical problems.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 &Unit-2
Test-2	25 Marks	Based on Unit-3, Unit-4& Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6 to Unit-9 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and referred video lecture on Strength of materials is available on JUET server.

Text Book:

1. "Mechanics of materials"; Timoshenko and Gere, CBS Publishers. 2011.
2. "Engineering Mechanics of Solids"; E.P.Popov, PHI,2009
3. "Mechanics of materials"; B. C. Punamia.and A.K. Jain, Laxmi publication.

Reference Books:

1. Nag and Chanda, Fundamentals of Strength of Materials, Wiley India.
2. Bansal R.K., Strength of Materials, Laxmi Publications.
3. Gere J. M., Mechanics of Materials, Thomson Press.
4. Pytel A. and kiusalaas J., Mechanics of Materials, Thomson Press.
5. Hearn E. J., Mechanics of Material Vol. I & II, Butterworth-Heinemann Publication.
6. Bedi D. S., Strength of Materials, S. Chand & Co. Ltd

Title: Manufacturing Technology **Code:**

L-T-P scheme:3-1-0 **Credit: 4**

Prerequisite: It is a foundation course of manufacturing.

Objective:

1. To understand basic manufacturing processes like casting, welding and metal forming
2. To learn various aspects of different manufacturing techniques such as various casting methods, welding methods and metal forming methods
3. To decide which manufacturing technology can be implemented for a specific product

Learning Outcomes:

CO1	Outline various manufacturing processes such as metal casting, welding and metal forming and their types
CO2	Describe various casting, welding and metal forming techniques
CO3	Develop the knowledge of casting, welding and metal forming processes and their

	practical use
CO4	Identify and use the proper technique required for the production process of any metallic product
CO5	Apply various manufacturing processes as per the requirement of the product
CO6	Demonstrate the practical exposure of casting, welding and metal forming

Course Content

Unit 1: Casting:

Introduction to Casting: Requirements of casting, Basic principle of casting

Sand Moulding and Core Making: Pattern materials, Pattern types, Allowances on pattern Types and properties of moulding sand, Sand conditioning, Sand moulding methods and types, Types of core, Core sand and core making, Moulding and core making machines, Special Sand Moulding Processes(based on sodium silicate and organic binders), Investment casting, Full mould casting, Plaster moulding, Vacuum moulding, VRH process

Permanent Mould Casting and Other Casting Methods: Permanent mould casting, Pressure die casting, Low pressure die casting, Squeeze casting, Centrifugal casting, Continuous casting.

Gating System design, Melting, Pouring and Shakeout : Requirement of gating system and risers in casting, Components of gating system, Types of gates and risers, Design of gating system and riser, Use of chaplets, chills, pads and exothermic materials in sand casting, Various melting furnaces, Solidification of casting (nucleation and grain growth), Casting shakeout, Casting defects and their remedy.

Unit 2: Welding:

Introduction to Welding: Requirement of welding, Classification of welding

Gas Welding and Allied Process: Gas welding, Gas cutting, Brazing

Arc Welding: Welding arc, Power source for arc welding, Arc welding consumables, Metal transfer in arc welding, Principles, setup, metallurgy, position, variants and application of different arc welding techniques: SMAW, SAW, GTAW, GMAW, Electroslag welding

Other Welding Techniques: Resistance welding, Friction welding, Thermit welding, Cold pressure welding.

Unit 3: Metal Forming Processes:

Bulk metal deforming: Elastic and plastic deformation, Yield and flow criteria, Concept of strain hardening, Hot and cold working, classification of metal deforming processes -rolling, forging, extrusion, wire and tube drawing. Machine and equipments for the metal deforming processes, Parameters and force calculations for different processes.

Sheet metal deforming and cutting: Role of sheet components, Shearing mechanism, Various press working operations. Presses for sheet metal working; Part feeding systems; Elements of die, punch and die clearances, Progressive, compound and combination dies; Forming processes like bending, cup drawing, coining, embossing, etc.

Teaching Methodology:

In foundry technology the student will have a broad knowledge of sand casting: Pattern making: requirement of pattern materials, different pattern materials and designing of the pattern; Moulding and core making: Moulding sand, sand conditioning, moulding and core making processes and machines and special moulding methods; permanent mould casting: requirement of permanent mould casting, design requirement of permanent moulds and types of permanent mould casting; designing of gating system and risers, cupola furnace and defects in metal casting.

In welding technology students will have a generalized knowledge on various welding technology used in manufacturing. They are going learn about arc welding processes, resistance welding, gas welding and brazing processes. In arc welding they are going to learn about the welding arc, arc welding power source, arc welding consumables and metal transfer. Also they are going to learn about shielded metal arc welding, submersed arc welding, gas tungsten arc welding, gas metal arc welding, electro-slag welding, electro-gas welding, resistance welding, oxy-acetylene welding and brazing processes.
In metal forming processes the students will have knowledge on stress and strain analysis and various yielding methods to understand the analysis of metal forming processes. They will have knowledge on classification of different metal forming processes and analysis on metal forging, metal rolling, metal drawing, metal extrusion, sheet metal bending and sheet metal deep drawing processes. In each process they will also learn about the machines used, the processes to be followed, defects in them and their remedies.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit 1
Test-2	25 Marks	Based on Unit 2 and Unit 1 (20%)
Test-3	35 Marks	Based on Unit 3, Unit 2 (15%) and Unit 1 (15%)
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials on manufacturing technology 1 (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Jain P L, Principles Foundry Technology, Tata McGraw Hill
2. Parmar R.S., Welding Process and Technology, Khanna Publishers.
3. Kumar Surendra, Technology of Matal Forming Processes, Prentice Hall of India

References Books/Materials:

1. Pandey P. C. and Singh C. K., Production Engineering Sciences, Standard Publisher.
2. Jain R.K., Production Technology, Khanna Publisher.
3. Kalpakjian S., Schemid S., Manufacturing, Engineering and Technology, Addison Wesley.
4. De Garmo, E. P., Black, J. T. and Kohser, R.A., Materials and Processes in Manufacturing, Prentice Hall of India Pvt. Ltd.
5. Rao P. N., Manufacturing Technology I, Tata McGraw Hill.
6. Ghosh A. and Mallik A. K., Manufacturing Science, EWP Pvt. Ltd.

Web References:

1. www.youtube.com/user/nptelhrd

Journals References:

1. *Journal of Manufacturing Science and Engineering*
2. Journal of Manufacturing Processes

Title: Managerial Economics (Value Added Course-II) **Code: HS102**
L-T-P scheme: 2-1-0 **Credit: 3**

Prerequisite: None

Objectives:

1. The course is concerned with the application of economic principles and methodologies to key management decisions within organizations.
2. It provides principles to foster the goals of the organization, as well as a better understanding of the external business environment in which an organization operates.
3. It is fundamentally a unique way of thinking about problems, issues and decisions that managers face in each of the functional areas of the organization as well as the strategic ones faced by general managers.

Learning Outcomes:

Course Outcome	Description
CO1	Outline what managerial economics is and how micro and macro economics differ from each other.
CO2	Describe basic concepts & elasticities of demand.
CO3	Develop an understanding of factors of production.
CO4	Identify different types of cost.
CO5	Apply logic to understand different market structures viz Perfect Competition; Monopoly; Monopolistic Competition; and Oligopoly.
CO6	Deploy and be proficient in contribution and break even analysis

Course Content :

Unit-1 : Introduction to Managerial Economics & Macro-economic Concepts: Definition of Economics, Meaning & Scope of Managerial Economics, Micro & Macro Economics concepts – National income, GDP, Inflation, Monetary Policy, Fiscal Policy, SLR, CRR, Concept of economic profit, Opportunity Cost, Discounting principle, time value of money, Equi marginal utility

Unit-2 : Demand Analysis: Law of demand**,** Individual & market demand, Determinants of market demand, Marginal Utility theory, Elasticity of demand – Price, Income, Cross, Advertising ,Theory of Consumer choice using Indifference Curve analysis, Demand forecasting techniques – Delphi , Survey , Time series analysis, Correlation, Regression analysis

Unit-3: Production Theory and Analysis: Production with one variable, optimal employment of a factor of production, Cobb Douglas production function, Productionwith two variable inputs, Production Isoquants, Production Isocosts, Optimal employment of two inputs, the expansion path, Basics of Supply, Market Equilibrium

Unit-4: Cost Theory and Analysis : Cost concepts – Opportunity, Explicit, Marginal, Incremental and Sunk, Relation between Production & Cost, Short run cost function, Long run cost function, Special topics -Profit contribution analysis, Break Even analysis

Unit-5 :Pricing under Different Market Structures : Perfect Competition - Determination of Price output relationship in short run, long run, Monopoly - Determination of Price output relationship in short run & long run , Price discrimination, Monopolistic Competition - Determination of Price output relationship in short run & long run , Product Differentiation ,Oligopoly -Types ,Determination of Price output relationship ,Kinky demand curve {Stickiness of Price},Price leadership model, Collusive and Non Collusive Oligopoly

Teaching Methodology:

Teaching methodology in this course involves classroom lectures as well tutorials. The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention. In tutorials, the teacher will be keeping track of each student's progress and address her/his individual difficulties. Written assignments and projects submitted by students as part of the course will also discussed in tutorials.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Reference Books/Material:

[1] Osborne, M. (2004), An introduction to game theory. Oxford University Press.
[2] Snyder, C., Nicholson, W. (2010), Fundamentals of microeconomics. Cengage Learning.
[3] Varian, H. (2010), Intermediate microeconomics: A modern approach, 8th ed. W. W. Norton.
[4] Bergstrom, T., Varian, H. (2014),Workouts in intermediate microeconomics. W. W. Norton
[5] Bernheim, B., Whinston, M. (2009). Microeconomics. Tata McGraw-Hill.
[6] Mankiw, N. (2007). Economics: Principles and applications, 4th ed. Cengage Learning.
[7] Snyder, C., Nicholson, W. (2010). Fundamentals of microeconomics. Cengage Learning.

Title: Basic Thermodynamics Lab **Code: ME207**
L-T-P scheme:0-0-1 **Credit: 1**

Prerequisite: Students should be studying "Basic Thermodynamics"

Objective:

1. To learn and be able to measure flow, velocity, and losses in open and closed channel flows.
2. To develop the abilities to understand the flow behavior and its impacts on industrial and daily life precesses.

Learning Outcomes:

Course Outcome	Description
CO1	Identify the working and construction of 2 and 4 stroke Petrol and Diesel engines.
CO2	Describe the working and construction of water tube and fire tube boilers along with the knowledge of modern boilers
CO3	Develop the magnitude of dryness fraction of wet steam
CO4	Understand the working and construction of refrigerator and air conditioner along with its COP calculations.
CO5	Calculate the thermal conductivity of given sold and liquid.
CO6	Able to calculate the numerical value of Stefan-Boltzmann constant.

Course Content:

Experiment-1: Study of simple vertical, Locomotive, Babcock Wilcox Boiler.
Experiment-2: Study of two stroke Petrol and Diesel Engine.
Experiment-3: Study of four stroke Petrol and Diesel engine.
Experiment-4: To determine the dryness fraction by separating calorimeter.
Experiment-5: To determine different efficiencies and performance of a double acting reciprocating compressor
Experiment-6: To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-H and T-S diagrams.
Experiment-7 To study the Ice- plant, its working cycle and determine its C.O.P and capacity.
Experiment-8: To Study the Mechanical and Air and Water heat pump and find its C.O.P.
Experiment-9: To determine the thermal conductivity of a metallic rod and insulating power.
Experiment-10: To determine the thermal conductivity of a solid by the guarded hot plate method.
Experiment-11: To verify the Stefan-Boltzmann constant for thermal radiation.
Experiment-12: Draw the characteristic curves for Francis turbine.
Experiment-13: Study of positive displacement and rotary pumps

Teaching Methodology:

This lab is run in conjunction with the theory course 18B11ME311 (Fluid Mechanics). It is an introductory course where basic aspects of thermodynamics, heat transfer, and refrigeration are

explained through practical demonstrations and models. The goals of the experiments include study of basic boiler and engine study, dryness fraction calculation, COP calculations, thermal conductivity calculations, and Stefan Boltzmann constant evaluations. Experimental setups and models such as boilers models, engine models, separating and throttling apparatus, compressor apparatus, refrigeration and air conditioning test rigs, and heat transfer apparatus are made available to the students. The lab experiments utilize U-tube manometer, piezometers, theromocouples, digital temperature indicators and stop watches. The lab runs closely with the lectures in such a way that experiments support the text covered in the class room.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	**Based on Lab Exercises: 1-6**
P-2		15 Marks	**Based on Lab Exercises: 7-13**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Basic Thermodynamics Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

[4]"Engineering Thermodynamics", P. K. Nag , Tata McGraw Hill.

[5]"Refrigeration and Air conditioning", C. P. Arora, Tata McGraw Hill.

[6]"Fundamentals of Heat and Mass transfer", P. F. Incropera and D. P. DeWitt, Wiley

Reference Books/Material:

[6] "Introduction to Thermodynamics", D. C. Spanner, Academic Press

[7] "Principle of Engineering Thermodynamics", Moran, Shapiro, Boettner, Bailey, whiley.

[8] "Heat Transfer", P. S. Ghoshdastidar, Oxford.

[9] "Engineering thermodynamics", E. Fermi, Dover book

[10] "Engineering Thermodynamics", Y. A. Cengel, Cimbala, Tata McGraw Hill.

Web References:

[1] http://vlab.co.in

Title: Strength of Materials Lab **Code: ME205**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied courses, "Engineering Mechanics lab".

Objective:

1. To learn and be able to analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
2. To learn and be able to perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts.

Learning Outcomes:

Course Outcome	Description
CO1	Understand statically determinate and indeterminate problems.
CO2	Determine the resistance and deformation in structural members subjected to various loading.
CO3	Apply knowledge of materials and structural elements to the analysis of simple structures.
CO4	Undertake problem identification, formulation and solution using a range of analytical methods.
CO5	Evaluate principal stresses, strains and apply the concept of failure theories for design.
CO6	Analyze and design thin, thick cylinders and springs.

Course Content:

1. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
2. To study the Brinell hardness testing machine & perform the Brinell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Impact testing machine and perform the Izod test.
5. To study the Impact testing machine and perform the Charpy test.
6. To study the Universal Testing Machine (UTM) and perform the tensile test.
7. To perform compression test on UTM.
8. To perform the shear/bending test on UTM.
9. To study the torsion testing machine and perform the torsion test.
10. To perform the fatigue test on fatigue testing machine.
11. To determine the deflection of simply supported beams.
12. To perform the spring test in tension and compression.
13. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.

Teaching methodology:

The aim of introducing this course is to give aexposure to the students on the important and fundamental concept in the extensive area of Materials and its behavior under different loading conditions. The concepts, ideas and techniques developed in SOM are indispensable in machine and structural design. The main focus of this course is to introduce fundamental concepts in SOM with special emphasis on practical problems.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	**Based on Lab Exercises: 1-7**
P-2		15 Marks	**Based on Lab Exercises: 8-13**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	

	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Strength of materials lab (will be added time to time): digital copy will be available on the JUET server

Text Book:

1. Laboratory Manual Available in Lab
2. Study material available in related folder of server
3. "Mechanics of materials"; Timoshenko and Gere, CBS Publishers. 2011.
4. "Engineering Mechanics of Solids"; E.P.Popov, PHI,2009
5. "Mechanics of materials"; B. C. Punamia.and A.K. Jain, Laxmi publication.

Reference Books:

1. Nag and Chanda, Fundamentals of Strength of Materials, Wiley India.
2. Bansal R.K., Strength of Materials, Laxmi Publications.
3. Gere J. M., Mechanics of Materials, Thomson Press.
4. Pytel A. and kiusalaas J., Mechanics of Materials, Thomson Press.
5. Hearn E. J., Mechanics of Material Vol. I & II, Butterworth-Heinemann Publication.
6. Bedi D. S., Strength of Materials, S. Chand & Co. Ltd

Title: Manufacturing Technology Lab **Code:**

L-T-P scheme: 0-0-1 **Credit: 1**

Prerequisite: Basics of workshop

Objective:

1. To study different testing methods for silica sand, moulding sand and design of pattern
2. To study SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes
3. To study different sheet metal operations such as bending of sheet metal and press working operations

Learning Outcomes:

CO1	Outline different casting, welding and sheet metal forming processes
CO2	Describe each process with their practical aspects
CO3	Develop the practical knowledge to manufacture products using casting, welding and sheet metal forming
CO4	Identify the required process for a product
CO5	Apply the knowledge to improve the methods
CO6	Demonstrate the skill of metal forming for practical use in the industry

Course Content

1. To test the moisture content of green sand.
2. To determine the grain fineness number.
3. Design and making of pattern for a desired casting (containing hole).
4. To find the clay content of the supplied moulding sand

5. To find the permeability number of the standard sand specimen of the moulding sand
6. Press work experiment such as blanking/piercing, washer making etc.
7. Wire drawing on soft material.
8. To perform Sheet bending operation.
9. Hand forging experiments.
10. Gas welding experiment
11. Shielded Metal Arc Welding (SMAW) experiment
12. Gas Metal Arc Welding (GMAW) and Gas Tungsten Arc Welding (GTAW) experiments
13. Resistance Spot welding experiment.
14. Soldering & Brazing experiment

Teaching Methodology:

In this lab the students will learn the requirement of different testing of moulding sand and design of pattern for a casting. They are going to learn GFN test, Moisture content test, Clay content test. And they are going to learn the design of pattern and manufacturing the designed pattern and use that pattern to get a casting for the designed one.

In welding techniques they are going to learn various safety aspects in welding. After that they will start learning different welding processes like SMAW, GMAW, GTAW, Oxy-acetylene welding and Resistance spot welding. In those processes they are going to learn the welding process, their compatibility, limitations and developments in them.

In metal forming section they are going to learn various bulk metal forming and sheet metal forming techniques. They are going to learn about those requirements of the processes to get a specific product, how to choose the tooling required for a process and how to get the required product with least errors in them.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	**Based on Lab Exercises: 1-7**
P-2		15 Marks	**Based on Lab Exercises: 8-14**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Digital copy of study material and videos will be available on the JUET server.

Text Book:

1. Jain P L, Principles Foundry Technology, Tata McGraw Hill
2. Parmar R.S., Welding Process and Technology, Khanna Publishers.
3. Kumar Surendra, Technology of Matal Forming Processes, Prentice Hall of India

References Books/Materials:

1. Rao P. N., Manufacturing Technology I, Tata McGraw Hill.
2. Hajra S. K. and Chaudhary, Workshop Technology, Vol. I, Khanna Publisher.
3. Jain R.K., Production Technology, Khanna Publisher.
4. Kalpakjian S., Schemid S., Manufacturing, Engineering and Technology, Addison Wesley.

5. Parmar R.S., Welding Process and Technology, Khanna Publishers.

Web References:

1. www.youtube.com/user/nptelhrd

Journals References:

1. *Journal of Manufacturing Science and Engineering*
2. Journal of Manufacturing Processes

Title of Course: Programming in Python **Course Code:**
L-T-P scheme: 0-0-2 **Course Credits: Audit**

Prerequisite: No explicit prerequisite course work is required, but students are expected to have a fundamental understanding of basic computer principles and previous experience using a personal computer.

***Objective*:** To emphasize object-oriented programming. Problem decomposition and principles of programming are stressed throughout the course. Advance aspects of programming may be taken care off through Python.

Learning Outcomes:

Course Outcome	Description
CO1	Installation and understanding features of Python.
CO2	Describe Python data types to handle programming problems
CO3	Develop understanding looping to handle new data types
CO4	Identify appropriate methods to solve challenging problems.
CO5	Apply programming knowledge to solve real world problems in the form of Project

Course Contents:

An Introduction to Python: Introductory Remarks about Python, Strengths and Weaknesses, A Brief History of Python, Python Versions, Installing Python, Environment Variables, Executing Python from the Command Line, IDLE, Editing Python Files, Getting Help, Dynamic Types, Python Reserved Words, Naming Conventions.

Basic Python Syntax: Introduction, Basic Syntax, Comments, String Values, String Operations, The format Method, String Slices, String Operators, Numeric Data Types, Conversions, Simple Input and Output, The print Function.

Language Components: Introduction, Control Flow and Syntax, Indenting, The if Statement, Relational Operators, Logical Operators, True or False, Bit Wise Operators, The while Loop, break and continue, The for Loop.

Collections: Introduction, Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries, Copying Collections, Summary.

Functions: Introduction, Defining Your Own Functions, Parameters, Function Documentation, Keyword and Optional Parameters, Passing Collections to a Function, Variable Number of Arguments, Scope Functions- "First Class Citizens", Passing Functions to a Function, Mapping Functions in a Dictionary, Lambda, Closures.

Text Book

1. Programming Python /Mark Lutz.

Reference Books

1. Think Python / Allen B Downey
2. Python 101 / Dave Kuhlman

Evaluation scheme:

<table>
<tr><th colspan="2">Exams</th><th>Marks</th><th>Coverage</th></tr>
<tr><td colspan="2">P-1</td><td>15 Marks</td><td>Based on Lab Exercises: 1-7</td></tr>
<tr><td colspan="2">P-2</td><td>15 Marks</td><td>Based on Lab Exercises: 8-14</td></tr>
<tr><td rowspan="4">Day-to-Day Work</td><td>Viva</td><td>20 Marks</td><td rowspan="4">70 Marks</td></tr>
<tr><td>Demonstration</td><td>20 Marks</td></tr>
<tr><td>Lab Record</td><td>15 Marks</td></tr>
<tr><td>Attendance & Discipline</td><td>15 Marks</td></tr>
<tr><td colspan="2">Total</td><td colspan="2">100 Marks</td></tr>
</table>

Title: Fluid Mechanics **Code: ME106**
L-T-P scheme:3-1-0 **Credit: 4**

Prerequisite: Students must have already studied courses, "*Engineering Mechanics, Partial Differential Equations, Vector Calculus*".

Objective:

1. To learn Basic principles and equations of fluid mechanics so that intuitive understanding of subject can be developed.
2. He will study numerous and diverse real-world engineering examples, so that his understanding of fluid mechanics principles strengthens more.

Learning Outcomes:

Course Outcome	Description
CO1	Understand basic fluid mechanical properties.
CO2	Outline the basic concepts of hydrostatics.
CO3	Apply conservation laws to real life fluid problems.
CO4	Should be able to analyze and design pipe flows
CO5	Formulate and solve one dimensional incompressible fluid flow problems
CO6	Describe the boundary layer phenomenon.

Course Content:

Unit-1:FUNDAMENTAL CONCEPTS AND FLUID STATICS: Definition of stress, definition of fluid, distinction between solid and fluid, concept of continuum. Fluid properties: Density, Specific weight, Viscosity, Dynamic and kinematic viscosity, no slip condition of viscous fluids, Compressibility, distinction between an incompressible and a compressible flow, surface tension of liquids, capillarity. Forces on fluid elements, normal stresses in a stationary fluid (pressure and Pascal's law), fundamental equation of fluid statics, pressure measuring devices, Hydrostatic thrusts on submerged surfaces (Both plane and Inclined surfaces), Buoyancy, Floatation, Stability of floating bodies.

Unit-2: FLUID KINEMATICS: Scalar and vector fields, flow field and description of fluid motion (Lagrangian and Aurelian approaches), variation of flow parameters in time and space, material derivative and acceleration, stream line , path lines and streak lines, one two and three dimensional flows, Translation, rate of deformation and rotation, vorticity, Concept of flow existence, concept of flow potential.

Unit-3: FLUID DYNAMICS: (Conservation equations and analysis of finite control volume) System and control volume concept, conservation of mass-the continuity equation (both in differential and integral form) for system and control volume, stream function and its physical significance, Conservation of momentum (Reynolds transport theorem, application of RTT to conservation of mass and momentum), Analysis of finite control volumes (both inertial and non-inertial control volumes), Euler's equation(both for infinitesimal control volume and along a stream line), conservation of energy and its reduced form i.e. Bernoulli's equation

Unit-4: APPLICATIONS OF EQUATION OF MOTIOIN AND MECHANICAL ENERGY: Bernoulli's equation in irrotational flow, plane circular vortex flows, fluids in relative equilibrium, principles of hydraulic siphon, losses due to geometric chances, flow measurement through pipes, flow through orifices and mouthpieces.

Unit-5: PRINCIPLES OF PHYSICAL SIMILARITY AND DIMENSIONAL ANALYSIS: Concept and types of physical similarity, dynamic similarity of flows governed by viscous, pressure, inertia, gravitation, surface tension and elastic forces (Reynolds, Euler, Froude, Weber,

Cauchy, Mach numbers).Dimensional analysis: Buckingham's theorem, Rayleigh's indicial method and Ipsen method.

Unit-6 : **VISCOUS INCOMPRESSIBLE FLOWS AND FLOWS THROUGH PIPES:** General viscosity law, Navier-Stokes equation, exact solutions of Navier-Stokes equation: Couette flow, Plane Poiseuille flow and Hagen Poiseuille flow and flow between two concentric rotating cylinders. Low Reynolds no, flows and theory of hydraulic lubrication.

Concept of friction factor in pipe flow, variation of friction factor (Moody's diagram), concept of flow potential and flow resistance, flow through branched pipes(pipes in series and parallel), introduction of Hardy Cross method, flow through pipes with side tappings, losses in pipe bends and fittings, power transmission by through a pipeline.

Unit-7: LAMINAR BOUNDARY LAYER AND INTRODUCITON TO TURBULENCE: Prandtl's boundary layer equations (order of magnitude analysis), Blasius flow over a flat plate, wall shear and boundary layer thickness, Momentum-Integral equation for boundary layer, separation of boundary layer, Karman-Pohlhausen approximate method for flat plate, entry flow in a duct, control of boundary layer separation. Characteristics of turbulent flows, laminar-turbulent transition, correlation functions, mean motions and fluctuations, governing equations for turbulent flow, Prandtl's mixing length hypothesis, universal velocity distribution law and friction factor in duct for large Reynolds number.

Teaching Methodology:

This course is one of the foundation course in the Mechanical discipline. The knowledge gained in this course will help the student to understand not only the industrial processes but, they will also be able to do some small applied research. The course is divided into seven units which have to be followed one after the other i.e. no unit should be skipped. Unit-1, 2, 3, 5, and 6 are to be explained in great depth as, these are the most valuable topics in terms of GATE and ESE examinations. After every broader topic an assignment will be given to students which has to submitted in due time. In tutorials the students will work collectively to understand the concepts with the help of practical problems.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3, Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6 and Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and assignments on Fluid Mechanics (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[7] "Introduction to fluid mechanics and fluid machines", S. K. Som, G. Biswas, McGraw-Hill Education

Reference Books/Material:

[11] "Fluid Mechanics", Frank M. White, McGraw-Hill Education

[12] "Fluid Mechanics", Yunas A. Cengel, Cimbala, McGraw-Hill Education
[13] "Advanced Engineering Fluid Mechanics", K. Muralidhar, G. Biswas, Narosa
[14] "Fluid mechanics", Sishadri and Patankar, Elsevier

Web References:

[1] pdumkafm.blogspot.com/http://www.techtutorials.info/ecommerce.html
[2] www.slideshare.net/pankajdumka1/solution-of-introductoin-to-fluid-mechanics-and-machinesprof-som-and-prof-biswas
[3] https://www.youtube.com/watch?v=fa0zHI6nLUo&list=PLbMVogVj5nJTZJHsH6uLCO00I-ffGyBEm

Title: Theory of Machines **Code:ME105**
L-T-P scheme:3-1-0 **Credit: 4**

Prerequisite: Students must have already studied course, "*Engineering Mechanics*".

Objective:

1. To provide the knowledge of different mechanisms, degree of freedom and kinematic analysis of mechanism and to explain different types of gears, gear trains.
2. To provide the concepts of static and dynamic mass balancing, knowledge of turning moment diagram and to provide the knowledge of the application of flywheels & Governors.
3. To provide the concepts of gyroscope and the vibration analyses of rigid body systems.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the knowledge of different mechanisms, degree of freedom, kinematic and dynamic analysis of mechanism.
CO2	Describe different types of gears, gear trains.
CO3	Develop the mathematical methods to analyze the static & dynamical forces acting on mechanical systems and balancing of single slider crank mechanism.
CO4	Identify the fluctuations in the speed of the engine and provide the concepts static and dynamic mass balancing, knowledge of turning moment diagram and the knowledge of the application of flywheels &

	Governors.
CO5	Apply the concept of Free, damped & forced vibration to determine the natural frequency, to find the damping coefficient and to find the effect of whiling of shaft.
CO6	Demonstrate the Gyroscopic effects on naval ships, on stability of four wheels and two wheels vehicle moving on curved path, Gyroscopic effects on an Aero plane.

Course Content:

Unit-1:Mechanisms and machines

Introduction to mechanism and machine, Kinematic link, Kinematic Pairs, Chains, Grashof's Criterion, Kinematic mechanisms, Inversions, Constrained motion, Degrees of freedom, Equivalent linkages, Mechanisms with lower pairs.

Unit-2: Velocity and acceleration analysis

Displacement analysis, Relative velocity, Instantaneous centre, Aronhold-Kennedy's theorem, Velocity and acceleration diagram, Coriolis component of acceleration, Klien's construction.

Unit-3: Gear and Gear trains

Introduction to gear, Types of gear, Different types of gear trains: Simple Gear Train, Compound Gear Train, Epicyclic Gear Train. Torque calculation.

Unit-4: Flywheel

Turning-moment diagrams, Fluctuations of energy, Fluctuations of speed, Coefficient of fluctuation of energy, Coefficient of fluctuation of speed, Energy stored in Flywheel, Flywheel in punching machine.

Unit-5: **Governor**

Types of governors, Characteristics of centrifugal governors, Stability of governor, Isochronous governor, Sensitiveness, Hunting, Governor Effort and power, Coefficient of insensitiveness.

Unit-6: Balancing

Balancing of rotating and reciprocating masses, Partial balancing of primary unbalanced force of reciprocating engine, Tractive force, Swaying couple, Hammer blow.

Unit-7: Gyroscope

Gyroscopes, Gyroscopic forces and couples, Gyroscopic stabilization, Gyroscopic effects on naval ships, Steering, pitching and rolling, Ship stabilization, Stability of four wheels and two wheels vehicle moving on curved path, Gyroscopic effects on an Aero plane.

Teaching Methodology:

This course is introduced to help students to understand the relative motion between the various parts of a machine and the forces which act on them. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine.

The entire course is broken down into seven separate units: Mechanisms and machines, Velocity and acceleration analysis, Gear and Gear trains, Flywheel, Governor, Balancing and Gyroscope. Each section includes the different aspects of the machine which help a student to gain more experience as a mechanical engineer. This theory course is complemented by a laboratory course under the name "Theory of Machine Lab" in the same semester that helps a student learn with hand-on experience.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2 & Unit-3

Test-2	25 Marks	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6& Unit-7 and around 30% from coverage of Test-1 & Test-2.
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Course-related resources will be provided on JUET server. This can include eBook, lecture material, supplementary course notes.

Text Book:

[1] Theory of Machine by SS Ratan

[2] Theory of Mechanisms and Machines by CS Sharma & Purohit

Reference Books/Material:

[15]Theory of Machine by R.S. Khurmi

Web References:

- https://nptel.ac.in/courses/112104121/
- https://nptel.ac.in/courses/112101096/#

Journals References:

- Mechanism and Machine Theory : Elsevier

Title: Computer Aided Design **Code:**
L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have already studied courses like "Manufacturing Technology-II", "Machine Drawing" and "Strength of materials."

Objectives

1. The objective of this course is to impart knowledge about mathematical elements of CAD, 2D and 3D transformations of objects for display as well as to make them aware about importance of synthetic parametric curve, surfaces and solids in design
2. To make students learn the important theoretical concepts, and the state-of-the-art technological developments in the area of modern manufacturing.
3. Various topics to be covered are basics of automation, NC programming (Manual and APT), concepts of group technology, Flexible Manufacturing system, CIM and robotics.

Learning Outcome

Course Outcome	Description
CO1	Outline basic fundamentals and scope of CAD, CAM and related technologies in industr environment and their relationship with product life cycle.

CO2	Describe concepts of transformations, types of modeling, parametric curves, surfaces a solids, NC, CNC and DNC machines and automation.
CO3	Develop ability to understand geometric modeling and execute the steps required in CA software for developing 2D and 3D models and perform transformations.
CO4	Identify the configurations of CAD modeling software, CNC machines, robots or Compu integrated system in any industry.
CO5	Apply acquired knowledge to write CNC part programs for industrial components as well as operate CNC machines, robots and CIM system.
CO6	Demonstrate skill to work in any automated manufacturing system.

Course Content

Introduction : Introduction to types of production and plant layout; introduction to terms like CAD, CAM, CIM, CAE, CAPP, CAIQC; scope of CAD/CAM; product life cycle and CAD/CAM; product design and manufacturing in conventional and CIM environment. (4)

CAD: Software and hardware in CAD; Introduction to 2D and 3D transformations: scaling, rotation and translation; introduction to wireframe, surface and solid modeling; analytic and synthetic curves and their representation; parametric representation of curves; introduction to parametric synthetic curves such as Hermite, Bezier, cubic spline and B-spline curves. Surface entities and surface representation, surface of revolution, sweep surfaces, quadric surface, ruled surface, coons patch etc.; solid entities and solid representation, fundamentals of solid modeling –Boundary Representation (B-rep), Constructive Solid Geometry (CSG), other representations.

TEACHING METHODOLOGY:This course is introduced to help students learn and understand the computer assisted design and manufacturing processes. The course is divided into two major parts namely, CAD and CAM. Students will be taught fundamentals of computer assisted design, modeling and analyses. Then they will be taught about CNC machines and their part programming. Finally, they will be made aware about FMS and CIM systems. This theory course is well complemented by a laboratory course under the name CAD/CAM Lab in the same semester that helps students learn with hand-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 and Unit-3 and around 30% from coverage Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Text Books:

1. Zeid, Ibrahim, CAD/CAM Theory and Practice, McGraw-Hill, Inc.
2. Groover and Zimmers, CAD/CAM: Computer Aided Design and Manufacturing, PHI

3. Groover M. P., Automation, Production Systems And Computer-integrated Manufacturing, PHI.
4. Kundra, Rao and Tiwari., Computer Aided manufacturing, Tata McGraw Hill Publishers,

References:

1. Rooney, J. and Steadman P., Principles of Computer-aided Design, Affiliated East-West Press Pvt Ltd.
2. Mortenson, Michael E., Geometric Modeling, John Wiley & Sons.
3. Steve Krar, Arthur Gill, CNC technology and programming, McGraw-Hill, 1990
4. James Madison, CNC machining hand book, Industrial Press Inc., 1996
5. Miller R. K., FMS/CIM Systems Integrated Handbook, Prentice Hall.

Title: Control System **Code:**
L-T-P Scheme: 3-1-0 **Credits:** 4

Prerequisite: Not Applicable

Objective:

1. To provide knowledge of the various physical system, their mathematical modeling.
2. To analyze the performance of a system using time-domain analysis techniques.
3. To familiarize the student with the basic concept of stability and apply stability analysis techniques.
4. To introduce concepts of controller and designing of convention control schemes.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various control system models with respect to their needs in the industry.
CO2	Describe the working of industrial control systems using the control theory and concepts.
CO3	Develop a mathematical model to represent a physical system.
CO4	Identify the stability conditions of a control scheme.
CO5	Apply time-domain and frequency domain analysis to evaluate the performance of a control system.
CO6	Demonstration and deployment of basic PID controller.

Course Content:

Unit-1: Introduction to control systems: Concept of control system, Open-Loop and Closed-loop systems, Elements of feedback control system. Advantages and applications of close loop control system. Review of laplace transform, Initial final value theorem, Final value theorem.

Unit- 2: Mathematic modeling: Mathematical modeling of electrical systems, mechanical systems, thermal system, liquid level system. Electrical analogues of other dynamic systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Block diagram reduction techniques. Signal Flow graph.

Unit-3: Time Domain Analysis: Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit 3: Frequency Domain analysis and Design: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit 4: Introduction to Controller Design: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.

Unit 5: State variable Analysis: Concepts of state variables. State variable representation. State space model. Conversion from State Variable model to Transfer Function model, Equivalence between Transfer Function model and State Variable representation . Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Teaching Methodology:
This course is introduced to develop the understanding of control systems in various areas of engineering. Starting from the basic concepts, the student will gradually develop an understanding of automatic systems used in the industry. The entire course is broken down into five units, such that each unit covers a particular aspect of the control and automation.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2 (Selected topics)
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Control Systems (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
[2] K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

Reference Books/Material:

[1] B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
[2] J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

Web References:

- https://nptel.ac.in/courses/107106081/
- https://web.stanford.edu/class/archive/ee/ee392m/ee392m.1034/
- https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-30-feedback-control-systems-fall-2010/lecture-notes/

Journals References:

- IEEE Control Systems
- IFAC Journal of Systems & Control, Elsevier
- International Journal of Control Systems and Robotics - IARAS

Title: Environnemental Science **Code: GE101**
L-T-P Scheme:2-0-0 **Credit: 2**
Prerequisite: The students must be aware of basic Environmental Science upto class 12^{th}. Basic knowledge of Environmental Science helps them to correlate in various division of Engineering during this course.
Objective:
The purpose behind this course is to make the students familiar with Environment (surrounding) and to understand the significance/importance of natural resource, biodiversity, environment pollution and impact of intervention of human being in the Ecosystem. This course is mandatory for all branches of the Engineering and Sciences.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in learning the significance and importance of environment in their life.

CO2 Describe the real world problems, challenges with the suitable case study based on conservation (natural resource and biodiversity), ecosystem, socio-economic development and remedial measure of the various pollutions (air, water, soil, noise and radiation).

CO3 Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in their surrounding (the Environment).

CO4 Identify and use of various techniques for solving the Environmental Problems.

CO5 Apply filed visit and justification by using various analytical techniques.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in the Environmental Science and related multidisciplinary areas that involve Environmental Science and help to develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

COURSE CONTENT

Modules	Description
Unit 1:	**Introduction to Environmental Science:** Multidisciplinary nature of environmental science; components of environment –atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.
Unit 2:	**Ecosystems:** What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
Unit 3:	**Natural Resources:** Renewable and Non-renewable Resources • Land Resources and land use change; Land degradation, soil erosion and desertification. • Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. • Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). • Heating of earth and circulation of air; air mass formation and precipitation. • Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.
Unit 4:	**Biodiversity and its conservation:** Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. • India as a mega-biodiversity nation; Endangered and endemic species of India. • Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ Conservation of biodiversity. • Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.
Unit 5:	**Environmental Pollution:** Environmental pollution: types, causes, effects and

controls; Air, water, soil, chemical and noise pollution. • Nuclear hazards and human health risks. • Solid waste management: Control measures of urban and industrial waste. • Pollution case studies.

Unit 6: **Environmental Policies & Practices:** Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC).
• Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.

Unit 7: **Human Communities and the Environment** Human population and growth: Impacts on environment, human health and welfares.
• Carbon foot-print.
• Resettlement and rehabilitation of project affected persons; case studies.
• Disaster management: floods, earthquakes, cyclones and landslides.
• Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan.
• Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
• Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 8: **Field Work:** Visit to a local area to document assets-river / forest / grassland /hill / mountain. polluted sites(Urban, rural ,industrial, agriculture), plants, insects, bird, Ecosystem (pond, river, hill slopes etc)

Teaching Methodology:

The core module Syllabus for Environment Science includes class room teaching and Field Work. The syllabus is divided into eight units covering lectures. The first seven units will cover 28 lectures, which are class room based to enhance knowledge skills and attitude to environment. Unit eight is based on field activities which will be covered in 4 lecture hours and would provide student firsthand knowledge on various local environmental aspects. Field experience is one of the most effective learning tools for environmental concerns. This moves out of the scope of the text book mode of teaching into the realm of real learning in the field, where the teacher merely acts as a catalyst to interpret what the student observes or discovers in his/her own environment. Field studies are as essential as class work and form an irreplaceable synergistic tool in the entire learning process. Course material provided by UGC for class room teaching and field activities is utilized.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 Unit 2 and Unit-3
Test-2	25 Marks	Based on Unit-4 & Unit-5 (70 %) and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6 to Unit-7 and around 30% from coverage of Test-1 and Text-2

Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book

[1] Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, Ahmadabad – 380013, India.
[2] De Anil Kumar, Environmental Chemistry, Wiley Eastern Ltd, 2007.
[3] Agarwal KC, 2001. Environmental Biology, Nidhi Publishers Ltd. Bikaner.

Reference Book

[1] 3. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
[2] Clark R B, Marine Pollution, Clanderson Press, Oxford (TB).2001.
[3] Cunningham WP, Cooper TH, Gorhani E & Hepworth MT, 2001. Environmental Encyclopedia, Jaico Publishing House, Mumbai, 1196 pgs.
[4] Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.
[5] Heywood VH, and Watson RT, 1995. Global Biodiversity Assessment. Cambridge University Press 1140pgs.
[6] Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws. Himalaya Publishing House, Delhi 284pgs.
[7] Mckinney ML and Schoch RM, 1996. Environmental Science Systems and Solutions. Web enhanced edition, 639pgs.

Course Title: Numerical methods **Code: MA105**
L-T-P scheme: 3-1-0 **Credits: 4**

Prerequisite: Students should have basic knowledge of calculus, differential equations and matrix algebra.

Objectives:
To make students aware of the concepts of numerical methods necessary for solving complicated mathematical problems numerically.

Learning Outcomes:

Course Outcome	This course will enable the students to:
CO1	Understand the concepts of finite differences, interpolation, extrapolation and approximation.

CO2	Learn various techniques of getting numerical solutions of system of linear equations and check the accuracy of the solutions.
CO3	Obtain numerical solutions of algebraic and transcendental equations.
CO4	Solve initial and boundary value problems in differential equations using numerical methods.
CO5	Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.
CO6	Apply numerical methods to diverse situations in physics, engineering and in other mathematical contexts.

Course Content:

Unit-1: Solution of linear system of equations- Direct and iterative methods. Eigen values and Eigen vectors, Jacobi and Householder methods. Solution of a single and a system of non-linear equations

Unit-2: Interpolation and Approximation

Unit-3: Numerical differentiation, Numerical Integration, Gauss quadrature

Unit-4: Initial and boundary value problems in ODE, Numerical solution of PDE by finite difference method, Method of weighted residuals (MWR).

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures, assignments and quizzes in the form of questions will also be given for practice.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on numerical methods will be available on the JUET server.

Text Books

1. "Applied Numerical Analysis", Gerald C.F., Wheatley P.O.,Pearson Education India; 7e, 2007.

2. "Numerical Methods", Jain, Iyengar &Jain, New age Int. Publication (P) Ltd, 6e.
3. "Numerical Methods", Grewal, B. S., Khanna Publisher; Eleventh edition, 2013.
4. "Advanced Engineering Math.", Erwin Kreyszig, John Wiley & Sons, INC.
5. "Introductory Methods of Numerical Analysis", S.S. Sastry, Prentice Hall India Ltd.

Title: Theory of Machines Lab **Code: ME207**
L-T-P scheme: 0-0-2 **Credit: 1**

List of experiment:

1. To study mechanism and various inversions of single slider crank chain.
2. To study mechanism and various inversions of double slider crank chain.
3. To study exact straight line motion mechanisms and approximate straight line motion mechanisms.
4. Determination of Coriolis component of acceleration of a slider crank mechanism.
5. To study various types of cam and follower arrangements.
6. To perform experiments on Watt and Porter governors to prepare performance characteristic curves.
7. To perform experiments on Hartnell governor to prepare performance characteristic curves.
8. To perform experiments on static and dynamic balancing system.
9. Determination of gyroscopic couple on Motorized Gyroscope.
10. To determine the natural frequency of vibration theoretically and experimentally of two rotor system.
11. To find the damping coefficient ofdamped torsional oscillation.
12. To verify the Dunkerley's rules.
13. To determine whiling speed of shaft in given different cases.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	**Based on Lab Exercises: 1-7**
P-2	15 Marks	**Based on Lab Exercises: 8-13**
Day-to-Day Work	40 Marks	**70 Marks**
Lab Record	15 Marks	
Attendance & Discipline	15 Marks	
Total	**100 Marks**	

Title: CAD LAB **Code:**
L-T-P scheme: 0-0-2 **Credit: 1**

Objectives:

- To make students practice feature-based, parametric CAD software package such as SolidWorks or Pro/ENIGINEER (now PTC Creo Element) and learn surface and solid modeling. It is also aimed at getting the students practice the CAD fundamentals like transformations and design of curves and surfaces.

- To provide practical experience to students with an opportunity of hands-on training on modern CNC machines and CIM system. Student will make part programs for CNC Lathe and Milling machines. They will also perform Robot programming.

Learning Outcome:

Course Outcome	Description
CO1	Outline basic fundamentals and scope of CAD, CAM and related technologies in industrial environment and their relationship with product life cycle.
CO2	Describe concepts modeling, types of modeling, parametric curves, surfaces and solids, NC, CNC and DNC machines and automation.
CO3	Develop ability to understand geometric modeling and execute the steps required in CAD software for developing 2D and 3D models and perform transformations.
CO4	Identify the configurations of CAD modeling software, CNC machines, robots or Computer integrated system in any industry.
CO5	Apply acquired knowledge to write CNC part programs for industrial components as well as to operate CNC machines, robots and CIM system.
CO6	Demonstrate skill to work in any automated manufacturing system.

List of Experiments:

1. Introduction to basic commands in Solidworks.
2. Introduction to advanced commands in Solidworks.
3. To make CAD models of a given parts in Solidworks.
4. Introduction to assembly and drawing module of Solidworks.
5. Announcement of a CAD project in Solidworks (to be completed in two labs)
6. CAD project continued…
7. Introduction to solid modeling software Pro/Engineer.
8. To write and simulate a part program for CNC Lathe for a given part.
9. To write and simulate a part program for CNC Lathe for a given part and perform machining operations on XLTURN CNC Lathe machine.
10. To write and simulate a part program for CNC Milling for a given part.
11. To write and simulate a part program for CNC Milling for a given part and perform machining operations on XLMILL CNC milling machine.
12. To introduce students with CAM software and generate word address format (G and M codes) using Pro/Manufacturing (Module of Pro/E) and EdgeCAM software.
13. To make a program for pick and place of a ball for 5-axis mini robot.
14. To demonstrate the working of Flexible Manufacturing System (FMS) to the students.

Teaching Methodology:

This course is introduced to help students learn and understand the computer assisted design and manufacturing processes. The course is divided into two major parts namely, CAD and CAM. Students will take hands-on experience on design software such as SolidWorks, Pro/Engineer, Abacus etc. They will also make and simulate part programs for CNC Lathe and Milling machines and perform machining on these machines. They will also do Robot programming. Finally, they will be performing automatic operations on FMS and CIM systems. This lab course is well complemented by a theory course under the name CAD/CAM in the same semester that helps students learn with hand-on experience.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Lab Exercises: 1-7
P-2	15 Marks	Based on Lab Exercises: 8-14
Day-to-Day Work	Viva	70 Marks
	Demonstration	
	Lab Record	
	Attendance & Discipline	
Total	**100 Marks**	

Text Books:

1. Zeid, Ibrahim, CAD/CAM Theory and Practice, McGraw-Hill, Inc.
2. Rogers, David F. and Adams, J. Alan, Mathematical Elements for Computer Graphics, McGraw-Hill Publishing Company.
3. Groover M. P., Automation, Production Systems And Computer-integrated Manufacturing, PHI.
4. HELP files of SolidWorks and Pro/Engineer
5. CNC XLTURN Manual by MTAB, Chennai
6. CNC XLMILL Manual by MTAB, Chennai

Reference Books:

1. Faux, I.D. and Pratt, M.J., Computational Geometry for Design and Manufacture, Ellis Horwood Limited (a division of John Wiley & Sons).
2. Rooney, Joe and Steadman Philip, Principles of Computer-aided Design, Affiliated East-West Press Pvt Ltd.
3. Rao, P.N., CAD / CAM Principles and Applications, McGraw Hill Publishers, New Delhi
4. Jha, N. K., Handbook of Flexible Manufacturing Systems, Academic Press Inc.

Title: Fluid Mechanics Lab **Code: ME208**
L-T-P scheme: 0-0-1 **Credit: 1**

Prerequisite: Students must have already studied the course, “Engineering Mechanics” and should be studying “Fluid Mechanics”

Objective:

1. To learn and be able to measure flow, velocity, and losses in open and closed channel flows.
2. To develop the abilities to understand the flow behavior and its impacts on industrial and daily life processes.

Learning Outcomes:

Course Outcome	Description
CO1	Outline procedures for standardization of experiments.
CO2	Apply the principle of discharge and velocity measurement in open and close channel.
CO3	Identify laminar and turbulent flows.
CO4	Describe and demonstrate the principle of Bernoulli’s and metacentric height.

CO5	Compute the losses in fluid flow
CO6	Develop the performance characteristics and test the performance of pumps and turbines

Course Content:

Experiment-1: To determine the coefficient of discharge of venturimeter.
Experiment-2: To verify the Bernoulli's Theorem.
Experiment-3: To find critical Reynolds number for a pipe flow.
Experiment-4: To determine the friction factor for pipes.
Experiment-5: To determine the coefficient of velocity of Pitostatic tube.
Experiment-6: To determine coefficient of discharge of an orificemeter.
Experiment-7 To determine the coefficient of discharge of Notch (V and Rectangular types).
Experiment-8: To determine the coefficient of discharge, contraction & velocity of an orifice.
Experiment-9: To determine the minor losses due to sudden enlargement, sudden contraction and bends.
Experiment-10: To determine the meta-centric height of a floating body.
Experiment-11: Draw the characteristic curves for pelton wheel.
Experiment-12: Draw the characteristic curves for Francis turbine.
Experiment-13: Study of positive displacement and rotary pumps

Teaching Methodology:

This lab is run in conjunction with the theory course 18B11ME411 (Fluid Mechanics). It is an introductory course where flow behaviour, fluid forces and analysis tools are introduced. The goals of the experiments include determination of discharge in open and closed channel, applications of the control volume approach, demonstration of the momentum and energy equations. Intricate flow phenomena such as separations and transition to turbulence are demonstrated. Experimental setups such as flow through a tube and open channel, Bernoulli's apparatus, orifice meter, venture meter, Pitot tubes and metacentric height apparatus are made available to the students. The lab experiments utilize U-tube manometer, piezometers, and stop watches. The lab runs closely with the lectures in such a way that experiments support the text covered in the class room.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	**Based on Lab Exercises: 1-7**
P-2		15 Marks	**Based on Lab Exercises: 8-14**
Day-to-Day Work	Viva on mini Project	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Fluid Mechanics Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Laboratory Manual available in Lab
[2] Study material available in related folder of Server
[3] "Introduction to fluid mechanics and fluid machines", S. K. Som, G. Biswas, McGraw-Hill Education

Reference Books/Material:

[1] "Fluid Mechanics", Frank M. White, McGraw-Hill Education

[2] "Fluid Mechanics", Yunas A. Cengel, Cimbala, McGraw-Hill Education
[3] "Advanced Engineering Fluid Mechanics", K. Muralidhar, G. Biswas, Narosa
[4] "Fluid mechanics", Sishadri and Patankar, Elsevier

Web References:

[1] http://eerc03-iiith.vlabs.ac.in/

Title: Material Science **Code:**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: It is a foundation course.

Objective:

1. Primary objective is to present the basic fundamentals of materials science and engineering.
2. Help students to possess a solid foundation in materials science and engineering, with emphasis on the fundamental engineering principles that govern the microstructure, properties, processing.
3. Help students to understand the broad issues relevant to materials, including professional and ethical responsibilities, impact of materials engineering on society and environment.

Learning Outcomes:

COURSE OUTCOME	DESCRIPTION
CO1	ANALYZE THE STRUCTURE OF MATERIALS AT DIFFERENT LEVELS, BASIC CONCEPTS OF CRYSTALLINE MATERIALS LIKE UNIT CELL, FCC, BCC, HCP, APF (ATOMIC PACKING FACTOR), CO-ORDINATION NUMBER ETC.
CO2	DESCRIBE DIFFUSION TECHNIQUES ALONG WITH VARIOUS MICROSCOPIC PROCEDURE
CO3	UNDERSTAND CONCEPT OF MECHANICAL BEHAVIOR OF MATERIALS AND CALCULATIONS OF SAME USING APPROPRIATE EQUATIONS
CO4	EXPLAIN THE CONCEPT OF PHASE & PHASE DIAGRAM &UNDERSTAND THE BASIC TERMINOLOGIES ASSOCIATED WITH METALLURGY. CONSTRUCTION AND IDENTIFICATION OF PHASE DIAGRAMS AND REACTIONS
CO5	UNDERSTAND AND SUGGEST THE HEAT TREATMENT PROCESS & TYPES. SIGNIFICANCE OF PROPERTIES VS MICROSTRUCTURE.

	SURFACE HARDENING & ITS TYPES. INTRODUCE THE CONCEPT OF HARDENABILITY & DEMONSTRATE THE TEST USED TO FIND HARDENABILITY OF STEELS
CO6	EXPLAIN FEATURES, CLASSIFICATION, APPLICATIONS OF NEWER CLASS MATERIALS LIKE SMART MATERIALS, PIEZOELECTRIC MATERIALS, BIOMATERIALS, COMPOSITE MATERIALS ETC.

Course Content

Unit 1: Introduction:

Introduction to Material: Historical perspective, Importance of materials, Classification of materials, Properties of materials– Mechanical, electrical, thermal, magnetic, optical, decorative and its applications, Modern materials – Smart materials, Bio and Nano materials; Atomic models and Chemical bonding.

Crystallography: Concept of unit cell space lattice, Bravais lattices, Common crystal structures, Atomic packing factor and density, Miller indices, Volume, Planar and Linear density, X-ray Crystallography techniques.

Imperfection in Solids: Types of imperfections, point Imperfections, line defects (Dislocations), planar defects, volume defects, Experimental techniques for identification of microstructure and defects.

Diffusion: Diffusion is solids, Diffusion mechanism, Steady-state diffusion, non-steady state diffusion, effects of temperature on diffusion

Unit 2: Phase Diagram:

Phase Diagrams: Phase diagram for pure substances, Gibbs phase rule, cooling curves, binary isomorphous alloy systems, the lever rule, the invariant reactions, Iron-Carbon Equilibrium-Diagram and its importance, Concept of solidification of metals.

Mechanical Behavior of Metals: Stress straindiagram, Properties of metals, Deformation of metals, Mechanism of deformation, Mechanical testing of materials (destructive and non-destructive testing).

Ferrous Materials: Iron and steel manufacture, Furnaces, Various types of carbon steels, Alloy steels and Cast irons, its properties and uses.

Heat Treatment Processes: Definition, purpose and classification of heat treatment processes such as Annealing, Normalizing, Quenching, Tempering, and Case hardening, Time-Temperature-Transformation (TTT) diagram**.**

Non-Ferrous Metals and Alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications, Various types Brass, Bronze, Bearing materials, its properties and uses, Aluminum alloys such as Duralumin, Other advanced materials/alloys

Unit 3: Ceramics, Polymers and other Materials:

Ceramics, Polymers and other Materials: Structure types, properties, and applications of ceramics. Mechanical/Electrical behaviour and processing of Ceramics. Various types

of polymers/plastics and its applications. Mechanical behaviour and processing of plastics. Future of plastics. Composite Materials and its uses. Brief description of other materials such as Magnetic, Dielectric, Optical, Thermal materials and concrete.

Teaching Methodology:

In introduction to material science the student will have a broad knowledge on the types of material and their application in the real life. Students will have concept of unit cell space lattice, bravais lattices, common crystal structures, atomic packing factor and density, miller indices, volume, planar and linear density, x-ray crystallography techniques, types of imperfections, point imperfections, line defects (dislocations), planar defects, volume defects, experimental techniques for identification of microstructure and defects.

In second unit of the course student will learn about the phase diagram for pure substances, Gibbs phase rule, cooling curves, binary isomorphous alloy systems, the lever rule, the invariant reactions, iron-carbon equilibrium diagram and its importance, concept of solidification of metals, stress strain diagram, properties of metals, deformation of metals, mechanism of deformation, mechanical testing of materials (destructive and non-destructive testing). Iron and steel manufacture, Furnaces, Various types of carbon steels, Alloy steels and Cast irons, its properties and uses. Non - ferrous metals and alloys, purpose and classification of heat treatment processes such as annealing, normalizing, quenching, tempering, and case hardening, time-temperature-transformation (TTT) diagram.

In third unit students will have a generalized knowledge on structure types, properties, and applications of ceramics. mechanical/electrical behavior and processing of ceramics, various types of polymers/plastics and its applications, mechanical behavior and processing of plastic, future of plastics, composite materials and its uses, brief description of other materials such as magnetic, dielectric, optical, thermal materials and concrete.

Evaluation Scheme:

EXAMS	MARKS	COVERAGE
TEST-1	15 MARKS	BASED ON UNIT 1
TEST-2	25 MARKS	BASED ON UNIT 2 AND UNIT 1 (20%)
TEST-3	35 MARKS	BASED ON UNIT 3, UNIT 2 (15%) AND UNIT 1 (15%)
ASSIGNMENT	10 MARKS	
TUTORIALS	5 MARKS	
QUIZ	5 MARKS	
ATTENDANCE	5 MARKS	
TOTAL	**100 MARKS**	

Learning Resources:

Tutorials on Material Science (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[2] William D. Callister, Jr., Fundamentals of material science and engineering- An interactive, John willey & Sons, Inc.
[3] Donald R. Askeland, P.P Fulay and W.J. Wright, The science and engineering of materials, sixth edition, Cengage Learning.
[4] V. Raghvan, Material science and engineering, prentice hall of India (PHI) Pvt. Ltd.

References:

[1] George E. Dieter, Mechanical metallurgy, Tata Mcgraw Hill education.
[2] H. Van Vlack, Elements of material science and engineering, Addision-wesley.

Web References:

2. www.youtube.com/user/nptelhrd

Journals References:

3. *Journal of Material Science*

Title: Design of Machine Elements **Code: ME110**
L-T-P scheme: 3-1-0 **Credit:** 4

Prerequisite: Students must have already studied courses, "Engineering Mechanics", "Strength of Materials" and "Theory of Machines"

Objective:

1. To familiarize the various steps involved in the design process
2. To know the principles involved in evaluating the shape, size and dimensions of machine components to satisfy functional and strength requirements
3. To learn to use standard practices and standard data

Learning Outcomes:

Course Outcome	Description
CO1	Outline various concepts of design and select commonly used machine components
CO2	Demonstrate understanding of various design consideration
CO3	Illustrate basic principles of machine design
CO4	Design machine elements for static as well as dynamic loading
CO5	Design machine elements on the basis of strength and rigidity concepts
CO6	Demonstrate and deployment of computer based techniques in the analysis, design and selection of machine components

Course Content:

Unit-1: DESIGN AGAINST STATIC LOAD: Modes of failure, Theories of failure, Graphical representation and comparison, Introduction to fracture mechanics, Stress concentration factor.

Unit-2: DESIGN AGAINST FLUCTUATING LOAD: Different types of fluctuating stresses, S-N Curve, Notch sensitivity, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation. Design for Manufacturing (DFM), Role of processing in design.

Unit-3: MATERIAL SELECTION: Material and Manufacturing in design, Material selection.

Unit-4: BELT, ROPE AND CHAIN DRIVES: Design of belt drives: Flat and V-belt drives, Geometrical factors, Mechanics of belt drives, Condition for transmission of maximum power, Selection of flat and V-belts, Design of rope drives, Design of chain drives with sprockets.

Unit-5: SHAFTS, KEYS AND COUPLINGS: Design of shaft under bending, twisting and axial loading, Shock factors, Rigidity considerations, Design of shaft under fluctuating loads, Critical speed of shafts, Keys, Couplings.

Unit-6: WELDED AND RIVETED JOINTS: Design of welded and riveted joints.

Unit-7: SPRINGS: Types of springs, Design of helical springs against tension, compression and fluctuating loads and their uses, Design of leaf springs, Surging phenomenon in springs.

Unit-8: CLUTCHES AND GEARS: Types of clutches, Design of plate clutch, conical clutch, centrifugal clutch. Types of gears, Nomenclature and Working of gears, Design of straight and helical spur gears.

Unit-9: BEARINGS: Selection of ball and roller bearings based on static and dynamic load carrying capacity using load-life relationship, Selection of bearings from manufacturer's catalogue. Types of lubrication, lubricants and their properties, Selection of suitable lubricants, Design of journal bearings.

Teaching Methodology:

This course is introduced to help students in applying their knowledge of Engineering Mechanics, Strength of Materials and Theory of Machines in order to explore the vast area of design in mechanical engineering and to enhance students' ability to design machines and mechanisms by framing the solution of open ended problems. The entire course is divided into nine separate units: Design against Static Load, Design against Fluctuating Load, Material Selection, Belt, Rope and Chain Drives, Shafts, Keys and Couplings, Welded and Riveted Joints, Springs, Clutches and Gears and Bearings. These sections have been framed to impart a systematic understanding of the basic principles of machine design and finally implement these principles to evaluate the shape, size and dimensions of machine components to satisfy functional and strength requirements. This theory course is well complemented by a laboratory course under the name Design of Machine Elements Lab in the same semester. This Lab course will enable a student to learn with hand-on experience.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2 and Unit-3
Test-2	25 Marks	Based on Unit-4, Unit-5, Unit-6 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-7, Unit-8, Unit-9 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Design of Machine Elements (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Design of Machine elements by V. B. Bhandari, McGraw Hill Education, 4th Edition, 2017.

[2] Mechanical Engineering Design by J. E. Shigley and L. D. Mitchell, McGraw-Hill Education; 10th Edition, 2014.

Reference Books/Material:

[1] Machine Design by Robert L. Norton, Pearson, 5th Edition, 2013.

[2] Design Data Book Compiled by PSG College of Engineering & Technology, Coimbatore

Web References:

- https://nptel.ac.in/courses/112105124/
- https://nptel.ac.in/courses/112106137/
- https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009/
- https://pe.gatech.edu/courses/machine-design-part-1

Journals References:

- Journal of Mechanical Design (JMD), ASME
- Materials & Design, Elsevier
- Design Studies, Elsevier

- Trends in Machine Design, STM Journals
- Finite Elements in Analysis and Design, Elsevier

Title: Measurement and Instrumentation **Code:**
L-T Scheme: 3-0-0 **Credits: 3**
Prerequisite: Nil
Objectives:

1. To introduce students to the automatic measurement process.
2. To understand students how different types of meters work and their construction.
3. To provide a student knowledge of the various types of sensors and their signal conditioning circuits.
4. To develop the ability to use modern tools necessary for hardware projects.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the measurement process and instrument characteristics concerning their needs in the industry.
CO2	Describe the working principle and operation of various types of measuring instruments.
CO3	Develop a measurement setup to meet industry expectations.
CO4	Identify and use various electrical instruments used in the measurement process.
CO5	Apply error analysis on a given measurement setup.
CO6	Demonstrate the application of various measurement devices.

COURSE OF CONTENTS

Unit 1: Fundamentals of Measurement: Measurement Methods, Generalized measurement System, Classification of Instruments, Static & Dynamic Characteristics, Errors & Uncertainty measurement of system, Linear & Non-linear Systems.

Unit 2: Transducers: Transducers – Classification of transducers, Temperature transducer, Pressure transducer, Displacement transducer, Strain gauge, LVDT, RTD, Thermistor, Thermocouple, Piezo-electric transducer.

Unit 3: Signal Conditioning Circuits : D.C. bridges and their application in measurement of resistance, Kelvin's double bridge, A.C. Bridges- general equation, Potentiometer- DC potentiometer, Multi-range potentiometer, Q-meter and its applications. Amplifiers, Attenuators, Filters, Instrumentation Amplifier, Analog to digital converts.

Unit 4: Electrical Instruments: Moving coil, Moving iron, PMMC, Dynamometer and Induction type instruments, Measurement of Voltage, Current, Power, Power Factor, Energy, Instrument Transformer - current and potential transformer, Measurement of Phase & Frequency.

Unit 5: Signal Generators and Display Devices : Multivibrators: astable, monostable and bistable types. Generation of square and triangular waveforms. IC 555 timer and its application in multivibrators. Construction & working of Basic CRO, its Components (Deflection plates, Screen, Aquadag, Time Base Generator, Oscilloscope Amplifiers), Measurements of phase and

frequency (Lissajous Patterns), Types of CRO, Special types of CRO, Types of CRO Probes. Digital Voltmeter

Teaching Methodology:

This course is introduced to familiarize the student with the devices and processes utilized in the automation industry. Starting from the basic concepts, the student will gradually develop an understanding of practical setups used in the industry. The entire course is broken down into five units, such that each unit covers a particular aspect of the measurement process. This theory course is well complemented by a laboratory course under the name Measurement and Instrumentation Lab in the same semester that helps a student learn with hands-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2 (Selected topic)
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Measurement & Instrumentation (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] A.K.Sawhney & Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, 12/e, Dhanpat Rai & Co. (P) Ltd.,2004

[2] Albert D.Helfrick & William D.Cooper, “Modern Electronic Instrumentation and Measurement Technique”,Low Price Edition, Pearson Education, 2005

[3] Ernest O.Doebelin, “Measurement Systems Application and Design”, 5/e, Tata McGraw –Hill Publishing Company Ltd., 2004

Reference Books/Materials:

[1] H.S.Kalsi, “Electronic Instrumentaion”, Technical Education Series, Tata McGraw –Hill Publishing Company Ltd.,2001

[2] D.C. Kulshreshtha, “Principles of Electrical Engineering”, Tata McGraw Hill Publishing Co

Web References:

- https://nptel.ac.in/courses/108105153/
- https://nptel.ac.in/courses/108/105/108105064/

Journals References:

[1] International Journal of Instrumentation Technology (Inderscience)
[2] IEEE Transactions on Instrumentation and Measurement

TITLE: COMPUTER INTEGRATED MANUFACTURING CODE:
L-T-P scheme: 3-0-0 CREDITS:3

Objectives:

- This course introduces students with computer assisted modern manufacturing technologies.
- The topics covered in this course include basics of automation, NC programming (manual and APT), concepts of group technology, Flexible Manufacturing system, CIM and robotics.
- The objective of this course is to make students learn the important theoretical concepts, and the state-of-the-art technological developments in the area of modern manufacturing.

Learning Outcome:

Course Outcome	Description
CO1	Outline basic concepts related to CIM like types of production, plant layout, sequencing and scheduling, group technology, types of automation and FMS.
CO2	Describe NC, CNC and DNC, computer aided process planning (CAPP) and Automated inspection.
CO3	Develop ability to classify parts into families via GT concepts, classification and coding schemes, PFA etc.
CO4	Identify the sequence of operation, generate process plan and simulate and write part programs for CNC milling and lathe; FMS introduction, component and layouts.
CO5	Apply acquired knowledge to perform machining, inspection and assembly operations on Flexible manufacturing system available in CIM lab of the department.
CO6	Demonstrate ability to work in a flexible manufacturing system in an organization.

COURSE CONTENT

Introduction: Automation, Need for Automation, Types of automation systems, Automation strategies, levels of automation, Introduction to NC, CNC and DNC and Computer integrated manufacturing, CIM wheel, components of CIM

Part programming: Introduction, NC coordinate system, fixed and floating zero machines, NC motion control systems, part programming methods, Manual part programming for milling and lathe using G and M codes, various canned cycles

Group Technology: part families, part classification and coding, production flow analysis, composite part concept, benefits of GT.

Flexible Manufacturing System: Definition of FMS, components of FMS, types of flexibilities, classification of FMS, primary and secondary material handling systems, FMS layout configurations, computer control system, FMS applications and benefits.

Automated Material Handling and AS/RS: Introduction, types of material handling equipment, automated guided vehicle system (AGVs), applications, vehicle guidance and routing, traffic control and safety system management, Basic components of AS/RS, types of AS/RS, AS/RS controls, special features.

Robotics: Definition, robot anatomy and related attributes, robot configuration, work volume, types of control systems, end effectors, industrial applications of robot, introduction to robot programming.

Automated Inspection & Testing: Automated inspection principles, off-line and on-line inspection, contact and noncontact inspection techniques, Co-ordinate measuring machine (CMM): Introduction and types of CMM.

Manufacturing Support System: Product design and CAD, concurrent engineering and Computer aided process planning (CAPP).

TEXT BOOK:

1. Groover M. P., Automation, Production Systems And Computer-integrated Manufacturing, PHI.
2. Miller R. K., FMS/CIM Systems Integrated Handbook, Prentice Hall

REFERENCES:

1. Parrish D. J, “Flexible manufacturing”, Butterworth – Heinemann Ltd, 1990
2. Rao, P.N., CAD / CAM Principles and Applications, McGraw Hill Publishers, New Delhi
3. Jha, N. K., Handbook of Flexible Manufacturing Systems, Academic Press Inc.

Title: Minor Project Part-1 **Code:ME213**
L-T-P scheme:0-0-4 **Credit: 2**
Prerequisite: Students must have already studied the fundamental courses, **"Mechanical Engineering"** and "**Mechanical Engineering Lab**".
Objective:

1. To learn and be able to implement the Mechanical Engineering in different industry.

Course Content:
UNIT-I IDENTIFICATION OF INNOVATIVE WORK: ,based upon Literature survey

Course Outcome	*Description*
CO1	Introduction to practical course requirement under the guidance of a faculty supervisor member to understand the respective design project to do innovative work with the application
CO2	Students are expected to do a literature survey and carry out development and/or experimentation in their respective design projects. Interaction with existing work of current researchers of their respective project work.
CO3	Development of the theoretical model and computational analysis of the existing working design project model.
CO4	Preparation of theoretical analysis for an innovative technique to overcome the current troubles of industrial applications related to their design project work.
CO5	Verification and validation techniques of their respective design project
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

UNIT-II student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.
UNIT-III The student is expected to do literature survey and carry out development and/or experimentation.
UNIT-IV Through project work the student has to exhibit both analytical and practical skills. The project is done in two semesters, i.e. 7th and 8th, on a continuous problem.
UNIT-V *Demonstrate deployment and basic maintenance skills of the* respective design project
Project is a course requirement wherein under the guidance of a faculty member, a final year student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through project work the student has to exhibit both analytical and practical skills. The project is done in two semesters, i.e. 7th and 8th, on a continuous problem.

Exams	Marks	Coverage
P-1	20 Marks	**Based on :** *Literature survey and Interaction with existing work*

			of current researchers of their respective project work.
P-2		15 Marks	**Based on:** *Development of the theoretical model and computational analysis of the existing working design project model.*
P3		20 Marks	**Based on:** *Demonstrate deployment and basic maintenance skills of the* respective design project.
Day-to-Day Work	Supervisor Marks [**Day- to- Day Marks**] [Attendance, Performance, Discipline]	35 Marks	**45 Marks**
	Thesis	10 Marks	
Total		**100 Marks**	

Learning Resources: Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. **As prescribed by respective project supervisor.**

Title: Design of Machine Elements Lab **Code:ME214**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied the course, "Design of Machine Elements"

Objective:

1. To familiarize with the various steps involved in the design process
2. To know the principles involved in evaluating the shape, size and dimensions of machine components to satisfy functional and strength requirements
3. To learn to use standard practices and standard data

Learning Outcomes:

Course Outcome	Description
CO1	Apply concepts of design and select commonly used machine components
CO2	Demonstrate understanding of various design consideration
CO3	Practice systematic approaches to mechanical design and analysis procedures
CO4	Understand, formulate and implement standards in the design of machine components in engineering practice
CO5	Produce analysis briefs, design sketches, assembly and detail drawings that clearly communicate machine element design and analysis
CO6	Demonstrate and deployment of computer based techniques in the analysis, design and selection of machine components

Course Content:

Experiment-1: Design of belts and pulleys

Experiment-2: Design of chain and rope drives

Experiment-3: Design of a shaft

Experiment-4: Design of keys and coupling

Experiment-5: Design of knuckle and cotter joint

Experiment-6: Design of welded and riveted butt joint

Experiment-7: Design of welded and riveted lap joint

Experiment-8: To Design of helical spring

Experiment-9: Design of leaf spring

Experiment-10: Design of spur gears

Experiment-11: Design of journal bearing

Experiment-12: Design of roller bearings

Experiment-13: Design of connecting rod

Experiment-14: Design of Piston

Teaching Methodology:

This Lab course has been introduced to help a student to learn with hand-on experience on design of machine element. The entire course is divided into fourteen experiments. Each experiment includes mechanical design principles applied to various machine elements in order to help a student gain more experience as Mechanical Engineer. This lab course is well complemented by a theory course under the name Design of Machine Elements in the same semester in order to enable the student to get acquainted, learn and discuss the technical details involved in the design and selection of machine components. This Lab course will enable a student to learn with hand-on experience.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	**Based on Lab Exercises: 1-7**
P-2		15 Marks	**Based on Lab Exercises: 8-14**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Laboratory Manual available in Lab. Study material of Design of Machine Elements Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Design of Machine elements by V. B. Bhandari, McGraw Hill Education, 4th Edition, 2017.

[2] Mechanical Engineering Design by J. E. Shigley and L. D. Mitchell, McGraw-Hill Education; 10th Edition, 2014.

Reference Books/Material:

[1] Machine Design by Robert L. Norton, Pearson, 5th Edition, 2013.

[2] Design Data Book Compiled by PSG College of Engineering & Technology, Coimbatore

Web References:

[1] https://nptel.ac.in/courses/112105124/

[2] https://nptel.ac.in/courses/112106137/

[3] https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009/

[4] https://pe.gatech.edu/courses/machine-design-part-1

Journals References:

[1] Journal of Mechanical Design (JMD), ASME

[2] Materials & Design, Elsevier

[3] Design Studies, Elsevier

[4] Trends in Machine Design, STM Journals

[5] Finite Elements in Analysis and Design, Elsevier

Title: Measurement & Instrumentation Lab **Code:**
L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Nil

Objectives:

1. To introduce students to the automatic measurement process.
2. To understand students how different types of meters work and their construction.
3. To provide a student knowledge of the various types of sensors and their signal conditioning circuits.
4. To develop the ability to use modern tools necessary for hardware projects.

Learning Outcomes: In reference to Measurement & Instrumentation (18B11EC314), the students will be able to:

Course Outcome	Description
CO1	Outline the measurement process and instrument characteristics concerning their needs in the industry.
CO2	Describe the working principle and operation of various types of measuring instruments.
CO3	Develop a measurement setup to meet industry expectations.
CO4	Identify and use various electrical instruments used in the measurement process.
CO5	Apply error analysis on a given measurement setup.
CO6	Demonstrate the application of various measurement devices.

Course Content:

Unit 1: Lab exercise based on introduction to DC bridges and measurement of resistance

Unit 2: Lab exercise based on working of AC bridges and measurement of inductance and capacitance

Unit 3: Lab exercise based on operation of transducer for strain and displacement measurement

Unit 4: Lab exercise based on measurement of temperature using active and passive transducers

Unit 5: Lab exercise based on implementation of signal conditioning circuits such as amplifier, analog to digital converter etc.

Teaching Methodology:

This course is introduced to help the students to familiarize with the devices and methods used for automatic measurement. In this course, the mixed technique of interactive discussion, regular assignments will be used. In the discussion the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion will be implemented in laboratory by using the practical setups.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	**Based on Lab Exercises: 1-5**
P-2		15 Marks	**Based on Lab Exercises: 6-11**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Measurement & Instrumentation Lab (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Laboratory Manual available in Lab
[2] A.K.Sawhney & Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, 12/e, Dhanpat Rai & Co. (P) Ltd.,2004
[3] B.C.Nakra & K.K.Chaudhary,Instrumentation Measurement And Analysis, Tata McGraw-Hill Publishing Company Ltd, New Delhi.,1996
[4] D.Patranabis, Principles of Industrial Instrumentation, 2/e, Tata McGraw-Hill Publishing Company Ltd, New Delhi.,1998

Reference Books/Materials:

[1] James W. Dally, William F. Riley & Kenneth G.McConnell, Instrumentation for Engineering Measurements,2/e,Wiley Student Edition, John Wiley & Sons,INC,2003.
[2] John P.Bentley, Principles of Measurement Systems, Low Price Edition, Pearson Education Asia,2000
[3] Dr.D.S.Kumar, Mechanical Measurements and Control, 3/e, Reprint-2004, Metropolitan Book Co. Private Ltd.,2004
[4] Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005.

Web References:

- https://nptel.ac.in/courses/108/108/108108147/
- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112104250/lec21.pdf
- https://www.electronics-tutorials.ws/io/io_1.html

Journals References:

- Sensors and Actuators A: Physical (Elsevier)

TITLE: CIM Lab **CODE:**
L-T-P : 0-0-2 **Credit: 1**

SCOPE AND OBJECTIVES

- This course is designed to provide practical experience to the students with an opportunity of hands-on training on modern CNC machines and CIM system.
- The topics covered in this course include the basics of automation, NC programming (Manual and APT), concepts of group technology, Flexible Manufacturing system, CIM and robotics etc.
- The objective of this course is to expose the students to practical aspects of automation and the state-of-the-art technological developments in the area of modern manufacturing.

LEARNING OUTCOME:

Course Outcome	Description
CO1	Outline basic concepts related to CIM like types of production, plant layout, sequencing and scheduling, group technology, types of automation and FMS.
CO2	Describe NC, CNC and DNC, types and components of FMS, part classification and coding schemes, computer aided process planning (CAPP) and Automated inspection.
CO3	Develop ability to write CNC part programs, formation of part families, pick and place programs for robot and automated inspection through CMM.
CO4	Identify the sequence of operation, generate process plan and simulate the FMS operation in off-line mode.
CO5	Apply acquired knowledge to perform machining, inspection and assembly operations on Flexible manufacturing system available in CIM lab of the department.
CO6	Demonstrate ability to work in a flexible manufacturing system in an organization.

COURSE CONTENT

1. Write a manual part program for Linear and Circular Contour (G01, G02, and G03) operation for the component.
2. Write a manual part program for Box Facing (G94) operation for the component.
3. Write a manual part program for Multiple Facing (G72) operation for the component.
4. Write a manual part program for Multiple Turning operation with G71 Cycle for the component.
5. Write a manual part program for Peck Drilling operation with G74 Cycle for the component.
6. Write a manual part program for Turning and Parting OFF operation through subroutines for the component.
7. Write a manual part program for Contouring (G40, G41) operation with Left cutter diameter compensation for the component.
8. Write a manual part program for Contouring (M98, M99) operation through subprogram for the component.

9. Write a manual part program for Mirroring (M70, M71, M80, and M81) operation for the component.
10. Write a manual part program for Drilling (G73, G83, G98, and G99) operation for the component.
11. Write a manual part program for Pocketing (G170, G171) operation for the component.
12. Write a program for pick and place operation for 5-axis robot
13. Write a program for continuous welding operation for 6-axis robot
14. Demonstration and study of CIM system Off-line and on-line mode.

TEXT BOOK:

1. Groover M. P., Automation, Production Systems And Computer-integrated Manufacturing, PHI.
3. CNC XLTURN Manual by MTAB, Chennai
4. CNC XLMILL Manual by MTAB, Chennai
5. Miller R. K., FMS/CIM Systems Integrated Handbook, Prentice Hall

REFERENCES:

6. Parrish D. J, "Flexible manufacturing", Butterworth – Heinemann Ltd, 1990
7. Rao, P.N., CAD / CAM Principles and Applications, McGraw Hill Publishers, New Delhi
8. Jha, N. K., Handbook of Flexible Manufacturing Systems, Academic Press Inc.

Title: Digital Signal Processing Lab **Code:**
L-T-P Scheme: 3-1-0 **Credit: 1**

Prerequisite: Students must have already studied courses, "*Signals & Systems"*

Objective:

1. To enhance comprehension capabilities of students through understanding of various functions of MATLAB
2. To study various transforms for signal analysis.
3. To learn different windowing techniques for filter design

Learning Outcomes: In reference to Digital Signal Processing (18B11EC413), the students will be able to:

CO1	Outline based on introduction to MATLAB and operation of its various functions, Discrete/digital signals and systems along with their representation ..
CO2	Describe concept of linear & circular convolution with MATLAB.
CO3	Develop the concept of various methods such as overlap add and overlap save used for convolution.
CO4	Identify different approaches for implementation of Z-transform, Region of convergence, Inverse Z-transform.
CO5	Apply important approach for time and frequency analysis signal by using Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms by using Decimation in Time and Decimation in Frequency techniques.

CO6	Demonstrate the concept of various windows for FIR and IIR filters design with MATLAB

Course Content:

Unit 1: Lab exercise based on introduction to MATLAB and generation of various signals.

Unit 2: Lab exercise based on implementation of linear & circular convolution with MATLAB

Unit 3: Lab exercise based on implementation of linear convolution using overlap adds and overlaps save methods with MATLAB

Unit 3: Lab exercise based on implementation of Z-transform, region of Convergence, Inverse Z-transform and its evaluation MATLAB

Unit 4: Lab exercise based on Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms using Decimation in Time and Decimation in Frequency techniques

Unit 5: Lab exercise based on implementation of various windows and FIR and IIR filters with MATLAB

Teaching Methodology:

This course is introduced to help the students to design various filters by using window functions. In this course, the mixed technique of interactive discussion, regular assignments will be used. In the discussion the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion will be implemented in laboratory by using Matlab.

Evaluation Scheme:

Exams	**Marks**		**Coverage**
P-1	**15 Marks**		**Based on Lab Exercises: 1-7**
P-2	**15 Marks**		**Based on Lab Exercises: 8-14**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Digital Signal Processing Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:

[1] "Digital Signal Processing: Principles Algorithms and Applications", Proakis & Manolakis, PHI 4e, 2015.

Reference Books/ Material:

[1] "Digital Signal Processing: A Computer Base Approach", S.K. Mitra, TMH, 2e, 2005.
[2] "Digital Signal Processing: Signals, Systems and Filters", Andreas Antoniou, TMH, 4e, 2015.
[3] "Texas Instruments, Digital Signal Processing Applications with the TMS 320 Family", Prentice Hall,2e,1987

Web References

[1] www.dspguide.com
[2] www.byclb.com/totorials/dsp advanced

Journal References

[1] IET Signal Processing Journal
[2] Journal of Advanced Research in Signal Processing & Applications, ADR publications
[3] Signal & Image Processing : An International Journal(SIPIJ)
[4] EURASIP Journal on Advances in Signal Processing
[5] International Journal of Wireless Personal Communications

Title:HSS Elective - 3 **Code:**
L-T-P scheme: 2**-1-0** **Credit: 3**

TITLE: Basics of Additive Manufacturing **CODE:**
L-T-P scheme: 3-0-0 **CREDITS: 3**

Objectives:

4. The objective of the course is to make the students aware about the additive manufacturing (AM) technology used for conceptual modeling, prototyping and rapid manufacturing.
5. Students will know about wide range of materials and applications of AM in industry and society.
6. Students will also know about file formats, rapid tooling and metal additive manufacturing processes.

Learning Outcome:

Course Outcome	Description
CO1	Outline the additive manufacturing process. Introduction, definition, Process chain, Strength and weakness of AM compared to conventional subtractive manufacturing processes.
CO2	Describe the working procedure of various AM processes. Classification and detail descriptions of various rapid prototyping and rapid tooling processes.
CO3	Develop understanding to differentiate rapid prototyping from rapid

	manufacturing, rapid manufacturing processes and various file formats.
CO4	Identify the strength and limitations of various file formats, errors and repair of files. AM process to be used for a particular application in industry.
CO5	Apply acquired knowledge in new product development and mass customization of products in various industries such as automobile, aerospace, medical, construction, fashion, electronics etc.
CO6	Demonstrate skill to build AM part by preparing CAD model, pre processing, part building and post processing the part.

COURSE CONTENT

INTRODUCTION: Overview, history, concept, definition and process chain of additive manufacturing.

CLASSIFICATION: Liquid based, solid based, and powder based AM processes; Fused Deposition Modeling of polymers, ceramics and metals, Laminated Object Manufacturing , Shape Deposition Manufacturing, Stereolithography and other liquid based systems, Laser sintering based technologies and their related details, 3D printing, Direct Metal Deposition, laser and Electron Beam melting based technologies.

DATA EXCHANGE FORMATS: Data formats for AM and associated details, Data conversion for AM and associated difficulties, Data validity checks for AM, Data repair procedures for AM, Slicing algorithms and related details, Direct slicing, Standard data formats for translation, Relevant AM file formats, STEP data format and its details.

APPLICATIONS: Applications of AM in different industries

RAPID TOOLING: Direct and indirect tooling processes.

RAPID MANUFACTURING: Different applications of AM for directly making end-use parts; Medical RP- dental, hearing aid, medical devices, bone-transplant, surgical planning and tissue engineering; Mass customization – production of customized products in mass scale.

REVERSE ENGINEERING: Definition of Reverse Engineering (RE), Need for RE, Three phases in the generic RE process – scanning (contact and non-contact scanners), point processing and geometric modeling.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3, Unit-4 and around 30% from coverage Test-1
Test-3	35 Marks	Based on Unit-5, Unit-6, Unit-7 and around 30% from covera of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

TEXT BOOK:

1. Chua, C K, Leong, K F and Lim CS, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific, 2003.
2. Gibson, I., Rosen, D.W. and Stucker, B., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, 2010.

REFERENCES:

1. Hopkinson, N, Hague, R, and Dickens, P, Rapid Manufacturing: An Industrial Revolution for a Digital Age: An Industrial Revolution for the Digital Age, Wiley, Jan 2006.
2. Raja, V. and Fernandes K.J., Reverse Engineering – An Industrial Perspective, Springer-Verlag London Ltd, 2008.
3. Kamrani, A.K. and Nasr, E.A., Rapid Prototyping – Theory and Practice, Springer Science and Business Media Inc., New York, NY 10013, USA, 2006.
4. Bartolo, P J (editor), Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping, Taylor and Francis, 2007.
5. Cooper K. G., Rapid Prototyping Technology: Selection and Application, CRC Press.

Title: Introduction to Microprocessors and Microcontrollers **Code:**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied "*Digital Electronics*" course.

Objective:

1. Students should learn a microprocessor's programming model at a level that enables them to write assembly language programs for the processor that meets given specifications, learn concepts associated with interfacing a microprocessor to memory
2. Learn how to control components of a microprocessor based system through the use of interrupts.
3. Students understand the basic operation of a microcontroller system and who have learned fundamental programming skills in assembly language.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various microprocessor and microcontroller with respect to their needs for the development of digital systems
CO2	Description of the characteristic parameters of 8085 microprocessor.
CO3	Development of the input output interfacing circuits.
CO4	Identification and use of various microcontrollers and their hardware description.
CO5	Application of microprocessor and microcontroller on a given assignment/ project.
CO6	Demonstration and deployment of basic design of microprocessor and microcontroller based computer systems.

Course Content:

Unit-1: Introduction to Microprocessor: Review of digital electronics , historical background, Microprocessor and microcontroller based computer systems.

Unit-2: 8085 Microprocessor: Introduction, 8085: pin-outs and the pin function, instruction set, bus timings, addressing mode, programming in 8085, programming example, counter and delay, stack and subroutine, basic Interrupt processing, hardware interrupts.

Unit-3: I/O Interfacing: Memory organization & Interfacing, I/O interfacing.

Unit-4: 8086 microprocessor: Pin-outs and the pin function, clock generators, bus buffering & latching, ready and wait states, minimum mode versus maximum mode, memory segmentation. Programming in 8086, programming example.

Unit-5: Introduction of microcontrollers: A microcontroller's survey, Development system for microcontrollers and case studies. 8051: microcontrollers Hardware, Input/output pins, ports & circuits, External memory, counters & timers, Serial Data input/output, interrupts. 8051 addressing mode: Programming the 8051.

Teaching Methodology:

This course is introduced to help student to understand basics of microprocessor and microcontroller. He will be able to understand and perform various programming of microprocessor and its interfacing. Lectures would be interactive and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides on Microprocessor and microcontroller (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Fundamentals of Microprocessors and Microcontrollers, 7th edition, Dhanpat Rai Publication, India, 2010 by B. Ram.

[2] Introduction to Microprocessors, Wiley Eastern (Latest Edition) R.S. Gaonkar.

Reference Books/Material:

[1] Advanced microprocessors and peripherals by AK Ray.
[2] The 8051 microcontrollers Architecture, Programming & application ,2nd edition by Kenneth .J. Ayala

Web References:

- https://www.tutorialspoint.com/
- https://www.lecturenotes.in

Journals References:

- Microprocessors and Microsystems journal Elsevier.
- Microprocessors and Microsystems journal Science direct.
- Journal of Microcontroller engineering and applications.

Title: Digital Signal Processing **Code:**
L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have already studied courses, "*Signals & Systems"*
Objective:

1. To enhance comprehension capabilities of students through understanding of designing procedure of digital filters both FIR and IIR using different approaches and their associated structures.
2. To study linear predictors for adaptive signal processing.
3. To learn different adaptive filtering algorithms and obtain results from multirate signal processing.

Learning Outcomes: The students will be able to:

CO1	Outline various discrete/digital signals and systems, their representation and processing
CO2	Describe concept of frequency domain analysis of discrete time signals
CO3	Develop the concept of basic filters and filtering process and their realization
CO4	Identify different approaches and their associated structures designed for both digital FIR and IIR filters.
CO5	Apply important algorithmic design paradigms and method of analysis.
CO6	Demonstrate the concept of multi-rate signal processing and sampling rate conversion & filtering algorithm for the real time application.

Course Content:

Unit 1: Discrete Signals: Review of Discrete time sequences and systems, Linearity, shift-invariance, causality and stability criterion. **Z-Transform:** Review of Z-transforms, Region of Convergence, Relationship between Z transform and Fourier Transform, Inverse Z-transform and its evaluation, System function and structures of a digital filter.

Unit 2: Discrete Fourier Transforms and FFT: Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms using Decimation in Time and Decimation in Frequency techniques, Chirp Z-transform.

Unit 3: IIR and FIR Filter Design: Basic Structures, Review of approximation of filter functions, Design of IIR filters based on Analog filter functions, Invariant & Modified Invariant Impulse Response techniques, Bilinear transformation method, Direct design approach, Linear phase description of FIR filters, Windowing and Frequency sampling techniques of design, Computer aided design techniques.

Unit 4: Some DSP Applications: Applications in speech processing and power spectrum estimation. Introduction to illustrate applications of DSP in image processing,

Unit 5: Adaptive and Multi-rate Systems: Introduction to Adaptive Filters, Design of Adaptive Filters using various techniques, Decimation & Interpolation, Filter design for Sampling Rate Conversation by a Rational Factor I/D.

Teaching Methodology:

This course is introduced to help the students to design various filters by using window functions. In this course, the mixed technique of interactive lectures, tutorials, and regular assignments will be used. In the lectures the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion in lecture will be done using design problems which will be implemented in laboratory individually in Matlab.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture and tutorial slides on Digital Signal Processing (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Proakis & Manolakis, Digital *Signal Processing: Principles Algorithms and Applications*, PHI.

Reference Books/ Material:

[1] S.K. Mitra, Digital Signal Processing: A Computer Base Approach, TMH

[2] Andreas Antoniou, Digital Signal Processing: Signals, Systems and Filters, TMH
[3] Texas Instruments, Digital Signal Processing Applications with the TMS 320 Family, Prentice Hall

Web References

[1] www.dspguide.com
[2] www.byclb.com/totorials/dsp advanced

Journal References

[1] IET Signal Processing Journal
[2] Journal of Advanced Research in Signal Processing & Applications, ADR publications
[3] Signal & Image Processing : An International Journal(SIPIJ
[4] EURASIP Journal on Advances in Signal Processing

Title: Digital Signal Processing Lab **Code:**
L-T-P Scheme: 3-1-0 **Credit: 1**

Prerequisite: Students must have already studied courses, "*Signals & Systems"*

Objective:

4. To enhance comprehension capabilities of students through understanding of various functions of MATLAB
5. To study various transforms for signal analysis.
6. To learn different windowing techniques for filter design

Learning Outcomes: In reference to Digital Signal Processing (18B11EC413), the students will be able to:

CO1	Outline based on introduction to MATLAB and operation of its various functions, Discrete/digital signals and systems along with their representation ..
CO2	Describe concept of linear & circular convolution with MATLAB.
CO3	Develop the concept of various methods such as overlap add and overlap save used for convolution.
CO4	Identify different approaches for implementation of Z-transform, Region of convergence, Inverse Z-transform.
CO5	Apply important approach for time and frequency analysis signal by using Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms by using Decimation in Time and Decimation in Frequency techniques.
CO6	Demonstrate the concept of various windows for FIR and IIR filters design with MATLAB

Course Content:

Unit 1: Lab exercise based on introduction to MATLAB and generation of various signals.

Unit 2: Lab exercise based on implementation of linear & circular convolution with MATLAB

Unit 3: Lab exercise based on implementation of linear convolution using overlap adds and overlaps save methods with MATLAB

Unit 3: Lab exercise based on implementation of Z-transform, region of Convergence, Inverse Z-transform and its evaluation MATLAB

Unit 4: Lab exercise based on Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms using Decimation in Time and Decimation in Frequency techniques

Unit 5: Lab exercise based on implementation of various windows and FIR and IIR filters with MATLAB

Teaching Methodology:

This course is introduced to help the students to design various filters by using window functions. In this course, the mixed technique of interactive discussion, regular assignments will be used. In the discussion the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion will be implemented in laboratory by using Matlab.

Evaluation Scheme:

Exams	Marks		Coverage
P-1	**15 Marks**		**Based on Lab Exercises: 1-7**
P-2	**15 Marks**		**Based on Lab Exercises: 8-14**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Digital Signal Processing Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:

[2] "Digital Signal Processing: Principles Algorithms and Applications", Proakis & Manolakis, PHI 4e, 2015.

Reference Books/ Material:

[4] "Digital Signal Processing: A Computer Base Approach", S.K. Mitra, TMH, 2e, 2005.
[5] "Digital Signal Processing: Signals, Systems and Filters", Andreas Antoniou, TMH, 4e, 2015.
[6] "Texas Instruments, Digital Signal Processing Applications with the TMS 320 Family", Prentice Hall,2e,1987

Web References
[3] www.dspguide.com
[4] www.byclb.com/totorials/dsp advanced
Journal References
[6] IET Signal Processing Journal
[7] Journal of Advanced Research in Signal Processing & Applications, ADR publications
[8] Signal & Image Processing : An International Journal(SIPIJ)
[9] EURASIP Journal on Advances in Signal Processing
[10] International Journal of Wireless Personal Communications

Title: Digital Signal Processing Lab **Code:**
L-T-P Scheme: 3-1-0 **Credit: 1**

Prerequisite: Students must have already studied courses, "*Signals & Systems"*
Objective:

7. To enhance comprehension capabilities of students through understanding of various functions of MATLAB
8. To study various transforms for signal analysis.
9. To learn different windowing techniques for filter design

Learning Outcomes: In reference to Digital Signal Processing (18B11EC413), the students will be able to:

CO1	Outline based on introduction to MATLAB and operation of its various functions, Discrete/digital signals and systems along with their representation ..
CO2	Describe concept of linear & circular convolution with MATLAB.
CO3	Develop the concept of various methods such as overlap add and overlap save used for convolution.
CO4	Identify different approaches for implementation of Z-transform, Region of convergence, Inverse Z-transform.
CO5	Apply important approach for time and frequency analysis signal by using Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms by using Decimation in Time and Decimation in Frequency techniques.
CO6	Demonstrate the concept of various windows for FIR and IIR filters design with MATLAB

Course Content:

Unit 1: Lab exercise based on introduction to MATLAB and generation of various signals.

Unit 2: Lab exercise based on implementation of linear & circular convolution with MATLAB

Unit 3: Lab exercise based on implementation of linear convolution using overlap adds and overlaps save methods with MATLAB

Unit 3: Lab exercise based on implementation of Z-transform, region of Convergence, Inverse Z-transform and its evaluation MATLAB

Unit 4: Lab exercise based on Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms using Decimation in Time and Decimation in Frequency techniques

Unit 5: Lab exercise based on implementation of various windows and FIR and IIR filters with MATLAB

Teaching Methodology:
This course is introduced to help the students to design various filters by using window functions. In this course, the mixed technique of interactive discussion, regular assignments will be used. In the discussion the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion will be implemented in laboratory by using Matlab.
Evaluation Scheme:

Exams	Marks		Coverage
P-1	**15 Marks**		**Based on Lab Exercises: 1-7**
P-2	**15 Marks**		**Based on Lab Exercises: 8-14**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Study material of Digital Signal Processing Lab (will be added time to time): Digital copy will be available on the JUET server.
Text Books:
[3] "Digital Signal Processing: Principles Algorithms and Applications", Proakis & Manolakis, PHI 4e, 2015.
Reference Books/ Material:

[7] "Digital Signal Processing: A Computer Base Approach", S.K. Mitra, TMH, 2e, 2005.
[8] "Digital Signal Processing: Signals, Systems and Filters", Andreas Antoniou, TMH, 4e, 2015.
[9] "Texas Instruments, Digital Signal Processing Applications with the TMS 320 Family", Prentice Hall,2e,1987
Web References

[5] www.dspguide.com
[6] www.byclb.com/totorials/dsp advanced

Journal References

[11] IET Signal Processing Journal
[12] Journal of Advanced Research in Signal Processing & Applications, ADR publications
[13] Signal & Image Processing : An International Journal(SIPIJ)
[14] EURASIP Journal on Advances in Signal Processing
[15] International Journal of Wireless Personal Communications

Title: Minor Project-2 **Code: ME216**

L-T-P scheme: 0-0-2 **Credit: 2**

Prerequisite: Students must have already studied the courses, "Fluid Mechanics, Thermodynamics, Heat and Transfer" and "Engineering Mechanics, Machine dynamics, Machine Design, Manufacturing Technology, Industrial Technology".

Objective:

1. To learn and be able to implement the front-end and back-end web-technologies.
2. To develop the abilities to call oneself full-stack web developer.

Course Outcome	Description
CO1	Introduction to practical course requirement under the guidance of a faculty supervisor member to understand the respective design project to do innovative work with the application
CO2	Interaction with existing work of current researchers of their respective project work.
CO3	Development of the theoretical model and computational analysis of the existing working design project model.
CO4	Preparation of theoretical analysis for an innovative technique to overcome the current troubles of industrial applications related to their design project work.
CO5	Verification and validation techniques of their respective design project
CO6	student is expected to do literature survey and carry out development and/or experimentation

UNIT-1 Identification of Innovative work, based upon Literature survey

UNIT- 2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 The student is expected to do literature survey and carry out development and/or experimentation.

UNIT-4 Through project work the student has to exhibit both analytical and practical skills. The project is done in two semesters, i.e. 7th and 8th, on a continuous problem.

UNIT-5 Verification and validation techniques of their respective design project

Teaching Methodology:A topic or problem will be allotted to the student after that relevant literature survey will be done by the student. Based upon the literature survey, it is expected from

the student to find the solution experimentally/theoretically to arrive at some concrete conclusion. . The student is expected to do literature survey and carry out development and/or experimentation

Evaluation Scheme:

Exams	Marks	Coverage
P-1	20 Marks	Based on Unit-1, Unit-2 & Unit-3
P-2	15 Marks	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
P-3	20 Marks	Based on Unit-6 to Unit-8 and around 30% from coverage of Test-2
supervisor Marks for performance and Attendance	35 Marks	
Report	10 Marks	
Total	**100 Marks**	

Learning Resources:
1. Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html
3. https://scholar.google.com/
Text Book: As prescribed by respective supervisor faculty member

Title: Advanced Manufacturing Processes **Code: ME303**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Manufacturing Technology-I*" and "*Manufacturing Technology-II*".

Objective:
1. To understand the working principles/mechanisms involved in different manufacturing processes
2. To learn and know about the applications of advanced manufacturing processes.
3. To encourage the students for doing their projects in the area of Advanced Manufacturing Processes

Learning Outcomes:

Course Outcome	Description
CO1	Outline various advanced manufacturing process based on energy sources and mechanism employed.
CO2	Describe the industrial or real world problems using advanced manufacturing concepts and systems.
CO3	Develop an idea to fabricate or modify the laboratory setups to find out the solution of industrial problems.
CO4	Identify the most influencing process parameters to manufacture a defect free product.
CO5	Apply most appropriate advanced technique to manufacture a product economically.
CO6	Demonstrate and deployment the mechanism of advanced manufacturing processes for solving real-world problems.

Course Content:

Unit-1:INTRODUCTION: Limitations of Conventional Manufacturing Processes, Need And Classification of Unconventional or Advanced Manufacturing Processes .

Unit-2:MECHANICAL ENERGY BASED UNCONVENTIONAL MACHINING PROCESSES: Process Principle, Analysis and Applications of Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultra-Sonic Machining.

Unit-3: UNCONVENTIONAL FINISHING PROCESSES: Need, classification, process principle and applications of Abrasive Flow Finishing, Magnetic Abrasive Flow Finishing, Magneto-Rheological Finishing.

Unit-4: THERMAL ENERGY BASED UNCONVENTIONAL MACHINING PROCESSES: Electric Discharge Machining, Laser Beam Machining, Electron Beam Machining, Ion Beam Machining, Plasma Beam Machining, and Electro Discharge Abrasive Grinding.

Unit-5: CHEMICAL ENERGY BASED UNCONVENTIONAL MACHINING PROCESSES: Process Principle, Analysis and Applications of Electrochemical Machining, Chemical Machining, Electrochemical Discharge Machining, Electro-Chemical Abrasive Grinding,

Unit-6: **UNCONVENTIONAL WELDING PROCESSES:**Need, process principle, advantages and applications ofLaser Beam Welding, Electron Beam Welding, Ultra-Sonic Welding, Plasma Arc Welding, and Explosive Welding.

Unit-7: UNCONVENTIONAL FORMING PROCESSES: Need, process principle, advantages and applications ofExplosive Forming, Electro Hydraulic Forming, Electromagnetic Forming, and Laser Bending.

Unit-8: Powder Metallurgy: Metal Powder Production, Treatment, Compaction, and Sintering.

Teaching Methodology:

This course is introduced to help students to understand the various non-traditional manufacturing processes with their applications. The entire course is broken down into eight separate units: Introduction, Unconventional machining processes, Hybrid machining processes, unconventional finishing processes, unconventional welding processes, unconventional forming

processes, and powder metallurgy. Students are motivated to do their projects in the area of advanced manufacturing processes using the laboratory facilities.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2 & Unit-3
Test-2	25 Marks	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6 to Unit-8 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Referred video lectures and lecture notes on Advanced Manufacturing Processes are available on JUET server.

Text Book:

[1] Ghosh and Mallik, Manufacturing Science, EWP Private Ltd.
[2] Jain V. K., Advance Machining Processes, Allied Publisher.
[3] Pandey P. C., Modern Machining Processes, TMH Publication.
[4] Benedict G.F., Non Traditional Manufacturing Processes, Marcel Dekker.

Reference Books/Material:

[1] El-Hofy, H., Advanced Machining Processes-Non-traditional and Hybrid Machining Processes, McGraw-Hill, NewYork.
[2] McGough J. A., Advanced Methods of Machining, Chapman and Hall Ltd., London.

Web References:

- www.nptel.com
- https://nptel.ac.in/courses/112/107/112107077/

Journals References:

- Journal of Manufacturing Processes: Elsevier
- Materials and Manufacturing Processes: Taylor & Francis
- Journal of Materials Processing Technology: Elsevier
- Advances in Manufacturing: Springer

Title: Advanced Metal Casting and NDT **Code:**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Workshop*" and "*Manufacturing Technology-I*".

Objective:

4. To understand the working principles involved in different non-destructive testing processes
5. To learn and know about the design of feeder, Gates and selection of appropriate casting process.
6. To encourage the students for doing minor projects in the area of non-destructive testing of materials.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various mechanism and principles involved in metal casting and non-destructive testing methods.
CO2	Describe the industrial or real world problems related to non-destructive testing methods.
CO3	Identify the most appropriate method of metal casting economically.
CO4	Develop the skills of product design for castability.
CO5	Apply most appropriate NDT method for testing a particular component or material.
CO6	Demonstrate and deployment the mechanism of non-destructive methods for solving real-world problems.

Course Content:

Unit-1:METAL CASTING-OVERVIEW: Applications and production, historical perspective, casting processes. Solid modeling of castings: casting features, modeling techniques, graphical user interface, model representation model exchange formats, model verification, mould cavity layout.

Unit-2:FEEDER DESIGN AND ANALYSIS: Casting solidification, solidification time and rate, feeder location, feeder and neck design, feed aid design, solidification analysis, vector element method, optimization and validation.

Unit-3: GATING CHANNEL LAYOUT: optimal filling time, gating element design, mould filling analysis, numerical simulation, optimization and validation, Process planning and costing: Casting process selection, process steps and parameters, tooling cost estimation, material cost estimation, and conversion cost estimation.

Unit-4: DESIGN FOR CASTABILITY: Product design for castability, process friendly design, and castability analysis.

Unit-5: NON-DESTRUCTIVE TESTING: Liquid penetrant test: Physical Principles, Procedure for penetrant testing, Penetrant testing methods, sensitivity, Applications and limitations.

Unit-6: **ULTRASONIC TESTING:** Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Thermography: Basic principles, Detectors and equipment, techniques, application, Magnetic particle testing.

Unit-7: RADIOGRAPHY: Basic principle, Electromagnetic radiation sources, radiographic imaging Inspection techniques, applications, limitations, typical examples. Eddy current test: Principles, instrumentation for ECT, techniques.

Unit-8:ACOUSTIC EMISSION: Principle of AET, Technique, instrumentation, sensitivity, applications, Acoustic emission technique for leak detection, Visual inspection and its importance in inspection, Infra-red imaging-methodology and applications.

Teaching Methodology:

This course helps students to understand the various mechanisms and principles involved in metal casting and non-destructive testing methods. The entire course is broken into eight separate units: Introductory part of metal casting, Feeder design, Gating layout, optimal mould filling time, and design for castability, non-destructive testing methods, radiography, and acoustic emission. Some experimental classes has been conducted for the NDT methods.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2 & Unit-3
Test-2	25 Marks	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6 to Unit-8 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Referred video lectures and lecture notes on Advanced Metal Casting and NDT are available on JUET server.

Text Book:

[5] “Production Engineering Sciences”, P.C. Pandey, C. K. Singh, Standard Publisher.

[6] “Manufacturing Science”, A. Ghosh A, A. K. Mallik, EWP Pvt. Ltd

[7] “Nondestructive Testing Techniques”, R. Prakash, New Age Science, 2009.

[8] “Nondestructive Testing Methods and New Applications”, M. Omar, Ed, InTech, 2012.

Reference Books

[3] “Materials and Processes in Manufacturing”, E. P. De Garmo, J. T. Black, R. A. Kohser, Prentice Hall of India Pvt. Ltd.

[4] “Materials Science and Engineering: An Introduction”, William D. Callister , David G. Rethwisch, Wiley
[5] “Nondestructive Testing: Radiography, Ultrasonics, Liquid Penetrant, Magnetic Particle, Eddy Current”, Louis Cartz, ASM International, 1995.
[6] **“**Introduction to Non-destructive Testing: A Training Guide”, Paul E. Mix, Second Edition, *Wiley*, 2005

Title: Maintenance Engineering **Code:**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied course, “Mathematics-1 and Mathematics-ii”.
Objective:

1. To understand the needs and types of maintenance. And to develop skill for keep asset in availability state based on requirement level of reliability and effectiveness.
2. To understand methods for evaluating maintenance cost in relation to achieve the availability and effectiveness of equipments.

Learning Outcomes:

Maintenance Engineering	
Course Outcome	**Description**
CO1	Outline the scope and concepts of maintenance engineering
CO2	Describe the tools, principles of maintenance.
CO3	Develop the skill needed for analysis of friction, wear and science of interacting surface.
CO4	Identify the engineering issues and tools for condition monitoring of equipments.
CO5	Apply reliability, availability, and maintainability (RAM) analysis for engineering system
CO6	Demonstrate application of maintenance managements and analysis tools.

Course Content:
UNIT-1 INTRODUCTION: Fundamentals of Maintenance Engineering, Maintenance engineering its importance in material & energy conservation, Inventory control, Productivity, Safety, Pollution control, Safety Regulations, Pollution problems, Human reliability.
UNIT-II MAINTENANCE MANAGEMENT: Types of maintenance strategies, Planned and unplanned maintenance, Breakdown, Preventive & Predictive maintenance their comparison, Computer aided maintenance, Maintenance scheduling, Spare part management, inventory control.
UNIT-III TRIBOLOGY IN MAINTENANCE: Friction wear and lubrication, Friction & wear mechanisms, Prevention of wear, Types of lubrication mechanisms, Lubrication processes. Lubricants types, general and special purpose, additives, testing of lubricants, Degradation of lubricants, Seal & packing.

UNIT-IV MACHINE HEALTH MONITORING: Condition based maintenance, Signature analysis, Oil analysis, Vibration, Noise and thermal signatures, online & off line techniques,

Instrumentation & equipment used in machine health monitoring. Instrumentation in maintenance, Signal processing, Data acquisition and analysis, Application of intelligent systems, Data base design.

UNIT-V RELIABILITY, AVAILABILITY, AND MAINTAINABILITY (RAM) ANALYSIS: Introduction to RAM failure mechanism, Failure data analysis, Failure distribution, Reliability of repairable and non-repairable systems, Improvement in reliability, Reliability testing, Reliability prediction, Utilization factor, System reliability by Monte Carlo Simulation Technique.

Teaching Methodology: This course is introduced to help students to understand the need and type of maintenance in production industry. The entire course is broken down into five major sections: Introduction and Definitions , management principle, tribology, condition monitoring and reliability & maintainability.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit -2 and unit -3 around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Digital copy of important material will be available on the JUET server.

TEXT BOOKS:

1. Krishnan Gopal and Banerji S. K., Maintenance & Spare parts Management, PHI
2. Mishra R. C. and Pathak K., Maintenance Engineering and Management, PHI
3. Anthony Kelley , Maintenance Planning & Control: East West Press.

REFERENCE BOOKS:

1. Shrivastava S.K., Industrial Maintenance Management, S. Chand Publications.
2. B.K.N. Rao, Handbook of Condition Monitoring,. Elsevier Science;
3. Higgins L., Mobley R. K. and Mobley K., Maintenance Engineering Hand Book. McGraw hill
4. Banga and Sharma, Industrial Engineering & Management Science, Khanna Publishers.

Title: Engineering Data Analytics **Code: ME306**

L-T-P scheme: 3-0-0 **Credit:** 3

Prerequisite: Students must have already studied course, "Engineering Mathematics"

Objective:

4. To provide the concepts of data analytics and analyzing data to convert information to useful knowledge
5. To impart a wide range of data analytic techniques namely, descriptive, inferential, predictive and prescriptive analytics.

Learning Outcomes:

Course Outcome	*Description*
CO1	Outline various concepts, principles and governing equations of data analytics
CO2	Demonstrate the ability to interpret complex data in various engineering domain
CO3	Illustrate analytical, experimental and computational tools needed to analyze these engineering data
CO4	Use these solutions to guide a corresponding design, manufacture or failure analysis
CO5	Describe the independent judgment required to interpret the results of these solutions
CO6	Demonstrate and deployment of the knowledge of advanced data analytics in practical engineering applications

Course Content:

Unit-1: Introduction: Introduction to the course, Descriptive Statistics, Probability Distributions (Nakagami, Chi square, Gamma, Gaussian etc)

Unit-2: Inferential Statistics: Inferential Statistics through hypothesis tests, Permutation and Randomization Test

Unit–3: Regression and ANOVA: Regression ANOVA (Analysis of Variance)

Unit-4: Machine Learning: Differentiating algorithmic and model based frameworks,

Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression and Classification

Unit- 5: Supervised Learning with Regression and Classification techniques -1: Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines

Unit-6: Supervised Learning with Regression and Classification techniques -2: Ensemble Methods: Random Forest, Neural Networks, Deep learning

Unit-7: Unsupervised Learning and Challenges for Big Data Analytics: Clustering, Associative Rule Mining, Challenges for big data analytics

Unit- 8: Prescriptive analytics: Creating data for analytics through designed experiments, Creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning

Teaching Methodology: Data Analytics is the science of analyzing data to convert information to useful knowledge. This knowledge will help students to understand the world better and in many contexts enable them to make better decisions. This course seeks to present students with a wide range of data analytic techniques and is structured around the broad contours of the different types of data analytics, namely, descriptive, inferential, predictive, and prescriptive

analytics. The entire course is divided into eight separate units: Introduction, Inferential Statistics, Regression and ANOVA, Machine Learning: Differentiating algorithmic and model based frameworks, Regression, Supervised Learning with Regression and Classification techniques -1, Supervised Learning with Regression and Classification techniques -2, Unsupervised Learning and Challenges for Big Data Analytics and Prescriptive analytics. These sections have been framed to impart a systematic understanding of the basic and advanced principles of data analytics and finally implement these principles to convert information to useful knowledge. This course is intended to enable the students to apply the knowledge of data analytics in practical engineering problems.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3, Unit-4, Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6, Unit-7, Unit-8 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Data Analytics (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:
[1] Anil Maheshwari; Data Analytics, McGraw Hill Education; First edition, 2017
[2] Bharti Motwani: Data Analytics using Python, Wiley, 2020

Reference Books:
[1] Montgomery, Douglas C., and George C. Runger.; Applied statistics and probability for engineers. John Wiley & Sons, 2010
[2] V. K. Jain; Data Science and Analytics, Khanna Publishing; First edition, 2018

Web References:
[1] https://nptel.ac.in/courses/106/107/106107220/
[2] https://nptel.ac.in/courses/106/106/106106212/

Journals References:
[1] International Journal of Data Science and Analytics, Springer
[2] Journal of Big Data, Springer
[3] Big Data Analytics, Springer
[4] Big Data Research, Elsevier
[5] Computational Statistics & Data Analysis, Elsevier

Title: Applications of Additive Manufacturing Lab **Code:**
L-T-P scheme: 0-0-8 **Credit: 4**

Objectives:

- To make the students aware about various applications of additive manufacturing.
- Students will know about wide range of materials, processes used to realize various products in different industries.

Learning Outcome:

Course Outcome	Description
CO1	Introduction, Process chain, Strength and weakness of AM, difference between mass production and mass customization
CO2	Describe different applications of AM in industries.
CO3	Develop understanding to differentiate AM process based on material, working and end applications.
CO4	Identify the strength and limitations of various processes to be used for a particular application in industry.
CO5	Apply acquired knowledge to produce customized products for specific industries such as automobile, aerospace, medical, construction, fashion, electronics etc.
CO6	Demonstrate skill to build AM part by preparing CAD model, pre processing, part building and post processing the part.

COURSE CONTENT

Introduction: Overview, concept of mass customization, industrial scope of additive manufacturing.
Rapid tooling: Direct and indirect tooling processes
Rapid manufacturing: LENS, DMLS, SLM, SLS etc.
Reverse Engineering: Definition of Reverse Engineering (RE), Need for RE, Three phases in the generic RE process – scanning (contact and non-contact scanners), point processing and geometric modeling.
Data conversion: Data conversion from different file formats to AM compatible file formats.
Applications in aerospace, automotive and other industrial applications, construction and architecture, medical and biomedical area, electronics industry, restoration of archeological remains, terrain modeling, fashion industry, food industry etc.
Bioprinting: Introduction, concept, bio-ink, processes, current status, benefits and challenges.

TEXT BOOK:

3. Gibson, I., Rosen, D.W. and Stucker, B., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, 2010.

4. Chua, C K, Leong, K F and Lim CS, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific, 2003.

REFERENCES:

6. Hopkinson, N, Hague, R, and Dickens, P, Rapid Manufacturing: An Industrial Revolution for a Digital Age: An Industrial Revolution for the Digital Age, Wiley, Jan 2006.
7. Raja, V. and Fernandes K.J., Reverse Engineering – An Industrial Perspective, Springer-Verlag London Ltd, 2008.
8. Kamrani, A.K. and Nasr, E.A., Rapid Prototyping – Theory and Practice, Springer Science and Business Media Inc., New York, NY 10013, USA, 2006.
9. Bartolo, P J (editor), Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping, Taylor and Francis, 2007.
10. Cooper K. G., Rapid Prototyping Technology: Selection and Application, CRC Press.

Title: Major Project Part-1 **Code: ME217**
L-T-P scheme: 0-0-8 **Credit: 4**

Prerequisite: Students must have already studied the fundamental courses, **"Mechanical Engineering"** and "**Mechanical Engineering Lab**".

Objective:

1. To learn and be able to implement the Mechanical Engineering in different industry.

Course Outcome	Description
CO1	Introduction to practical course requirement under the guidance of a faculty supervisor member to understand the respective design project to do innovative work with the application
CO2	Students are expected to do a literature survey and carry out development and/or experimentation in their respective design projects. Interaction with existing work of current researchers of their respective project work.
CO3	Development of the theoretical model and computational analysis of the existing working design project model.
CO4	Preparation of theoretical analysis for an innovative technique to overcome the current troubles of industrial applications related to their design project work.
CO5	Verification and validation techniques of their respective design project
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

Course Content:

UNIT-I Identification of Innovative work, based upon Literature survey

UNIT-II student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-III The student is expected to do literature survey and carry out development and/or experimentation.

UNIT-IV Through project work the student has to exhibit both analytical and practical skills. The project is done in two semesters, i.e. 7th and 8th, on a continuous problem.

UNIT-V *Demonstrate deployment and basic maintenance skills of the* respective design project

Project is a course requirement wherein under the guidance of a faculty member, a final year student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through project work the student has to exhibit both analytical and practical skills. The project is done in two semesters, i.e. 7th and 8th, on a continuous problem.

Exams	**Marks**		**Coverage**
P-1	20 Marks		**Based on :** *Literature surveyand Interaction with existing work of current researchers of their respective project work.*
P-2	15 Marks		**Based on:** *Development of the theoretical model and computational analysis of the existing working design project model.*
P3	20 Marks		**Based on:** *Demonstrate deployment and basic maintenance skills of the* respective design project.
Day-to-Day Work	Supervisor Marks [**Day- to-Day Marks**] [Attendance, Performance, Discipline]	35 Marks	**45 Marks**
	Thesis	10 Marks	
Total		**100 Marks**	

Learning Resources: Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book: As prescribed by respective project supervisor.

Title: Advanced Mechanics of Solids **Code:**
L-T-P scheme: 3-0-0 **Credit: 3**
Prerequisite: Students must have already studied courses, “Engineering Mechanics” and “Strength of Materials”
Objective:

1. To provide the fundamental concepts and principles in the analysis of solids in three dimensions

2. Comparison of the 3D elasticity solutions to boundary value problems and frame simplified solutions

Learning Outcomes:

Course Outcome	*Description*
CO1	Outline various concepts, principles and governing equations of mechanics of solid in three dimensions
CO2	Demonstrate the ability to interpret complex three dimensional problems
CO3	Illustrate analytical, experimental and computational tools needed to solve the idealized three dimensional problems
CO4	Use these solutions to guide a corresponding design, manufacture or failure analysis
CO5	Describe the independent judgment required to interpret the results of these solutions
CO6	Demonstrate and deployment of the knowledge of advanced mechanics of solids in practical engineering structures

Course Content:

Unit-1: INTRODUCTION: Review of basic concepts and equations in mechanics, Classification of materials, Outline of general techniques to solve boundary value problems.

Unit-2: STRESS AND STRAINS IN 3-D: Cauchy formula, Principal Stress, hydrostatic stress, deviatoric stress, stress transformations, Mohr circle, octahedral shear stress, strain energy densities, etc.

Unit-3: STRAIN ENERGY AND IMPACT LOADING: Definitions, expressions for strain energy stored in a body when load is applied: (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's & Maxwell's theorems.

Unit-4: UNSYMMETRICAL BENDING: Properties of beam cross section, product of inertia, ellipse of inertia, slope of the neutral axis, stresses and deflections, shear center and the flexural AXIS.

UNIT-5: BENDING OF CURVED BARS: Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars and rings, deflection of rings by Castigliano's theorem stresses in simple chain link, deflection of simple chain links.

Unit-6: THICK PRESSURE VESSELS: Derivation of Lame's equations, radial & hoop stresses and strains in thick and compound cylinders and spherical shells subjected to internal fluid pressure only, wire wound cylinders, hub shrunk on solid shaft.

Unit-7: ROTATING MEMBERS: Stresses in uniform rotating rings and discs, stresses in rotating rims, rotating cylinders, hollow and solids cylinders.

Unit-8: COLUMNS AND STRUTS: Straight and initially curved columns and struts, Rankine's formula.

Teaching Methodology: This course is introduced to help students in applying their knowledge of Engineering Mechanics and Strength of Materials in order to explore the vast area of applied mechanics and to enhance students' ability to solve problems related to theory of elasticity and plasticity. The entire course is divided into eight separate units: Introduction, Stress and Strains in 3-D, Strain Energy and Impact Loading, Unsymmetrical Bending, Bending of Curved Bars, Thick Pressure Vessels, Rotating Members and Columns and Struts. These sections have been framed to impart a systematic understanding of the basic and advanced principles of mechanics of materials and finally implement these principles to evaluate design, manufacture or failure analysis to satisfy functional and strength requirements. This course is intended to enable the students to apply the knowledge of advanced mechanics of solids in practical engineering problems.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3, Unit-4, Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6, Unit-7, Unit-8 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Advanced Mechanics of Solids (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[3] Advanced Mechanics of Solids by L. S. Srinath, McGraw Hill Education, 2010.

[4] Advanced Mechanics of Materials by Kamal Kumar and R. C. Ghai, 7th Edition, Khanna Publishers

Reference Books:

[3] Advanced Strength of Materials by J. P. Den Hartog Dover Publications, 2014.

[4] Advanced Mechanics of Materials and Applied Elasticity, Saul K. Fenster and Ansel C. Ugural, 5th Edition, Prentice Hall, 2011.

Web References:

- https://nptel.ac.in/courses/112101095/

- https://ocw.mit.edu/courses/mechanical-engineering/2-002-mechanics-and-materials-ii-spring-2004/

Journals References:

- Mechanics of Materials, Elsevier
- Strength of Materials, Springer
- Applied Mechanics and Materials, Scientific.Net
- Mechanics of Advanced Materials and Structures, Taylor & Francis
- JSME international journal. Ser. 1, Solid mechanics, strength of materials

Title: Measurement and Metrology **Code:**
L-T-P scheme: 3-0-0 **Credit: 4**

Prerequisite: Students must have already studied courses, "Engineering Mechanics".

Objective:

1. To know Indian standards and International standards of measurement
2. To learn different measuring equipment's used for various measurement system along with their capability
3. To learn various instruments and their methods of used in engineering metrology
4. To know Indian standards and International standards of measurement
5. To learn different measuring equipments used for various measurement system along with their capability
6. To learn various instruments and their methods of used in engineering metrology

Learning Outcomes:

Course Outcome	Description
CO1	Outline different measuring instruments to measure the qualitative and quantitative characteristics.
CO2	Describing the fits and tolerances to improve the existing performance.
CO3	Develop an idea to evaluate quality of job, machine and instruments.
CO4	Identify the most influencing measuring device to measure surface properties.
CO5	Apply the concept of measuring and metrology to solve the industrial or real world problems.
CO6	Demonstrate various measuring instrument and their basic principles of working.

Course Content:

Unit-1: Introduction to metrology: Definition, types, need of inspection, terminologies, and methods of measurement, selection of instruments, measurement errors, units, measurement standards, calibration.

Unit-2: Limits, fits and gauges: Limits, fits, tolerance and allowance, theory of limits and fits and their selection, hole based and shaft based systems, Indian standard system of limits and fits. Interchangeability, selective assembly, limit gauges, Taylor's principle of limit gauging, plug gauges, ring gauges.

Unit-3: Measurement and measurement system: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, and repeatability, linearity, loading effect, system response-time and delay, errors in measurements.

Unit-4: Pressure and Temperature measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, bridge man gauge. Vacuum measurement: vacuum gauges viz. McLeod gauge. Electrical methods of temperature measurement: resistance thermometers, thermistors and thermocouples, pyrometer.

Unit-5: Measurement of surface finish: Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish software. Measurement of straightness, flatness, squareness, parallelism, roundness, non-contact profiling systems Taper measurement, angle measurement, radius measurement.

Unit-6:Measurement of screw threads and gears and Interferometry: Measurement of various elements of threads, major, minor and effective diameter, measurement of pitch, gear inspection, measurement of tooth thickness, gear tooth caliper, Parkinson's gear tester. Principle of interference, interference bands, interference patterns, flatness interferometer, Gauge length interferometer

Teaching methodology:

The aim of introducing this course is to give aexposure to the students on the important and fundamental concept in the extensive area of Materials and its behavior under different loading conditions. The concepts, ideas and techniques developed in SOM are indispensable in machine and structural design. The main focus of this course is to introduce fundamental concepts in SOM with special emphasis on practical problems.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 &Unit-2
Test-2	25 Marks	Based on Unit-3& Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 & Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	

Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Measurement & Metrology (will be added from time to time): Digital copy will be available on the JUET server.

REFERENCES:

Text Books:

1. Beckwith Marangoni and Lienhard, Mechanical measurements, Pearson Education, 6th Ed
2. R.K.Jain, Engineering Metrology, Khanna Publishers
3. A K Sawhney, A course in Mechanical Measurements and Instrumentation, J.C Kapur Publishers, 3rd Ed

Reference Books:

1. I.C.Gupta, Engineering Metrology, DhanpatRai Publications, Delhi
2. Ernen O Dobeblein, Measurements Systems, Applications & Design, 5th Ed
3. Alsutko, Jerry. D.Faulk, Industrial Instrumentation, Thompson Asia Pvt. Ltd.
4. R.S. Shirohi& H.C. Radhakrishna, Mechanical Measurements, New Age Intl. Pvt, 3rd Ed

Title: Major Project (Part-II) **Code:ME218**

L-T-P scheme: 0-0-2 **Credit: 8**

Prerequisite: Students must have already studied the courses, " Fluid Mechanics, Thermodynamics, Heat and Transfer" and "Engineering Mechanics, Machine dynamics, Machine Design, Manufacturing Technology, Industrial Technology".

Objective:

1. To learn and be able to implement the front-end and back-end web-technologies.
2. To develop the abilities to call oneself full-stack web developer.

Course Outcome	Description
CO1	Introduction to practical course requirement under the guidance of a faculty supervisor member to understand the respective design project to do innovative work with the application
CO2	Students are expected to do a literature survey and carry out development and/or experimentation in their respective design projects. Interaction with existing work of current researchers of their respective project work.
CO3	Development of the theoretical model and computational analysis of the existing working design project model.
CO4	Preparation of theoretical analysis for an innovative technique to overcome the current troubles of industrial applications related to their design project work.
CO5	Verification and validation techniques of their respective design project
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

Course Content

UNIT-1 Identification of Innovative work, based upon Literature survey

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 The student is expected to do literature survey and carry out development and/or experimentation.

UNIT-4 Through project work the student has to exhibit both analytical and practical skills. The project is done in two semesters, i.e. 7th and 8th, on a continuous problem.

UNIT-5 *Demonstrate deployment and basic maintenance skills of the* respective design project

Teaching Methodology:

Project is a course requirement wherein under the guidance of a faculty member, a final year student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through project work the student has to exhibit both analytical and practical skills. The project is done in two semesters, i.e. 7th and 8th, on a continuous problem.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	20 Marks	Based on Unit-1, Unit-2 & Unit-3
P-2	15 Marks	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
P-3	20 Marks	Based on Unit-6 to Unit-8 and around 30% from coverage of Test-2
supervisor Marks for performance and Attendance	35 Marks	
Report	10 Marks	
Total	**100 Marks**	

Learning Resources:

1. Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

Title: Operations Research **Code:ME311**
L-T-P scheme: 3-0-0 **Credit: 3**
Prerequisite: Students must have already studied course, "Mathematics".

OBJECTIVES

The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the scope and applications of operations research methods
CO2	Describe the problem formulations in operations research.
CO3	Develop the Operations research model for decision problems.
CO4	Identify the operation research tools useful for industrial problems and key issues in linear programming, sequencing decision problem in industry.
CO5	Apply the tools learned for better material management and efficient utilization of resources in industry
CO6	Demonstrate the problem solving skills in production, project managements and maintenance.

Course Content:

UNIT-I INTRODUCTION – Definition– Characteristics and Phases – Types of models – Operation Research models – applications.

Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques -Two–phase method, Big-M method – Duality Principle.

UNIT-II TRANSPORTATION PROBLEM – Formulation – Optimal solution, unbalanced transportation problem –Degeneracy. Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem

UNIT-III SEQUENCING – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines.

THEORY OF GAMES : Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games -graphical method.

UNIT-IV WAITING LINES: Introduction – Single Channel – Poisson arrivals – exponential service times –with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals.

UNIT-V PROJECT PLANNING AND SCHEDULING: Introduction to project planning. PERT/ CPM network components. PERT & CPM analysis. Project schedule with uncertain activity times. Project time-cost trade off.

UNIT-VI INVENTORY CONTROL:

Meaning of inventory Control. Inventory costs. Deterministic inventory models. Static economic order quantity models. Introduction to probabilistic Inventory models.

UNIT-VII REPLACEMENT AND MAINTENANCE MODELS:

Introduction and types of failure. Replacement of item whose efficiency deteriorates with time. Replacement of item that completely fail. Replacement problems.

Teaching Methodology:

This course is introduced to help students to understand the scope of operations research. The entire course is broken down into four major sections: Introduction, linear programming, sequencing and waiting line, Project planning and inventory control, and Replacement And Maintenance. Each section includes numerical problems and methodology to analyze the problem.

The goal is to maintain a balance between theory, numerical computation, and problem setup for solution by optimization software, and applications to engineering systems.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit -3, Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Digital copy of important material will be available on the JUET server.

Text Books:

1. Taha. H.A, Operations research: An Introduction, Pearson educ.

2. Sharma J.K., Operations research, Trinity press

References:

1. Schaum's Outline of Operations Research.
2. Kapoor . V.K. , Operations Research (Quantitative Techniques for Management)
3. JainK.C. Industrial Engineering & Operations Research.

Title: Laser Material Processing **Code: ME312**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied conventional material processing courses, "*Manufacturing Technology-I*" and "*Manufacturing Technology-II*".

Objective:

1. To learn about the basic knowledge of the laser beam generation and different types of lasers and their characteristics.
2. To learn the capabilities of laser for different advanced materials processing.
3. To study about the laser micro machining and different laser hybrid machining processes.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various laser material processes based on their mechanisms.
CO2	Describe the industrial applications using LASER as processing tool.
CO3	Develop an idea to process the difficult to process materials using different classes of LASERS.
CO4	Identify the most influencing process parameters to fabricate a defect free product using Electromagnetic radiation.
CO5	Apply most appropriate LASER processing technique to process a product economically.
CO6	Demonstrate and deployment the different laser processing techniques for solving real-world problems.

Course Content:

Unit-1: Introduction: Light and Laser – Historical background, Generation of laser beam, Classification/ Types of lasers, Characteristics and application of lasers. Applications of Lasers in Material Processing, Lasers in Engineering.
Unit-2: Laser Materials Processing: Introduction, classification of laser materials processing methods, Laser beam material Interaction, Temperature distribution during laser heating, melting and vaporization, Melt depth, fractional melt depth, Variation of temperature gradient.
Unit-3: Laser Beam Machining: Process capabilities of laser, Laser beam machining (LBM), Process principle, analysis and applications of laser Drilling, Cutting, Turning, and Milling processes.
Unit-4: Laser Forming: Process principle, analysis and applications of Laser forming processes such as Laser Bending, Mechanism of Laser Bending.
Unit-5: Laser Welding and Surface Treatment: Process principle of Laser Welding, analysis and applications of laser welding, cladding, surface alloying and heat treatment processes
Unit-6: Laser Based Rapid Prototyping: Process principle and analysis of laser based rapid prototyping such as Stereolithography, Selective laser sintering
Unit-7: Laser Assisted Material Processing: Laser assisted machining (LAM), Laser hybrid machining processes, Laser Micromachining, and Latest developments in laser material processing.

Teaching Methodology:

This course is introduced to help students to understand the various material processing techniques using lasers and their applications. The entire course is broken down into seven separate units: Introduction, laser materials processing, laser machining processes, laser forming processes, laser welding and heat treatment processes, rapid prototyping, laser micromachining, and laser assisted processes. Students are motivated to do research work in the area of laser material processing.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2 & Unit-3
Test-2	25 Marks	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6 to Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Referred video lectures and lecture notes on Laser Material Processing are available on JUET server.

Text Book:

[1] Pandey P. C., Modern Machining Processes, TMH Publication.
[2] Steen W. M., Laser Material Processing, Springer, 2003.
[3] Chryssolouris G., Laser Machining- Theory and Practice (Mechanical Engineering Series), Springer, 1991.

Reference Books/Material:

Luxton J.T., Parker D.E, Industrial lasers and their applications, Prentice Hall, 1987.

Web References:
[1] www.nptel.com
[2] https://nptel.ac.in/courses/112/104/112104028/

Journals References:
[1] Journal of Manufacturing Processes: Elsevier
[2] Materials and Manufacturing Processes: Taylor & Francis
[3] Journal of Materials Processing Technology: Elsevier
[4] Optics and Lasers in Engineering: Elsevier
[5] Optics and Laser Technology: Elsevier

Title: Finite Element Technique **Code: ME314**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied course, " *Strength of Materials, Design of Machine Elements and Advanced Mechanics of Solids* ".

Objective:

1. The main objective of this subject is to provide a practical training in engineering design using finite element methods. When components have complex construction, shape, and general boundary conditions (loading and restraint) the designer will often use finite element methods to determine their structural integrity.
2. The first half of the module aims at introducing the fundamental principles of the modeling for statics and dynamics analyses.
3. In the second half of the module the students will be taught how to use the method in practice, to critically assess and evaluate the results.

Learning Outcomes:

Course Outcome	Description
CO1	Outline of this subject is to provide a practical training in engineering design using finite element methods.
CO2	Describe the use of finite element methods to determine their structural integrity when components have complex construction, shape, and general boundary conditions (loading and restraint).
CO3	Develop the fundamental principles of the modeling for statics analysis.
CO4	Identify the important stress analysis technique and how it may be used to design components.
CO5	Apply the finite element methods for small displacement linear elastic analysis, develop good models and interpret the numerical results in design.
CO6	Demonstrate the method in practice, critically assess and evaluate the results.

Course Content:

Unit-1:Fundamental concepts

Introduction, Stresses and equilibrium equations, Boundary conditions, Strain-displacement, Relations, Stress- strain relations, The Rayleigh-Ritz method, Galerkin's method,Application: Axial deformation of bars, Axial spring element, Matrix algebra, Gaussian elimination.

Unit-2: One-dimensional problems

Finite element modeling, Coordinates and a shape functions, Galerkin approach treatment of boundary conditions, Quadratic shape functions, Temperature effects.

Unit-3:Two-dimensional problems

Finite element modeling, Constant strain triangle, Axis symmetric solids subjected to axis symmetric loading, Axis symmetric formulation, Triangular element, Four- node quadrilateral, Numerical integration stress calculations, High order element, Nine-node quadrilateral, Eight-node quadrilateral, Six-node triangle.

Unit-4: Beams, frames & truss element

Introduction, Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports, Plane frames. 2D & 3D Truss element.

Unit-5:**Three-dimensional problems**

Introduction, Finite element formulation, Stress calculations, Mesh preparation, hexahedral elements and Higher- order elements, Heat transfer Problem.

Teaching Methodology:

This course is introduced to provide a numerical method for solving problems of engineering and mathematical physics, which include structural analysis, heat transfer analysis, thermal analysis

etc. This course is introduced to help students to understand a method which can reduce the degrees of freedom from infinite to finite with the help of discretization or meshing. The entire course is broken down into six units: Fundamental concepts, One-dimensional problems, Two-dimensional problems, Beams, frames & truss element, Three-dimensional problems and Dynamic considerations.
Each section helps a student to gain detail knowledge of the subject to solve different types of engineering problems.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5& Unit-6 and around 30% from coverage of Test-1 & Test-2.
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Course-related resources will be provided on JUET server. This can include eBook, lecture material, supplementary course notes.

Text Book:

[1] Finite Element Analysis by P.Seshu

Reference Books/Material:

[1] Finite Element Method for Engineering by C.V. Girija Vallabhan
[2] The Finite Element Method for Engineers by Kenneth H. Huebner

Web References:

[1] https://nptel.ac.in/courses/112/104/112104116/
[2] https://ocw.mit.edu/resources/res-2-002-finite-element-procedures-for-solids-and-structures-spring-2010/

Journals References:

[1] Finite Elements in Analysis and Design: Elsevier
[2] Computer-Aided Engineering: IET

Title: Computational Fluid Dynamics **Code: 18B14ME744**