Semester-III

Transform Calculus, Fourier Series and Numerical Techniques			
Course Code	**21MAT31**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	0	Exam Hours	--

Course objectives:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering
- applications, using numerical methods.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1 **8 HOURS**

Laplace Transforms: Definition and Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function – problems.
Inverse Laplace Transforms: Inverse Laplace transform - problems, Convolution theorem to find the inverse Laplace transform(without proof) and problems, solution of linear differential equations using Laplace transform..

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2 **8 HOURS**

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis, examples from engineering field.

Teaching-Learning Process	. Chalk and talk method / PowerPoint Presentation

Module-3 **8 HOURS**

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simple problems.
Difference Equations and Z-Transforms: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform. Simple problems.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4 **8 HOURS**

Numerical Solutions of Ordinary Differential Equations (ODE's): Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Range - Kutta method of fourth order, Milne's and Adam-Bashforth predictor and corrector method (No derivations of formulae), Problems.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5 **8 HOURS**

Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne's predictor and corrector method.(No derivations of formulae).
Calculus of Variations: Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- CO1: Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5:Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of the maximum marks (400 marks out of 100). A student shall be deemed to have satisfied the academic requirements if the student secures not less than 40% (40 Marks out of 100)in the CIE.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of the 4th week of the semester
5. Second assignment at the end of the 9th week of the semester

Course Seminar suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

Or

Learning MATHS tools and solving a few problems from each module using MATHS tools (e.g. MATLAB, SciLab etc)

6. Conducting at least 05 labs sessions within the Academic Duration.

The sum of three tests, two assignments, and a seminar/Lab sessions using MATHS tools will be out of 100 marks

The student shall secure minimum 40% of marks of course to qualify and become eligible for award of degree

Suggested Learning Resources:

Books

1. Advanced Engineering Mathematics,E. Kreyszig,John Wiley & Sons,10th Edition, 2016
2. Higher Engineering Mathematics,B.S. Grewal,Khanna Publishers,44th Edition, 2017
3. Engineering Mathematics,Srimanta Pal et al,Oxford University Press,3rd Edition, 2016
4. Advanced Engineering Mathematics,C.Ray Wylie, Louis C.Barrett,McGraw-Hill Book Co,6th Edition, 1995
5. Introductory Methods of Numerical, Analysis,S.S.Sastry,Prentice Hall of India,4th Edition 2010,
6. Higher Engineering Mathematics,B.V.Ramana,McGraw-Hill,11th Edition,2010
7. A Text Book of Engineering Mathematics,N.P.Bali and Manish Goyal,Laxmi Publications,2014

Web links and Video Lectures (e-Resources):

.1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester - III

Casting, joining and Forming Process			
Course Code	**21ME32**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

To study various metal forming processes.

- To provide knowledge of various casting process in manufacturing.
- To provide detailed information about the moulding processes.
- To Provide information on casting of ferrous and non-ferrous alloys and inspection techniques to detect defects.
- To acquaint with the basic knowledge on fundamentals of metal forming processes.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

Module-1 **8 HOURS**

INTRODUCTION & BASIC MATERIALS USED IN FOUNDRY

Introduction: Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy.

Introduction to casting process & steps involved. Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.

Sand molding: Types of base sand, requirement of base sand. Binder, Additives definition, need and types

Preparation of sand molds: Molding machines- Jolt type, squeeze type and Sand slinger. Study of important molding process: Green sand, core sand, dry sand, sweep mold, CO2 mold, shell mold, investment mold, plaster mold, cement bonded mold.Cores: Definition, need, types. Method of making cores, concept of gating (top, bottom, parting line, horn gate) and risering (open, blind) Functions and types

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2 **8 HOURS**

MELTING & METAL MOLD CASTING METHODS

Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace.

Casting using metal molds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes.

Teaching-Learning Process	. Chalk and talk method / PowerPoint Presentation

Module-3 **8 HOURS**

SOLIDIFICATION & NON FERROUS FOUNDRY PRACTICE

Solidification: Definition, Nucleation, solidification variables, Directional solidification-need and methods. Degasification in liquid metals-Sources of gas, degasification methods.

Fettling and cleaning of castings: Basic steps involved. Sand Casting defects- causes, features and remedies. Advantages & limitations of casting process.

Nonferrous foundry practice: Aluminum castings - Advantages, limitations, melting of aluminum using lift-out type crucible furnace. Hardeners used, drossing, gas absorption, fluxing and flushing, grain refining, pouring temperature. Stir casting set up, procedure, uses, advantages and limitations.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4 **8 HOURS**

Mechanical Working of Metals: Introduction to metal forming processes & classification of metal forming processes. Hot working & cold working of metals. **Forging:** Classification of forging processes. Forging machines equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis. Smith forging, drop forging & press forging. Forging Equipment, Defects in forging. **Rolling**: Classification of rolling processes. Types of rolling mills, Variables of rolling process, expression for rolling load. Roll separating force, Rolling defects.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5	**8 HOURS**
Drawing & Extrusion: Drawing of wires, rods & pipes, Variables of drawing process. Difference between drawing & extrusion. Types of Extrusion: Direct, reverse, impact, hydrostatic extrusion. Dies for extrusion, stock penetration. Extrusion ratio of force equipment (with and without friction) **Sheet Metal Operations:** Blanking, piercing, punching, drawing, draw ratio, drawing force, variables in Drawing, Trimming, and Shearing. Bending - types of bending dies, Bending force calculation, Embossing and coining. Types of dies: Progressive, compound and combination dies.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
	PART A
	Preparation of sand specimens and conduction of the following tests:
1	Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2	Permeability test
3	Sieve Analysis to find Grain Fineness Number(GFN) of Base Sand
4	Clay content determination in Base Sand
	PART B
	Foundry Practice
5	Use of foundry tools and other equipment's.
6	Preparation of molding sand mixture.
7	Preparation of green sand molds using two molding boxes kept ready for pouring. • Using patterns (Single piece pattern and Split pattern) • Without patterns. Incorporating core in the mold. (Core boxes). Preparation of a casting (Aluminum or cast iron-Demonstration only)
	PART C
	Forging Operations
Use of forging tools and other equipment's	
8	Calculation of length of the raw material required to prepare the model considering scale losses
9	Preparing minimum three forged models involving upsetting, drawing and bending operations. Demonstration of forging model using Power Hammer.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Acquire experimentation skills in the field of material testing.
- Develop theoretical understanding of the mechanical properties of materials by performing experiments.
- Apply the knowledge to analyse a material failure and determine the failure inducing agent/s.
- Apply the knowledge of testing methods in related areas.
- Understand how to improve structure/behaviour of materials for various industrial applications

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources: Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Manufacturing Process-I	Dr.K. Radhakrishna	Sapna Book House	5th Revised Edition 2009
2	Manufacturing & Technology Foundry Forming and Welding	P.N.Rao	Tata McGraw Hill	3rd Ed., 2003
3	Workshop Technology	HazaraChoudhry	Media Promoters & Publishers Pvt. Ltd	Vol-II, 2004
4	Production Technology	R. K. Jain	Khanna Publications	2003
5	Fundamentals of Metal casting	R.A.Flinn	Addison Wesley	1963
6	Principles of Metal casting	R.W. Heine, C.R.Lope r & P.C.	Tata McGraw Hill,	2001
Reference Books				
1	Manufacturing Science	Amitabh Ghosh and	affiliated East West Press	2003
2	Fundamentals of Metal Machining and Machine.	G. Boothroyd	McGraw Hill	2000
3	Manufacturing Technology	SeropeKalpakjia n, Steuen. R. Sechmid	Pearson Education Asia	5th Ed. 2006
4	Processes and Materials for Manufacturing	R.A. Lindberg	Pearson Education	4th Ed. 2006

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Semester - III

MATERIAL SCIENCE & ENGINEERING			
Course Code	**21SM33**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- The foundation for understanding the structure and various modes of failure in materials common in mechanical engineering.
- Topics are designed to explore the mechanical properties of metals and their alloys, polymers, ceramics ,smart materials and composites.
- The means of modifying such properties, as well as the processing and failure of materials.
- Concepts of use of materials for various applications are highlighted.

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

MODULE-1 **8 HOURS**

Basics, Mechanical Behaviour, Failure of Materials Introduction to Crystal Structure – Coordination number, atomic packing factor, Simple Cubic, BCC, FCC and HCP Structures, Crystal imperfections – point, line, surface and volume imperfections, Atomic Diffusion: Phenomenon, Fick's laws of diffusion;Factors affecting diffusion.
Mechanical Behavior:Stress-strain diagrams showing ductile and brittle behavior of materials, Engineering and true strains, Linear and non-linear elastic behavior and properties, Mechanical properties in plastic range. Stiffness, Yield strength, Offset Yield strength, Ductility, Ultimate Tensile strength, Toughness, Plastic deformation of
single crystal by slip and twinning, Mechanisms of strengthening in metal

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-2 **8 HOURS**

Fracture: Type I, Type II and Type III,
Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, Fatigue properties, S-N diagram, Fatigue testing.
Creep: Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation. Concept of fracture toughness.

Teaching-Learning Process	. Chalk and talk method / PowerPoint Presentation

MODULE-3 **8 HOURS**

Alloys, Steels, Solidification
Concept of formation of alloys: Types of alloys, solid solutions, factors affecting solid solubility (Hume Rothery rules), Binary phase diagrams: Eutectic, and Eutectoid systems, Lever rule, Substitutional and interstitial solid solutions, Intermediate phases, Gibbs phase rule Effect of non- equilibrium cooling, Coring and
Homogenization Iron-Carbon (Cementite) diagram: description of phases, Specifications of steels. Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, Crystal growth, Numerical on lever rule

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-4 **8 HOURS**

Polymers and polymerizations: Structure and properties of thermoplastics and thermoses, Engineering Applications - property modifications -Mechanical and thermal behaviour –processing methods.
Ceramics: Nature and structure of Ceramics -Refractory Abrasives glasses -glass ceramics -Advanced ceramics processing methods.
Other materials: Smart materials and Shape Memory alloys, properties and applications.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 5 **8 HOURS**

Composites: Definition; Classification and characteristics of composite materials, Volume fraction, Laminated composites, particulate composites, fibrous composites. Types of reinforcements, their shape and size, production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites and their Applications. Fundamentals of production of composites, Processes for production of composites, Constitutive relations of composites, Numerical problems on determining properties of composites	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
	PART A
1	Preparation of specimen for Metallographic examination of different engineering materials. To report microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2	Heat treatment: Annealing, normalizing, hardening and tempering of steel. Metallographic specimens of heat treated components to be supplied and students should report microstructures of furnace cooled, water cooled, air cooled, tempered steel. Students should be able to distinguish the phase changes in a heat treated specimen compared to untreated specimen.
3	Brinell, Rockwell and Vickers's Hardness tests on untreated and heat treated specimens.
4	To study the defects of Cast and Welded components using Non-destructive tests like: a) Ultrasonic flaw detection b) Magnetic crack detection c) Dye penetration testing.
	PART B
5	Tensile, shear and compression tests of steel/aluminium/cast iron/Plastic/Composites specimens using Universal Testing Machine
6	Torsion Test on steel bar.
7	Flexural Test on steel/aluminium/cast iron/Plastic/Composites specimens
8	Izod and Charpy Tests on steel/aluminium/cast iron/Plastic/Composites Specimen
9	To study the wear characteristics of ferrous and non-ferrous materials under different parameters.
10	Fatigue Test (demonstration only).
	Can be Demo experiments for CIE
	Can be Demo experiments for CIE
	Can be Demo experiments for CIE
	Can be Demo experiments for CIE

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Describe the mechanical properties of metals, their alloys and various modes of failure.
- Understand the microstructures of ferrous and non-ferrous materials to mechanical properties.
- Explain the processes of heat treatment of various alloys.
- Understand the properties and potentialities of various materials available and material selection procedures.
- Know about composite materials and their processing as well as applications..

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

4. The question paper will have ten questions. Each question is set for 20 marks.
5. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
6. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Foundations of Materials Science and Engineering	Smith	McGraw Hill,	4th Edition, 2009
2	Material science and Engineering and Introduction,	William D. Callister	Wiley.	2006
Reference Books				
1	Materials Science and Engineering	V.Raghavan	PHI	2002
2	The Science and Engineering of Materials	Donald R. Askland and Pradeep.P.	Cengage Learning	4lh Ed., 2003.
3	Mechanical Metallurgy	George Ellwood Dieter	McGraw-Hill	

Web links and Video Lectures (e-Resources):
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Semester-III

Engineering Thermodynamics			
Course Code	**21SM34**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:3:0:0	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- Learn about thermodynamic system and its equilibrium
- Understand various forms of energy - heat transfer and work
- Study the basic laws of thermodynamics including, zeroth law, first law and second law.
- To understand the applications of the first and second laws of Thermodynamics to various gas processes and cycles.
- To study the Carnot Cycle and the concept of Entropy
- To understand the various Air standard and Vapor power cycles and their Performance.
- To understand the concepts related to Refrigeration and Air conditioning.
- To get conversant with Psychrometric Charts, Psychrometric processes, human comfort conditions.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

MODULE 1 **8 HOURS**

Introduction: Role of Thermodynamics in Engineering and Science, Applications of Thermodynamics:
Basic Definitions: Thermodynamic System and Control Volume, Surroundings. Macroscopic and Microscopic Analysis. Definition of Substance, Properties of Substance, Intensive and Extensive, Mathematical Representation of Property, State of substance. Thermodynamic Equilibrium, Concept of Quasi Equilibrium Process and Cycle. Fundamental Units, Units of Force, Energy, Specific Volume, Pressure etc. Equality of Temperature, The Zeroth Law of Thermodynamics, Temperature Scales..

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 2 **8 HOURS**

Heat and Work: Definition of Thermodynamic Work, Units for Work, Forms of Work. Definition of Heat, Inter Convertibility of Heat/work into Work/heat, Governing Principles, Sign Convention. **First Law of Thermodynamics:** Statement of First Law of Thermodynamics: First Law for Cyclic Process, First Law for Change of State of a System. Internal Energy, A New Thermodynamic Property. Enthalpy, The Constant Volume and Constant Pressure

Teaching-Learning Process	. Chalk and talk method / PowerPoint Presentation

MODULE 3 **8 HOURS**

Second Law of Thermodynamics: Definition of Heat Engine and Reservoirs, Kelvin-Planck and Clausius Statements of the Second Law, Reversible and Irreversible Engines and processes, Causes of Irreversibility, Internal and External Irreversibility.
Carnot Cycle: Efficiency of a Carnot Cycle, Thermodynamic Temperature Scale, Ideal Gas Temperature Scale.
Entropy: Clausius Inequality, Entropy - A Property of a System, Entropy of A Pure Substance, Entropy Change in Reversible Process, Thermodynamic Property Relation, Calculation of Change in Entropy, Principle of Increase of Entropy.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 4 **8 HOURS**

Analysis of Power Generation Cycles: Air-standard Power Cycles, Concept, Carnot Cycle, Otto Cycles, Diesel Cycle, Dual Cycle, Brayton Cycle. Efficiency and Mean Effective Pressure. Vapor Power Cycles,, Deviation of Actual Cycle from Ideal Cycles.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 5	8 HOURS
Analysis of Refrigeration Cycles: Air-standard Cycles, Joule Cycle. Introduction to Refrigeration Systems, Vapor-compression Refrigeration Cycle, Vapor-absorption Cycle. **Psychometrics and Air-conditioning Systems:** Psychometric properties of Air, Psychometric Chart, Analysing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Cooling towers	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems.
- Evaluate the feasibility of cyclic and non-cyclic processes using second law of thermodynamics
- Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers and change in properties
- Apply thermodynamic concepts to analyse the performance of gas power cycles.
- Apply thermodynamic concepts to analyse the performance of vapour power cycles
- Understand the principles and applications of refrigeration systems.
- Apply Thermodynamic concepts to determine performance parameters of refrigeration and air conditioning systems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Basic and Applied Thermodynamics	P.K.Nag	Tata McGraw Hill	2nd Ed., 2002
2	Basic Engineering Thermodynamics	A.Venkatesh	Universities Press,	2008
3	Applications of Thermodynamics	V.Kadambi, T. R.Seetharam, K. B. Subramanya	Wiley Indian Private Ltd	1st Edition 2019
4	An Introduction to Thermo Dynamics	Y.V.C.Rao	Wiley Eastern Ltd	2003
Reference Books				
1	Thermodynamics- An Engineering Approach	YunusA.Cenegal and Michael A.Boles	Tata McGraw Hill publications	2002
2	Thermodynamics for engineers	Kenneth A. Kroos and Merle C. Potter	Cengage Learning	2016
3	Engineering Thermodynamics	J.B.Jones and G.A.Hawkins	John Wiley and Sons.	
4	Thermodynamics	Radhakrishnan	PHI	2nd revised
5	Principles of Engineering Thermodynamics	Michael J, Moran, Howard N. Shapiro	Wiley	8th Edition

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester-III

Machine Drawing and GD&T			
Course Code	**21SMLL35**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:2:0	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits	01	Exam Hours	03

Course objectives:

- To acquire the knowledge of CAD software and its features.
- To familiarize the students with Indian Standards on drawing practices.
- To impart knowledge of thread forms, fasteners, keys, joints and couplings.
- To make the students understand and interpret drawings of machine components leading to preparation of assembly drawings manually and using CAD packages.
- To acquire the knowledge of limits, tolerance and fits and indicate them on machine drawings.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

MODULE 1 **8 HOURS**

Introduction: Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing, Drawing units, grid and snap. Conversion of pictorial views into orthographic projections of simple machine parts (with and without section). Hidden line conventions. Precedence of lines. Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections. Conversion of pictorial views into orthographic projections of simple machine parts. Hidden line conventions. Precedence of lines. Conversion of pictorial views into orthographic projections of simple machine parts (with section planes indicated on the part).

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 2 **8 HOURS**

Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External) square and Acme. Sellers thread, American Standard thread

Teaching-Learning Process	. Chalk and talk method / PowerPoint Presentation

MODULE 3 **8 HOURS**

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 4 **8 HOURS**

Keys: Parallel key, Taper key, Feather key, Gib-head key and Woodruff key. Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.
Couplings: Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, and universal coupling (Hooks' Joint).

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 5 **8 HOURS**

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.
Assembly Drawings: (Part drawings shall be given)
1. Plummer block (Pedestal Bearing)

2. Lever Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Tool head of shaper.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Identify the national and international standards pertaining to machine drawing.
- Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings.
- Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.
- Interpret the Machining and surface finish symbols on the component drawings.
- Preparation of the part or assembly drawings as per the conventions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

- 1.First test at the end of 5th week of the semester
- 2.Second test at the end of the 10th week of the semester
- 3.Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- 1.First assignment at the end of 4th week of the semester
- 2.Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE

Suggested Learning Resources:

Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Machine Drawing	K.R. Gopala Krishna	Subhash Publication	2005

2	Machine Drawing	N.D.Bhat&V.M. Panchal	Charoratar publishing house	2005
Reference Books				
1	A Text Book of Computer Aided Machine Drawing	S. Trymbaka Murthy	CBS Publishers, New Delhi	2007
2	Engineering drawing	P.S.Gill	S K Kataria and Sons	2013
3	Machine Drawing	N. Siddeshwar, P. Kanniah, V.V.S. Sastri	Tata McGraw Hill	2006

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

III-Semester

Data Base Management Systems			
Course Code	**21SM381**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	01	Exam Hours	01

Course objectives:

- the creation of data structures and relieve the programmer of the problems of setting up complicated files.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Module-1	
Data Base: System Applications: A Historical Perspective, File Systems versus a DBMS, the Data Model, Levels of Abstraction in a DBMS, Data Independence, Structure of a DBMS Introduction to Database Design: Database Design and ER Diagrams, Entities, Attributes, and Entity Sets,	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	
ER Model:Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design With the ER Model	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	
SQL: Queries, Constraints, Triggers:form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, triggers and active data bases.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	
Schema refinement: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	
Transaction processing: Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)
At the end of the course the student will be able to:

1. Gain knowledge of fundamentals of DBMS, database design and normal forms.
2. Master the basics of SQL for retrieval and management of data.
3. Be acquainted with the basics of transaction processing and concurrency control.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, 3rd Edition, Tata Mc Graw Hill
2. Database System Concepts, Silberschatz, Korth, 5th edition, Mc Graw hill.

Reference Books:

1. Database Systems design, Implementation, and Management, Peter Rob and Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
3. Introduction to Database Systems, C.J.Date Pearson Education
4. Oracle for Professionals, The X Team, S.Shah and V. Shah, SPD.
5. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL,Shah,PHI.
6. Fundamentals of Database Management Systems, M. L. Gillenson, Wiley Student Edition.
8.

Web links and Video Lectures (e-Resources):

-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

III-Semester

Introduction to Python			
Course Code	**21SM382**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	01	Exam Hours	01

Course objectives:

- Python is a computer programming language often used to **build websites and software, automate tasks, and conduct data analysis**. Python is a general-purpose language, meaning it can be used to create a variety of different programs and isn't specialized for any specific problems.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1.

Module-1	
Introduction: what do you mean by python,why python? Good to know,Python syntax compared to other programming languages.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	
Beginning Python Basics: the print statement,comments,python data structure and data types,string operation in python,simple input and outputs.	
Teaching-Learning Process	. Chalk and talk method / PowerPoint Presentation

Module-3	
Python Programme Flow: Indentation,The If statement and its related statement,an example with if statement and its related statement.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	
Functions and Modules: Creat your own functions,functions parameters,variable arguements,scope of function,function documentation.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	
Functions and Modules: Errors,Exception handling with try,handling multiple exception	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. The course is designed to provide Basic knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

4. First test at the end of 5th week of the semester
5. Second test at the end of the 10th week of the semester
6. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705.

Web links and Video Lectures (e-Resources):

-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester- IV

Complex Analysis, Probability and statistics Methods &Linear Programming			
Course Code	21MAT41	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	0	Exam Hours	03

Course objectives:

- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution
- Occurring in digital signal processing, design engineering and microwave engineering.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1 **8 Hours**

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences.
Construction of analytic functions: Milne-Thomson method-Problems.

Teaching-Learning Process	1. Video demonstration or Simulations, 2. Chalk and Talk.

Module-2 **8 Hours**

Conformal transformations: Introduction. Discussion of transformations:$w = Z^2, w = e^z, w = z + \frac{1}{z}, (z \neq 0)$.
Bilinear transformations- Problems.
Complex integration: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.

Teaching-Learning Process	1. Video demonstration or Simulations, 2. Chalk and Talk.

Module-2 **8 Hours**

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.

Teaching-Learning Process	1. Video demonstration or Simulations, 2. Chalk and Talk.

Module-3 **8 Hours**

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation -problems. Regression analysis- lines of regression –problems.
Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form-

$y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.

Teaching-Learning Process	1. Video demonstration or Simulations, 2. Chalk and Talk.

Module-4 **8 Hours**

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.
Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

Teaching-Learning Process	1. Video demonstration or Simulations, 2. Chalk and Talk.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field
- theory.
- Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image
- processing.
- Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of the maximum marks (400 marks out of 100). A student shall be deemed to have satisfied the academic requirements if the student secures not less than 40% (40 Marks out of 100)in the CIE.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of the 4th week of the semester
- Second assignment at the end of the 9th week of the semester

Course Seminar suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

OR

Learning MATHS tools and solving a few problems from each module using MATHS tools (e.g. MATLAB, SciLab etc)

- Conducting at least 05 labs sessions within the Academic Duration.

The sum of three tests, two assignments, and a seminar/Lab sessions using MATHS tools will be out of 100 marks

The student shall secure minimum 40% of marks of course to qualify and become eligible for award of degree.

Suggested Learning Resources:Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition,2016
2	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Edition, 2017
3	Engineering Mathematics	Srimanta Pal et al	Oxford University Press	3rd Edition,2016
Reference Books				
1	Advanced Engineering Mathematics	C.Ray Wylie, Louis C.Barrett	McGraw-Hill	6th Edition 1995
2	Introductory Methods of Numerical Analysis	S.S.Sastry	Prentice Hall of India	4th Edition 2010
3	Higher Engineering Mathematics	B.V.Ramana	McGraw-Hill	11th Edition,2010
4	A Text Book of Engineering Mathematics	N.P.Bali and Manish Goyal	Laxmi Publications	2014

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester - IV

Machining Jigs and Fixtures			
Course Code	21ME42	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- To know the various subtractive machining processes in industries.
- To calculate the values of various forces involved in the machining operations.
- To understand and determine tool wear and tool life of different machining processes.
- To know various non-conventional machining and hybrid machining processes.
- To know the design of jigs and fixtures for various industrial/ machining members.

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

Module-1	**8 Hours**
Introduction to Machining Processes and Machine Tools: Subtractive manufacturing processes and classifications. **Construction, specification operations of machine tools**:– Lathe, Shaping, Milling, Drilling, Grinding Machine. **Introduction to CNC machines:** CNC Lathe, Milling, Drilling, Machine Center.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

Module-2	**8 Hours**
Mechanics of Metal Cutting: Single point turning tool geometry (SPTT) influences the chip formation mechanisms of the Orthogonal and Oblique cutting process. **Cutting Force Analysis (Orthogonal Cutting):** Analysis of machining forces and power requirement, 'Merchant's model of Orthogonal Cutting and Theory of Lee & Shaffer' Chip Velocity, Velocity relationships (simple numerical); the influence of cutting temperature on machinability. **Cutting Fluids**: Characteristics of Cutting fluids, Selections, and applying methods of cutting fluids.	
Teaching-Learning Process	1. . Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

Module-3	**8 Hours**
Machinability and Tool Life Process of cutting tool failure wears and time relationship, tool wear index, feed marks, the effect of tool wear on the machined surface, surface finish, machinability, machinability index/rating, tool life & variables affecting tool life, tool materials. **Finishing Process:** Importance of surface finishing processes, Grinding, Abrasive Flow Machining, Honing. Sanding, Abrasive blasting, Polishing, Lapping. **Surface Finishing and Protection**: Powder Coating, Liquid Coating, Electroplating, Galvanizing, Anodizing.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

Module-1	**8 Hours**

Advanced Machining Process; Importance and classification of advanced machining process; Process principal, process parameters, and application of: - Abrasive Jet Machining (AJW), Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM); Ultrasonic Machining (USM); Electrical Discharge Machining (EDM); Wire Electrical Discharge Machining (WEDM); Electro Chemical Machining (ECM). Laser Beam Machining (LBM), Electron Beam Machining (EBM), and Plasma Arc Machining (PAM). **Hybrid Machining Process:** Importance of hybrid machining process; Process principal, process parameters, and application of: - Electrochemical Discharge Machining (ECDM), Ultrasonic Assisted Electric Discharge Machining (UAEDM), Electrochemical Discharge Grinding (EDG), Powder Assisted Electric Discharge Machining (PAEDM).	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.
MODULE 5 **8 HOURS**	
Jigs and Fixtures: Importance of jigs and fixtures; the difference between jigs and fixtures; types of jigs and fixtures; essential features of jigs and fixtures, Materials used.Factors to be considered for the design of Jigs and Fixtures; Jigs: Template, Plate, Channel, Diameter, Leaf, Rung, Box,Fixtures: Turning, Milling, Broaching, Grinding, Boring, Indexing, Tapping, Duplex, Welding, and Assembly fixtures.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	One Job on Lathe machine with simple operations (turning, facing, Thread cutting and tapering) on low carbon steel and/or heat-treated low carbon steel, and Demonstration of tungsten carbide cutting tool inserts.
2	Operations and One Job each on shaping/milling machine
3	Simple operations and One Job on the drilling and grinding machine.
4	Demonstration/Experimentation of simple programming of CNC machine operations.
5	To study the tool geometry of a single point turning tool (SPTT) in the American Standards Association (ASA) system.
6	Cutting force measurement with dynamometers (Demonstration) for turning, drilling, grinding operations.
7	Application of cutting fluids in turning operations and case study on optimizing process parameters on turning operation.
8	Analysis of chip formation and chip reduction coefficient in turning of mild steel by HSS tool with different depth of cut, speed, and feed rate.
9	Experiment on tool wears and tool life on anyone conventional machining process.
10	Experiment on anyone advanced machining process
11	Design of Jigs and Fixture for any one application using any software tool.
12	Experiment using Drill/template Jig and Demonstration on turning and grinding fixtures.
13	Experiment using milling Indexing fixtures.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

At the end of the course the student will be able to:

- Demonstrate the Conventional CNC machines and advanced manufacturing process operations
- Determine tool life, cutting force, and economy of the machining process.
- Analyze the influence of various parameters on machine tools' performance.
- Select the appropriate machine tools and process, the Jigs, and fixtures for various applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:Books

1. Shaw, M C, (2014), Metal Cutting Principles, Oxford University Press.
2. McGeough, J A, (1988), Advanced Methods of Machining, Springer.
3. Boothroyd, G., and Knight, W. A., Fundamentals of Machining and Machine Tools, CRC Press.
4. Chattopadhyay, A B, (2013), Machining and Machine Tools, Wiley India.
5. Mikell P. Groover, (2019), Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publications.

Rao P. N., Manufacturing Technology II, Tata McGraw Hill.

Web links and Video Lectures (e-Resources):

1. V. K. Jain, Advanced Machining Processes, NPTEL Course Department of Mechanical Engineering, IIT Kanpur, Link: http://nptel.ac.in/courses/112104028/.
2. U. S. Dixit, Mechanics of Machining, NPTEL Course Department of Mechanical Engineering Guwahati, Link: http://nptel.ac.in/courses/112103248/.

A. B. Chattopadhyay, Manufacturing Processes II, NPTEL Course of Department of Mechanical Engineering, IIT Kharagpur, https://nptel.ac.in/courses/112/105/112105126/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Visit any one machining center or machining industry and/or

Case study on process parameter influence on anyone advanced machining process and hybrid machining process.

Semester - IV

Fluid Mechanics and Heat Transfer			
Course Code	21SM43	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- To have a working knowledge of the basic properties of fluids and to understand the concept of surface tension and capillarity.
- To study the kinematics of fluid and to understand the flow characteristic and dynamics of flow field for various engineering applications.
- Study the modes of heat transfer.
- Learn how to formulate and solve 1-D steady and unsteady heat conduction problems.
- Apply empirical correlations for fully-developed laminar, turbulent internal flows and external boundary layer convective flow problems.
- Study the basic principles of heat exchanger analysis and thermal design.
- Understand the principles of boiling and condensation including radiation heat transfer related to engineering problems.

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

MODULE-1 **8 HOURS**

Introduction and Fluid Properties: Definition of fluid, types of fluids, Properties of fluids-Mass density, Weight density, Specific volume, Specific gravity, Viscosity, Newton's law of viscosity, Phenomenon of surface tension and Capillarity. Simple numerical problems.

Fluid statics and Fluid Kinematics: Pascal's law and hydrostatic law. Total pressure and centre of pressure acting on a vertical and inclined submerged surface. Types of fluid flow, rate of flow, Continuity equation, velocity and acceleration, velocity potential function, stream function and simple numerical problems.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

MODULE-2 **8 HOURS**

Fluid Dynamics: Equations of motion, Euler's Equation and Bernoulli's equation of motion. Momentum equation. Applications of Bernoulli's theorem such as venturi-meter, orifice meter (No derivation for discharge), rectangular and triangular notch, pitot tube. Viscous flow: viscous flow through circular pipes and between parallel pipes. simple numerical problems.

Boundary layer theory: Boundary layer concept. Development of boundary layer. Hydrodynamic boundary layer. Definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness. Flow through pipes. Major losses- Darcy equation. Minor losses (No derivations).

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

MODULE-3 **8 HOURS**

Introductory concepts and definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Types of boundary conditions. General three-dimensional
Heat Conduction Equation: Steady-state one-dimensional heat conduction problems (Without heat generation and Constant thermal conductivity). Simple numerical problems.

Brief Introduction to: Variable thermal conductivity, heat generation, Thermal Resistances, Critical Thickness of Insulation in cylinder and spheres, Extended Surfaces or Fins, Fin Efficiency and Effectiveness, Applications, Transient heat conduction: Definition, Different cases (No numericals).

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

MODULE-4 **8 HOURS**

Numerical Analysis of Heat Conduction: Introduction, one-dimensional steady conduction and one dimensional unsteady conduction, boundary conditions, solution methods. **Thermal Radiation:** Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Spectral emissive power, Wien's displacement law, Planck's laws, Stefan-Boltzmann law, Emissivity and Kirchhoff's Laws, View factor, Net radiation exchange between parallel plates, Radiation Shield.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

MODULE 5 **8 HOURS**

Convection: Newton's law of cooling, Dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection. Concepts of hydrodynamic and Thermal boundary layer. **Heat Exchangers:** Definition, Classification, applications, LMTD method, Effectiveness - NTU method. **Introduction to boiling and Condensation:** Pool boiling, film wise and drop wise Condensation.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk. 4. Laboratory Demonstrations and Practical Experiments.

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Determine the viscosity of oil using Red wood viscometer and Say-bolt viscometer.
2	Measurement of pressure using different Manometers for high and low pressure measurements (manometers using different manometric fluids).
3	Working principle of different flow meters and their calibration (orifice plate, venture meter, turbine, Rota meter, electromagnetic flow meter)
4	Working principle of different flow meters for open channel and their calibration
5	Determination of head loss in pipes and pipe fittings having different diameters, different materials and different roughness
6	Reynolds apparatus to measure critical Reynolds number for pipe flows
7	Effect of change in cross section and application of the Bernoulli equation
8	Impact of jet on flat and curved plates
9	Measurement of coefficient of pressure distribution on a cylinder at different Reynolds Numbers
10	Wind tunnel calibration using Pitot static tube
11	Determination of drag and lift co-efficients of standard objects using wind tunnel.
12	Use any CFD package to study the flow over aerofoil/cylinder

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Identify and calculate the key fluid properties used in the analysis of fluid behaviour.
- Apply the knowledge of fluid statics, kinematics and dynamics while addressing problems of mechanical engineering.
- Understand the modes of heat transfer and apply the basic laws to formulate engineering systems.
- Understand and apply the basic laws of heat transfer to extended surface and unsteady state heat transfer problems.

- Analyze heat conduction through numerical methods and apply the fundamental principle to solve radiation heat transfer problems.
- Analyze heat transfer due to free and forced convective heat transfer.
- Understand the design and performance analysis of heat exchangers and their practical applications, Condensation and Boiling phenomena.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

4. The question paper will have ten questions. Each question is set for 20 marks.
5. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
6. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources: Reference Books

1. Fox, R. W., Pitchard,P. J.,and McDonald, A. T., (2010), Introduction to Fluid Mechanics, 7thEdition, John Wiley & Sons Inc.
2. Cimbala, J.M., Cengel, Y. A. (2010),Fluid Mechanics: Fundamentals and Applications, McGraw-Hill
3. Frank M White., (2016), Fluid Mechanics, 8thEdition , McGraw-Hill
4. P K Nag., (2011), Heal and Mass Transfer, McGraw-Hill
5. Frank Kreith., (2011), Principles of Heat Transfer, 7th Edition, Cengage learning

Additional References:

1. A text book of Fluid Mechanics and Hydraulic Machines, Dr. R K Bansal, Laxmi publishers
2. Fundamentals of Fluid Mechanics, Munson, Young, Okiishi&Hebsch, John Wiley Publicationss, 7th Edition
3. Holman J P., (2008), Heat Transfer, Tata McGraw-Hill, 9th Edition.
4. Incropera F.P.., (2006), Fundamentals of Heat and Mass Transfer, 5th Edition

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Semester- IV

MECHANICS OF MATERIALS			
Course Code	21SM44	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To know the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.
- To know behaviour & properties of engineering materials.
- To understand the stresses developed in bars, compounds bars, beams, shafts, and cylinders.
- To understand the concepts of calculation of shear force and bending moment for beams with different supports.
- To expose the students to concepts of Buckling of columns and strain energy.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

MODULE 1 **8 HOURS**

Stresses and Strains: Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk.

MODULE 2 **8 HOURS**

Analysis of Stress and Strain: Introduction to three dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear tress, Mohr circle for plane stress conditions.

Cylinders-Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lames equations.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk.

MODULE 3 **8 HOURS**

Shear Force and Bending Moment: Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant / varying loads.

Stress in Beams: Bending and shear stress distribution in rectangular, I and T section beams.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk.

MODULE 4 **8 HOURS**

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory.

Torsion: Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin walled sections.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk.

MODULE 5 **8 HOURS**

Columns: Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.

Strain Energy: Strain energy due to axial, shear, bending, torsion and impact load. Castigliano's theorem I and II

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- CO1: Understand simple, compound, thermal stresses and strains their relations and strain energy.
- CO2: Analyse structural members for stresses, strains and deformations.
- CO3: Analyse the structural members subjected to bending and shear loads.
- CO4: Analyse shafts subjected to twisting loads.
- CO5: Analyse the short columns for stability.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

7. The question paper will have ten questions. Each question is set for 20 marks.

8. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Mechanics of Materials	Mechanics of Materials J M	Cengage	Eighth edition 2013
2	Fundamentals of Strength of	P N	PHI Learning Pvt. Ltd	2013
3	Strength of Materials	R K Rajput	S. Chand and Company Pvt.	2014
Reference Books				
1	Strength of Materials	R. Subramanian	Oxford	2005
2	Strength of Materials	S. S. Ratan	Tata McGraw Hill	2nd Edition, 2008
3	Mechanics of materials Strength	S C Pilli and N	Cengage	2019
4	Mechanics of Materials F	Ferdinand Beer,	McGraw Hill Education	Latest edition
5	Mechanics of Materials	R C Hibbeler	Pearson	Latest edition

Web links and Video Lectures (e-Resources):

-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester- IV

Biology For Engineers			
Course Code	21BE45	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:2:0	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits		Exam Hours	

Course objectives:

-

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. .

Module-1	
Teaching-Learning Process	

Module-2	
Teaching-Learning Process	.

Module-3	
Teaching-Learning Process	

Module-4	
Teaching-Learning Process	

Module-5

Teaching-Learning Process	

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

9. The question paper will have ten questions. Each question is set for 20 marks.

10. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:Books

1.

Web links and Video Lectures (e-Resources):

• .
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning •

Semester- IV

MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY			
Course Code	21MEL46	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:0:0:0	SEE Marks	50
Credits	01	Exam Hours	100

Course objectives:
Students will be able

- To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
- To illustrate the use of various measuring tools & measuring techniques.
- To understand calibration techniques of various measuring devices.

Sl.NO	Experiments
1	Study of instruments for Liner measurement and angular measurements: Slip gauges- Measurement of angle-sine bar, Sine centre, Angle gauges, Optical instruments for angular measurements.
2	Study of Autocollimator-Applications for measuring straightness and squareness.
3	Study of different Comparators and calibration of Dial indicator, Electrical comparators, LVDT, Pneumatic comparators
4	Study of Terminology of screw threads and Measurement of major diameter, Minor diameter, Pitch, Angle and Effective diameter of screw threads by 2- wire and 3-wire methods
5	Gear tooth measurement using Gear tooth Vernier and Parkinson Gear Tester
6	Various parameter measurement using computerized profile projector
7	Surface topology measurement using Surface Roughness Tester
8	Calibration of Pressure gauge, Thermocouple and Load cell
9	Determination of modulus of elasticity and modulus of rigidity of a mild steel specimen using strain gauges
10	Calibration of Micrometer and Vernier caliper using slip gauges
11	Circularity measurement using Electronic and Mechanical comparator
12	Demonstration of Measurement using Coordinate Measuring Machine (CMM) / Laser Scanner
13	Choose any product used in the day to day life based on his/her choice, prepare a measurement plan and implement the measurement with existing tools)

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:
At the end of the course the student will be able to:

- Understand Calibration of pressure gauge, thermo couple, LVDT, load cell, micrometer.
- Apply concepts of Measurement of angle
- Demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
- Analyse Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth Vernier/Gear tooth micrometre
- Understand the concepts of measurement of surface roughness.
- Demonstrate the use of Coordinate Measuring Machine (CMM) / Laser Scanner

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

Engineering Metrology and Measurements, N.V.Raghavendra and L. Krishnamurthy, Oxford University Press

Semester- IV-

Quality Engineering			
Course Code	**21ME481**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	01	Exam Hours	01

Course objectives:

- To impart knowledge on inspection, measurement, quality control, validation and certification of products.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	
Basic concepts: Measurement and inspection; Role of metrology in quality assurance; Errors; Length standards; Gauges and comparators; Linear and angular measurements; Fits and tolerances.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-2	
Measurement Practices: Optical metrology and laser interferometers; Measurement of flatness, straightness and form errors; Surface finish measurements.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-3	
CMM; Vision applications in Metrology; Nano-measurements.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-4	
Statistical Methodologies: Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5	
Standards and Certifications: BIS, ISO, SAE, ASME, ASTM, IEEE. Case studies: Inspection and Validation practices adopted in various industries.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:
1.Understand various metrology principles and techniques
2. Identify and select suitable techniques and equipments to inspect and to ensure product quality
3. Know about various quality control methodologies, standards and certifications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

Suggested Learning Resources:

Books

Books

T. G. Beckwith, R. D. Marangoni and J. H. Lienhard, Mechanical Measurements, 6th edition, Pearson Higher Education, 2007, ISBN: 0132296071.

R. K. Jain, Engineering Metrology, Khanna Publishers, 20th Reprint, 2014, ISBN: 817409153X.

References

1. D. J. Whitehouse, Hand book of surface and nanometrology, 2nd Edition, CRC Press, 2010, ISBN: 9781420082012.

2. G. T. Smith, Industrial Metrology, Springer, 2002, ISBN: 9781852335076.

2. 3. A. M. Badadhe, Metrology and Quality Control, Technical Publications, 2006, ISBN: 8189411861. 4. R. C. Gupta, Statistical Qualtiy Control, 8th edition, Khanna Publishers, 2008, ISBN: 8174091114.

Web links and Video Lectures (e-Resources):

-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester- IV

Mechanical Design Concepts			
Course Code	**21ME482**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	01	Exam Hours	01

Course objectives:

- This is a basic course on mechanical engineering design focusing on the principles of design, load analysis, stress analysis and final failure analysis of mechanical systems.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Module-1

Kinematics and Dynamics: Introduction to mechanisms; position, velocity and acceleration of planar mechanisms; dynamics of planar mechanisms; case studies

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Stress and Strain – axially loaded members; torsion of circular bars; bending of prismatic beams

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Failure Theories – failure of ductile and brittle materials under static loading; mechanism of fatigue failures; fatigue failure models;

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Machine Elements – Design of non-permanent joints - threaded fasteners, mechanics of power screws;

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Design of permanent joints – welding; gears – nomenclature, force analysis, Lewis bending equation, design of spur and helical gears.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

2. Students would be able to apply basic concepts related to mechanical design to design various mechanical systems in aerospace, automotive, naval, wind energy, chemical (nuclear) reactor, oil exploration, solid and fluid transportation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

4. First test at the end of 5th week of the semester
5. Second test at the end of the 10th week of the semester
6. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

R. L. Norton, Machine Design – an integrated approach, 5th edition, Pearson education Inc., 2014. ISBN-13: 9780133356717.

. E. Shigley, C. R. Mischke and R. G. Budynas, Mechanical Engineering Design, 7th edition McGraw-Hill, 2004. ISBN-13: 978-0071232708.

References

1. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, 5th edition, Wiley-India, 2011. ISBN-13: 978-1118012895.

2. M. F. Spotts, T. E. Shoup and L. E. Hornberger, Design of Machine Elements, 8th edition, Pearson education Inc., 2003. ISBN-13: 9780130489890.

3. 3. A. K. Mallik, A. Ghosh and G. Dittrich, Kinematic analysis and synthesis of mechanisms, 1st edition, CRC Press, ISBN: 0-8493-9121-0.

Web links and Video Lectures (e-Resources):

-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester- V

Entrepreneurship, Management and Economics			
Course Code	21SM51	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To help the students to understand the fundamental concepts and principles of management; the basic roles, skills, functions of management, various organizational structures and basic knowledge of marketing.
- To impart knowledge, with respect to concepts, principles and practical applications of Economics, which govern the functioning of a firm/organization under different market conditions.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1 **8 Hours**

Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought- early management approaches – Modern management approaches. Planning: Nature, importance and purpose of planning process Objectives -Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Module-2 **8 Hours**

Organizing and Staffing: Nature and purpose of organization Principles of organization - Types of organization - Departmentation Committees Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning Only) Nature and importance of staffing--Process of Selection & Recruitment (in brief). Directing & Controlling: Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief).

Teaching-Learning Process	. 1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Module-3 **8 Hours**

Introduction: Engineering and economics, Problem solving and decision making, Laws of demand and supply, Difference between Microeconomics & Macroeconomics, equilibrium between demand & supply, elasticity of demand, price elasticity, income elasticity. Law of Returns, Interest and interest factors, simple and compound interest, Cash flow diagrams, personal loans and EMI payment calculation with flexible interest rates, Discussion and problems.

Teaching-Learning Process	. 1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Module-4 **8 Hours**

Present, future and annual worth and rate of returns: Basic present worth comparisons, Present worth-equivalence, Assets with unequal lives and infinites lives, future worth comparisons, payback comparisons, Equivalent annual worth comparisons, situations for annual worth comparisons. Asset life, Rate of return, minimum acceptable rate of return, IRR anomalies and misconceptions, Cost of capital, comparisons of all present future and annual worth with IRR, product costing, Discussions and problems.

Teaching-Learning Process	. 1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Module-5 **8 Hours**

Costing and depreciation: Components of costs, estimation of selling price, marginal cost, first cost, all kinds of overheads, indirect cost estimation with depreciation, mensuration and estimation of material cost, cost estimation of

mechanical process, idling time. Product costing (approaches to product costing), causes of depreciation, methods of computing depreciation charges, straight line method, declining balance method, sum of years method, sinking fund method, service output methods, taxation concepts, personal income taxes and corporate taxes, Discussions and problems.

Teaching-Learning Process	. 1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO1: Understand needs, functions, roles, scope and evolution of Management

CO2: Understand importance, purpose of Planning and hierarchy of planning and also2nalyse its types.

CO3: Discuss Decision making, Organizing, Staffing, Directing and Controlling.

CO4: Select the best economic model from various available alternatives.

CO5: Understand various interest rate methods and implement the suitable one.

CO6: Estimate various depreciation values of commodities.

CO7: Prepare the project reports effectively.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the	Edition and Year
Textbook/s				
1	Mechanical estimation and	T.R. Banga& S.C. Sharma	Khanna Publishers	17th edition 2015
2	Engineering Economy	Riggs J.L	McGraw Hill	4th edition
3	Engineering Economy	Thuesen H.G	PHI	2002
4	Principles of Management	Tripathy and Reddy	Tata McGraw Hill	3rd edition 2006
Reference book/s				
1	Mechanical estimation and	T.R. Banga& S.C. Sharma	Khanna Publishers	17th edition 2015
2	Engineering Economy	Riggs J.L	McGraw Hill	4th edition
3	Engineering Economy	Thuesen H.G	PHI	2002
4	Principles of Management	Tripathy and Reddy	Tata McGraw Hill	3rd edition 2006

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester - V

Data Structures and Algorithm			
Course Code	21SM52	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- Understanding basic *data structures and algorithms*
- To assess how the choice of **data structures and algorithm** design methods impacts the performance of programs
- To solve problems using **data structures** such as linear lists, stacks, queues, binary trees and graphs and

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

MODULE-1 **8 HOURS**

Introduction: Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations, Review of Arrays, Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays, Array Operations: Strings: Basic Terminology, Storing, Operations and Pattern Matching algorithms. Programming Examples

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

MODULE-2 **8 HOURS**

Stacks and Queues Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression, Recursion - Factorial, GCD, Fibonacci Sequence, Tower of Hanoi. Queues: Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues . Programming Examples

Teaching-Learning Process	. 1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

MODULE-3 **8HOURS**

Linked Lists: Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Applications of Linked lists.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

MODULE-4 **8 HOURS**

Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

MODULE 5 **8 HOURS**

Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing. Files and Their Organization: Data Hierarchy, File Attributes, Text Files and Binary Files, Basic File Operations, File Organizations and Index+

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Design, Develop and Implement a menu driven Program in C for the following Array operations a. Creating an Array of N Integer Elements b. Display of Array Elements with Suitable Headings c. Inserting an Element (ELEM) at a given valid Position (POS) d. Deleting an Element at a given valid Position(POS) e. Exit.
2	Design, Develop and Implement a Program in C for the following operations on Strings a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations
3	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit
4	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^(Power) and alphanumeric operands.
5	Design, Develop and Implement a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks
6	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit
7	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, Ph No a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit
8	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue f. Exit
9	**Can be Demo experiments for CIE**
10	**Can be Demo experiments for CIE**
11	**Can be Demo experiments for CIE**

12	**Can be Demo experiments for CIE**

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Explain different types of data structures, operations and algorithms
- Apply searching and sorting operations on files
- Make use of stack, Queue, Lists, Trees and Graphs in problem solving
- Develop all data structures in a high-level language for problem solving

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

3. The question paper will have ten questions. Each question is set for 20 marks.
4. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
5. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be

included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources: Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Fundamentals of Data Structures in C	Ellis Horowitz and artaj Sahni	Universities Press	2nd edition, 2014
2	Data Structures	Seymour Lipschutz	Schaum's Outline Series', McGraw Hill Education,	2014
Reference Books				
1	Data Structures: A Pseudocode Approach with C	Richard Gilberg, Behrouz A Forouzan	Course Technology Inc	2nd edition, 2004
2	Data Structures using C	Reema Thareja,	Oxford University Press	2nd edition, 2014
3	An Introduction to Data Structures with Applications	Jean-Paul Tremblay & Paul G. Sorenson	McGraw Hill	2nd edition, 2014

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Semester-V

Finite Element Analysis			
Course Code	21SM53	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To learn the basic principles of finite element analysis procedure
- To understand the design and heat transfer problems with application of FEM.
- Solve 1 D, 2 D and dynamic problems using Finite Element Analysis approach.
- To learn the theory and characteristics of finite elements that represent engineering structures.
- To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1 **8Hours**

Introduction to Finite Element Method: General steps of the finite element method. Engineering applications of finite element method. Advantages of the Finite Element Method.
Boundary conditions: Homogeneous and non-homogeneous for structural, heat transfer and fluid flow problems. Potential energy method, Rayleigh Ritz method, Galerkin's method, Displacement method of finite element formulation. Convergence criteria, Discretisation process

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-2 **8Hours**

Types of elements: 1D, 2D and 3D, Node numbering, Location of nodes. Strain- displacement relations, Stress-strain relations, Plain stress and Plain strain conditions, temperature effects. **Interpolation models:** Simplex, complex and multiplex elements, linear interpolation polynomials in terms of global coordinates 1D, 2D, 3D Simplex Elements

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-3 **8Hours**

Introduction to the stiffness (Displacement) method: Introduction, Derivation of stiffness matrix, Derivation of stiffness matrix for a spring element, Assembly the total stiffness matrix by superposition. One-Dimensional Elements-Analysis of Bars and Trusses, Linear interpolation polynomials in terms of local coordinate's for1D, 2Delements. Higher order interpolation functions for 1D quadratic and cubic elements in natural coordinates, Constant strain triangle.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-4

Beams and Shafts: Boundary conditions, Load vector, Hermite shape functions, Beam stiffness matrix based on Euler-Bernoulli beam theory, Examples on cantilever beams, propped cantilever beams, Numerical problems on simply supported, fixed straight and stepped beams using direct stiffness method with concentrated and uniformly distributed load.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-5

Dynamic Considerations: Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, axi-symmetric triangular element, quadrilateral element, beam element. Lumped mass matrix of bar element, truss element, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

Course Outcomes: At the end of the course, the student will be able to:

CO1: Identify the application and characteristics of FEA elements such as bars, beams, plane and iso- parametric elements.

CO2: Develop element characteristic equation and generation of global equation.

CO3: Formulate and solve Axi-symmetric problems.

CO4: Apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, axi-symmetric and dynamic problems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

6. The question paper will have ten questions. Each question is set for 20 marks.
7. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	A first course in the Finite Element Method	Logan, D. L	Cengage Learning	6th Edition 2016
2	Finite Element Method in Engineering	Rao, S. S	Pergaman Int. Library of Science	5th Edition 2010
3	Finite Elements in Engineering	Chandrupatla T. R	PHI	2nd Edition 2013
Reference Books				
1	Finite Element Method	J.N.Reddy	McGraw -Hill International Edition	
2	Finite Elements Procedures	Bathe K. J	PHI	

3	Concepts and Application of Finite Elements Analysi	Cook R. D., et al.	Wiley & Sons	4th Edition 2003

E- Learning
VTU, E- learning

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester-V

Machine Design			
Course Code	21SM54	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
2. To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
3. To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcome

Module-1	**8Hours**
Introduction to Mechanical Design– Course Overview, Design Process; Materials – Material Properties, Materials Selection, Combined Loading, Failures Resulting from Static Loading – Static Strength, Stress Concentration, Failure Theories for Ductile and Brittle Materials, Cyclic Stress, Fatigue Regimes.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-2	**8Hours**
Fatigue of Structures:S.N. curves, Endurance limit, Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams, Notches and stress concentrations, Neuber's stress concentration factors, plastic stress concentration factors – Notched S-N curves..	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-3	**8Hours**
Design of couplings: Couplings: Rigid and flexible coupling-types and applications, design of Flange coupling, and Bush and Pin type coupling. **Introduction Permanent Joints**: Types of permanent joints-Riveted and Welded Joints. Riveted joints: Types of rivets, rivet materials, Caulking and fullering, analysis of riveted joints, joint efficiency, failures of riveted joints, boiler joints, riveted brackets.(only Theory)	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-4	**8Hours**
Springs: Types of springs - stresses in Helical coil springs of circular and non-circular cross sections. Tension and compression springs, springs under fluctuating loads, Leaf Springs: Stresses in leaf springs. Equalized stresses, Energy stored in springs, Torsion, Belleville and Rubber springs.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-5	**8Hours**
Fracture Mechanics: Strength of cracked bodies, potential energy and surface energy, Griffith's theory, Irwin – Orwin extension of Griffith's theory to ductile materials, Stress analysis of cracked bodies.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1. Apply the principle of solid mechanics to design machine member under variable loading.
CO2. Introduce fatigue failure of materials
CO3. Ability to design Couplings and joints for industrial applications.
CO4. Ability to design various Springs for strength and stiffness.
CO5. Correctly apply fracture mechanics to predict brittle fracture. Identify and describe the basic fracture and fatigue mechanisms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

8. The question paper will have ten questions. Each question is set for 20 marks.
9. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Design of Machine Elements,	V B Bhandari	Tata McGraw Hill	4th Ed., 2016.
2	Machine Design	Shigley, J.E	McGraw Hill	
3	Fracture Mechanics Fundamentals and Applications	T.L. Anderson	Taylor and Francis Group Ltd.,	1s Ed., 2016

Reference Books

1	Machine Design- an integrated approach	Robert L. Norton	Pearson Education	2nd edition.
2	Design of Machine Elements	V.M. Faires		
3	Machine Design	Hall, Holowenko, Laughlin (Schaum's Outline series)	Tata McGraw Hill Publishing	Special Indian Edition, 2008
4	Elements of Machine Design	H.G.Patil, S.C.Pilli, R.R.Malagi, M.S.Patil	IK International	First edition,2019
5	Elements of Fracture Mechanics	Prashant Kumar	Tata McGraw Hill, New	

Design Data Hand Book:

.[1] Design Data Hand Book, Dr.K lingaiah vo,l I and II, Tata McGraw-Hill Education India

[2] Design Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS publication

Web links and Video Lectures (e-Resources):

1. Design of Machine Elements I, IIT Kharagpur, https://nptel.ac.in/courses/112105124

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester-V

Smart Manufacturing Lab-1			
Course Code	21SML55	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	100

Course objectives:

- Learn CAD Modelling Techniques for RP
- Generating STL files from the CAD Models
- Fabricate using RP Machine
- Develop the skill to operate the Robot
- Learn different Robotic programming languages

Sl.NO	Experiments
1	Review of CAD Modelling Technique and Introduction to RP.
2	Forming Groups and Assigning creative Idea.
3	Generating STL files from the CAD Models and Working on STL files.
4	Modeling Creative Designs in CAD Software
5	Assembling Creative Designs in CAD Software.
6	Processing the CAD data in catalyst software(Selection of Tool path generation).
7	Simulation in Catalyst (or any other)software.
8	Sending the tool path data to FDM RP(or any other)machine.
9	Fabricating the physical part on FDM RP machine.
10	Removing the supports& post processing (Cleaning the Surfaces)
11	Demonstrating Creative working Models.
12	Converting CT/MRI Scan data into STL files using MIMICS software (Demo)
	Demonstration Experiments (For CIE)
1	Forward and inverse kinematics of two axis planar articulated robot using analytical and DH algorithm using Lego NXT.
2	Forward and inverse kinematics to control hand movements in NAO.
3	Study and Selection of Gripper.
4	Implementation of trajectory planning algorithm for straight line motion using Matlab and executing PID based control of two axis planar articulated robot in Lego NXT.
5	Analysis and Simulation using FANUC Robo guide software(or any other)and real time programming of Fanuc M710i.
6	Robot (or any other).
7	Programming of Adept Cobra S600 SCARA robot (or any other).
8	Forward and inverse kinematics of two axis planar articulated robot using analytical and DH algorithm using Lego NXT.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Optimize the process parameters of FDM Machine to improve the quality of the parts produced.
- Build complex engineering assemblies in plasticmaterials with less process planning.
- Improve surface finish of fabricated plastic components for the engineering applications.
- Design and fabricate working models for the conceptual testing applications.
- Apply forward and inverse kinematic solutions.
- Implement trajectory planning algorithm.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of the semester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

-

Semester- V

Research Methodology &Intellectual Property Rights			
Course Code	21SM56	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	02	Exam Hours	02

Course objectives:

- To develop understanding of the basic framework of research process. To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- understand some basic concepts of research and its methodologies
- organize and conduct research in a more appropriate manner
- write a research report and thesis
- write a research proposal

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1 **8Hours**

Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem.
Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Module-2 **8Hours**

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.
Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations,

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Module-3 **8Hours**

Building Intellectual Property Rights, Law of Patents, **Fundamentals of Patent Law** - Evolution of the patent system, Patentability Requirements; Patentable Subject Matter; Industrial Applicability/Utility; Novelty; Anticipation by publication; Anticipation by public knowledge and public use; Anticipation by public display; Anticipation by sale; Inventive Step/Non-Obviousness; Novelty Assessment; Inventive Step Assessment; Specification, **Drafting of A Patent Specification** - Introduction Patent Specification; Provisional Specification Complete Specification, Parts of the complete specification; **Patent Procedure in India** - PATENT PROCEDURE; Registration and Renewal fee payment; **Patent Infringement** - Infringement of a patent; Literal Infringement; Equivalence Infringement; Indirect Infringement; Defenses - Experiment - Research or Education - Bolar Exemption- Government use- Patent Exhaustion- Patent Misuse- Inequitable Conduct - Remedies- Injunction- Account of profits- Costs; **International Patent Regimes** - International Instruments; Paris Convention; TRIPS AGREEMENT; PCT; BUDAPEST TREATY, **Patenting Biotechnology Inventions** - Unique nature of Biotechnology; Patentability Requirements and Biotechnology Inventions; Patentable Subject Matter- USA- Europe- India; **Patentability of Software Inventions** - Patentability of Software Inventions in USA; Patentability of software inventions in Europe; Patentability of Software Inventions in India.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Module-4	8Hours
Law of Copyright and Designs, **Understanding Copyright Law** - Historical Overview – Justification For Copyright Law - The Natural Law Justification - The Economic Rationale of Copyright Clause, Basic Concepts Underlying copyright Law - Idea – Expression Dichotomy Originality / Creativity – Fixation **Term of Protection**, **Subject - Matter of Copyright** - Literary Works - Dramatic Works - Musical Work - Artistic Works - Cinematograph Films and Sound recordings, **Acquisition of Copyright in India**, Rights of the Copyright Owner - Economic Rights - Moral Right or Droid Moral Right of Authorship or Paternity Rights - Rights against Distortion or Mutilation of the Original Works or Integrity Rights - Limitations - Limitations set under International Regime – Berne Convention - Rome Convention - Trips Agreement - Three Step Test, Infringement of Copyright -Transfer of copyright - License and Assignment - License and consent -Duration of a License Form and Content - Disputes in Respect of Licence -Types of Licenses - Exclusive and Non-Exclusive Licenses.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk
Module-5	**8Hours**
Basic Principles of Design Rights - Justification for Protecting Designs - Historical Perspective - Features of Shape, configuration, Pattern or Ornament - or Composition of lines or colour - New or Original - Applied to an Article, **Excluded Subject - Matter** - Method or Principle of Construction - Features Dictated Solely by Function - Mechanical Device - Trademark, or Property Mark, or Artistic Work - immoral Designs and Designs Contrary to Public order–**Rights of the Owner of Designs and Tests for Infringement. Assignment of Design Rights, Infringement of Designs**	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration 3. Chalk and Talk

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem .
- Explain the functions of the literature review in research, carrying out a Iiterature search, developing theoretical and conceptual frameworks and writing a review. .
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections. .
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports o Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE will same as 1 credit theory course for the 1st and 2nd semester; however, for **higher** semesters depending upon the type of the course, the CIE pattern may be MCQ type (100 questions) or the same as other core theory courses**.**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination(SEE):

SEE paper will be set for 100 questions each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **120 minutes.** Marks scored are scaled down to 50 Marks.

The suggested question paper pattern is MCQ for the 1st and 2nd semester however, **for higher** semester/s depending on the type of the course SEE may be a written examination, a pattern similar to other theory course

For non-MCQ pattern of CIE and SEE

Continuous Internal Evaluation (CIE):

At the beginning of the semester, the instructor/faculty teaching the course has to announce the methods of CIE for the course.

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

10. The question paper will have ten questions. Each question is set for 20 marks.
11. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, third edition, 2018.

2. 2. Research Methodology a step-by-step guide for beginners. Ranjit Kumar, SAGE Publications, 3rd Edition, 201-1. [For the topic Reviewing the literature under module 2),

3. 3. Study Material, (For the topic Intellectual Property under module 5), Professional Programme Intellectual

4. 4. Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester-V

Environmental studies			
Course Code	21CIV57	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

- 1

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. .

Module-1	
Teaching-Learning Process	

Module-2	
Teaching-Learning Process	.

Module-3	
Teaching-Learning Process	

Module-4	
Teaching-Learning Process	

Module-5

Teaching-Learning Process	

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1.

Web links and Video Lectures (e-Resources):

• .
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning •

Semester-V

Robotics and Automation			
Course Code	**21SM581**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	01	Exam Hours	01

Course objectives:

- This course synthesizes the disciplines of Mechanical and Electrical Engineering to provide a comprehensive overview of the various technologies and tools used to develop mechatronic devices.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

2.

Module-1	
Mechatronic and Measurement Systems: Overview of mechatronic systems and devices in manufacturing, overview of sensors, transducers and control systems in manufacturing,	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	
Elements and Analysis of Electric Circuits, Diode, transistor, and thyristor Circuits, operational Amplifier (Op-Amp) Circuits, digital Logic and logic Families	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	
Data Monitoring using Arduino: Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Analog-to-Digital (A/D) and Digital-to-Analog (D/A) Conversion	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	
Robotics in Automation: Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation Analog input / output, Programming and interfacing with Sensors in manufacturing applications.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	
Robotics in Automation motion: Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, applications in manufacturing.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

2. At the end of the course, a student will be able to 1. integrate various electromechanical devices in manufacturing.
3. 2. automate a manufacturing system with various sensors, actuators and controllers.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

4. First test at the end of 5th week of the semester
5. Second test at the end of the 10th week of the semester
6. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1.A. Smaili and F. Mrad, Applied Mechatronics, 1st edition, Oxford University Press, 2007. ISBN: 9780195307023.
2. J. Nussey, Arduino for Dummies, 1st edition, Wiley, 2013. ISBN: 9781118446379.
3. M. P. Groover, Industrial Robotics: Technology, Programming and Applications, 2nd edition, McGraw- Hill, 2012. ISBN: 9780070265097.

References

1. 1. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2008. ISBN: 9788131732533.
2. 2. D. G. Alciatore, M. B. Histand, Introduction to Mechatronics and Measurement Systems, 3rd edition, Tata Mcgraw Hill Education, 2007. ISBN: 9780070648142.

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester-V

Special Manufacturing Processes			
Course Code	**21SM582**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	01	Exam Hours	01

Course objectives:

- To learn about various unconventional machining processes, process parameters and their influence on performance and their applications.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

3.

Module-1

unconventional machining:An Overview of unconventional machining, need, classification and selection. Process that make use of mechanical energy such as ultrasonic machining, water jet and abrasive jet machining methods.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Electrochemical and Chemical Metal Removing Processes: electrochemical machining, electrochemical honing, electrochemical grinding, and chemical machining.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Thermal Metal Removal Processes methods: plasma arc machining, neutral particle etching,electric discharge machining, hot machining, electron beam machining and laser beam machining.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Milling Machine Exercises :
Simple prismatic parts, Contour milling using vertical milling machine, Spur gear cutting in milling machine and Helical Gear Cutting in milling machine

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Grinding Exercises:
Plain Surface grinding, Cylindrical grinding
Measurement of cutting forces in Milling / Turning Process
EDM, Laser cutting and Rapid Prototyping

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)
At the end of the course the student will be able to :
1.Identify the necessity of "Special manufacturing Process"
2. Define with examples the concept of "Special manufacturing"
3. List the main classifications of the manufacturing processes with examples

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

7. First test at the end of 5th week of the semester
8. Second test at the end of the 10th week of the semester
9. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

5. First assignment at the end of 4th week of the semester
6. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741
2. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464

References

1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-812654737

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester-VI

Production and Operation Management			
Course Code	**21SM61**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. To make the students understand the functions of production, planning and controls, generating new products, issues in production

2. To provide the knowledge of principles of forecasting, forecasting methods, types and its accuracy.

3. To provide the knowledge on facilities location, lean management, Six Sigma and Quality Control.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcom

Module-1	**8 Hours**
Functions of Production Planning controls operations and productivity, productivity measurement, design of goods and services: selection, generating new products, product development, issues in product design.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	**8 Hours**
Forecasting- Importance of forecasting- types of forecasting and their uses- General principles of forecasting- forecasting techniques- qualitative methods and quantitative methods- accuracy of forecasting methods.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	**8 Hours**
Factors affecting facilities location, mathematical models for facilities, location, types of facilities- layout: product layout, process layout, group technology layout, assembly line balancing, computerized layout: ALDEP, CRAFT, CORELAP	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	**8 Hours**
Lean Management, philosophy and creation of lean enterprise, JIT concepts - Kanban Systems- Elements of Total Quality Management, Six Sigma Quality Control, MRP, Lot sizing techniques in MRP.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	**8 Hours**
Scheduling Policies- techniques, flow shop and job shop scheduling techniques. Inventory Management- Functions of Inventories- relevant inventory costs-ABC analysis- VED analysis- EOQ model.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to understand the importance of forecasting, uses of long term and short term forecasting, and application of qualitative and quantitative methods for finding the future demands.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

The question paper will have ten questions. Each question is set for 20 marks.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Modern Production, Operations Management	Baffa and Rakesh Sarin	Wiley	8th Edition, 2016
2	Operation Management	B Mahadevan	Pearson Edu.	2018
Reference Books				
1	Production Control A Quantitative Approach	John E Biegel		
2	Production and Operations Management	S N Chary	Mc Graw Hill Edu	6th Edition, 2019

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Semester -6

Artificial Intelligence and Machine Learning			
Course Code	**21SM62**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	05	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- Explain Artificial Intelligence and Machine Learning
- Illustrate AI and ML algorithm and their use in appropriate applications

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes

MODULE-1	
What is artificial intelligence?, Problems, problem spaces and search, Heuristic searchtechniques	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-2	
Knowledge representation issues, Predicate logic, Representation knowledge using rules. Concpet Learning: Concept learning task, Concpet learning as search, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-3	
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL principle, Bates optimal classifier, Gibbs algorithm, Navie Bayes classifier, BBN, EM Algorithm	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-4	
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL principle, Bates optimal classifier, Gibbs algorithm, Navie Bayes classifier, BBN, EM Algorithm	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 5	
Instance-Base Learning: Introduction, k-Nearest Neighbour Learning, Locally weightedregression, Radial basis function, Case-Based reasoning. Reinforcement Learning: Introduction, The learning task, Q-Learning	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	**Experiments**
1	
2	
3	
4	
5	

6	
7	
8	
9	**Can be Demo experiments for CIE**
10	**Can be Demo experiments for CIE**
11	**Can be Demo experiments for CIE**
12	**Can be Demo experiments for CIE**

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Appaise the theory of Artificial intelligence and Machine Learning.
- Illustrate the working of AI and ML Algorithms.
- Demonstrate the applications of AI and ML.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Machine Learning	Tom M Mitchell	McGraw Hill Education	1st Edition 2017
2	Artificial Intelligence	Elaine Rich, Kevin K and S B Nair	McGraw Hill Education	3rd Edition 2017
Reference Books				
1	Artificial Intelligence	Saroj Kaushik	Cengage learning	
2	Artificial Intelligence: A Modern Approach	Stuart Rusell, Peter Norving	Pearson Education	2nd Edition
3	Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems	AurÈlienGÈron	Shroff/O'Reilly Media	1st Edition, 2017
4	The Elements of Statistical Learning	Trevor Hastie, Robert Tibshirani, Jerome Friedman, h	springer series	2nd edition
5	Introduction to machine learning	Ethem Alpaydın	MIT Press	second edition
6	Artificial Intelligence and Machine Learning	Srinvivasa K G and Shreedhar	Cengage	

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

VI Semester

Industrial Internet of Things			
Course Code	**21SM63**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	05	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- Understanding the concept of IOT.
- Understanding the interconnection and integration of the physical world and the cyberspace.
- Exposure to design &development of IOT Devices

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1

Introduction and Concepts: What is IOT, Genesis of IOT, IOT and Digitization, IOT Impact, Convergence of IT and IOT,IOT Challenges, IOT Network Architecture and Design, Drivers behind new network architectures, Comparing to architectures, A simplified IOT architecture, the core IOT functional Stack, IOT Data Management and compute stack.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Smart Objects: The "Things" in IOT, Sensors, Actuators and smart objects, Sensor networks, Connecting smart objects, communication criteria, IOT Access Technology.
Domain Specific IoT's:
Home Automation, cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and life style.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

IP as the IoT network layer: The business case for IP, The need for optimization, optimizing IP for IoT, Profile and Compliances, Application protocols for IoT, The Transport Layer, IoT application Transport Methods.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Data and Analysis for IoT: An Introduction to data Analytic for IoT, Machine Learning, Big Data Analytic Tools and Technology,edge streaming analytics ,Network analytics, Securing IoT, A Brief History of OT Security,Common Challenges in OT Security, How IT and OT security practices and systems vary, Formal risk.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

IoT Physical Devices and Endpoints: Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino programming, IoT Physical Devices and endpoints.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

- Interpret the impact and challenges posed by ioT networks leading to new architectural models.
- Compare and Contrast the deployment of smart objects and the technologies to connect them to network.
- Appraise the role of IoT protocols for efficient network communication.
- Elaborate the need for Data Analytics and security in IoT.
- Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

4. The question paper will have ten questions. Each question is set for 20 marks.
5. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:
Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	IoT Fundamentals: Networking Technologies,protocols and use cases for the Internet of Things.	David Hanes,Gonzalo salgueiro, patrick	Pearson education (Cisco press Indian Reprint	I Edition
2	Internet of things	Srinivas K G	CENGAGE Learning India	2017
Reference Books				
1	Internet of Things(A hands-on-Approach)	Vijay Madisetti and Arshdeep Bahga	VPT	iEdition,2014
2	Internet of Things: Architecture and Design principles	Raj kamal	mcGraw hill education	I Edition,2017
3	Designing the Internet of things	Adrian mcEwen	Wiley publishers	2013

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VI Semester

Cloud Computing			
Course Code	**21SM641**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	05	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- Explain the fundamentals of cloud computing
- Illustrate the cloud application programming and aneka platform
- Contrast different cloud platforms used in industry

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	
Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-2	
Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud **computing, Workflows:** Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-3	
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-4	
Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5	
Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

- Compare the strengths and limitations of cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player
- Address the core issues of cloud computing such as security, privacy and interoperability11
- Design Cloud Services
- Set a private cloud

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

The question paper will have ten questions. Each question is set for 20 marks.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Cloud Computing Theory and Practice	Dan C Marinescu	Elsevier(MK)	2013
Reference Books				

	1	Rajkumar Buyya , James Broberg, Andrzej Goscinski	Computing Principles and Paradigms	Willey	2014	
	2	Cloud Computing Implementation, Management and Security	John W Rittinghouse, James F Ransome	CRC Press	2013	

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VI Semester

Composite Materials			
Course Code	**21SM642**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	05	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To know the behaviour of constituents in the composite materials
- To Enlighten the students in different types of reinforcement
- To Enlighten the students in different types of matrices
- To develop the student's skills in understanding the different manufacturing methods available for composite material.
- To understand the various characterization techniques
- To illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1

Introduction to Composite Materials: Definition, classification & brief history of composite materials.
Constituent of composite materials: Reinforcements, Matrix, Coupling agents, coatings & fillers.
Reinforcements: Introduction, Glass Fibers, Boron Fibers, Carbon Fibers, Organic Fibers, Ceramic Fibers, Whiskers, Other Non-oxide Reinforcements, Comparison of Fibers
Matrix Materials: Polymers, Metals and Ceramic Matrix Materials.
Interfaces: Wettability, Crystallographic nature of interface, types of bonding at the interface and optimum interfacial bond strength.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Polymer Matrix Composites (PMC): Processing of PMC's; Processing of Thermoset Matrix Composites, Thermoplastic Matrix Composites, Sheet Moulding Compound and carbon reinforced polymer composites. Interfaces in PMC's, Structure & Properties of PMC's, applications
Metal Matrix Composites: Types of metal matrix composites, Important Metallic Matrices, Processing, Interfaces in Metal Matrix Composites, Properties & Applications.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Ceramic Matrix Composites (CMC): Processing of CMC's; Cold Pressing & Sintering, Hot Pressing, Reaction Bonding Processes, Infiltration, Directed Oxidation, In Situ Chemical Reaction Technique, Sol-Gel, Polymer Infiltration & Pyrolysis, Electrophoretic Deposition, Self-Propagating High Temperature Synthesis. Interfaces, properties and applications of CMC's.
Carbon Fiber/Carbon Matrix Composites: Processing of Carbon/Carbon Composites, Oxidation protection of Carbon/Carbon Composites, Properties of Carbon/Carbon Composites, and application of Carbon/Carbon Composites.
Multi-filamentary Superconducting Composites: The Problem of Flux Pinning, Types of Super Conductor, Processing & structure of Multi filamentary superconducting composites. Applications of multi-filamentary superconducting composites**.**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Non-conventional Composites: Introduction,
Nano composites; Polymer clay nanocomposites, selfhealing composites, self-reinforced composites. Bio-composites,
Laminates; Ceramic Laminates, Hybrid Composites.
Performance/Characterization of Composites: Static Mechanical Properties; Tensile Properties, Compressive Properties, Flexural Properties, In-Plane Shear Properties, Interlaminar Shear Strength.
Fatigue Properties; Tension–Tension Fatigue, Flexural Fatigue.
Impact Properties; Charpy, Izod, and Drop-Weight Impact Test.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Micromechanics of Composites: Density, Mechanical Properties**;** Prediction of Elastic Constants, Micromechanical Approaches, Halpin-Tsai Equations, Transverse Stresses, Thermal properties. Numerical Problems.

Macromechanics of Composites: Introduction, Elastic constants of an isotropic material, elastic constants of a lamina, relationship between engineering constants and reduced stiffnesses and compliances.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

CO1: Use different types of manufacturing processes in the preparation of composite materials
CO2: Analyze the problems on macro mechanical behavior of composites
CO3: Analyze the problems on micromechanical behavior of Composites
CO4: Determine stresses and strains relation in composites materials.
CO5: Understand and effective use of properties in design of composite structures
CO6: Perform literature search on a selected advanced material topic.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

6. The question paper will have ten questions. Each question is set for 20 marks.
7. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Composite Material Science and Engineering	Krishan K. Chawla	Springer	Third Edition First Indian Reprint 2015
2	Fibre-Reinforced Composites, Materials, Manufacturing, and Design	P.K. Mallick	CRC Press, Taylor & Francis Group	Third Edition
3	Mechanics of Composite Materials & Structures	MadhijitMukhopadhay	Universities Press	2004
Reference Books				
1	Mechanics of Composite materials	Autar K. Kaw	CRC Taylor & Francis	2nd Ed, 2005
2	Stress analysis of fiber Reinforced Composites Materials	Michael W, Hyer	Mc-Graw Hill International	2009
3	Mechanics of Composite Materials	.Robert M. Jones	Taylor & Francis	1999
E- Learning • VTU, E- learning				

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VI Semester

Non Traditional Machining			
Course Code	**21SM643**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	05	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To learn various concepts related to modern machining processes & their applications.
- To appreciate the differences between conventional and non-conventional machining processes.
- To acquire a functional understanding of non-traditional manufacturing equipment.
- To know about various process parameters and their influence on performance and their applications.
- To impart knowledge on various types of energy involved in non-traditional machining processes.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1

Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Ultrasonic Machining (USM): Introduction, Equipment and material process, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM. Abrasive Jet Machining (AJM): Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD).

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

ELECTROCHEMICAL MACHINING (ECM): Introduction, Principle of electro chemical machining, ECM equipment, elements of ECM operation, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM **process parameters:** Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM. PLASMA ARC MACHINING (PAM): Introduction, non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions. Safety precautions, applications, advantages and limitations.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

LASER BEAM MACHINING (LBM): Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations. ELECTRON BEAM MACHINING (EBM): Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

CO1: Understand the compare traditional and non-traditional machining process and recognize the need for Non-traditional machining process.

CO2: Understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM, AJM and WJM.

CO3: Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations.

CO4: Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM.

CO5: Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM & EBM

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

First test at the end of 5th week of the semester

Second test at the end of the 10th week of the semester

Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

First assignment at the end of 4th week of the semester

Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

The question paper will have ten questions. Each question is set for 20 marks.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Modern Machining Process	P.C Pandey and H S Shah	McGraw Hill Education India Pvt. Ltd.	2000

2	Production technology	HMT	McGraw Hill Education India Pvt. Ltd	2001
Reference Books				
1	New Technology	Dr. Amitabha Bhattacharyya	The Institute of Engineers (India)	2000

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VI Semester

Micro and Smart System Technology			
Course Code	**21SM644**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	05	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- Gain knowledge of Smart Materials, Sensors & Actuators, Microsystems.
- Understand the Operation of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	
Introduction to Micro and Smart systems :Miniaturization, Microsystems versus MEMS, Micro-fabrication, Smart Materials, Structures & Systems, Integrated Microsystems ,Application of Smart Materials & Microsystems.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-2	
Micro and Smart Devices and Systems: Principles and Materials: Definitions and salient features of sensors, actuators, and systems. Sensors: silicon capacitive accelerometer, piezo-resistive pressure sensor, Portable blood analyzer, conduct metric gas sensor. Actuators: Micro mirror Array for Video Projection, Piezoelectric based ink-jet print head, electrostatic comb-drive, and Magnetic micro relay experimental modal analysis, machine condition monitoring and diagnosis.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-3	
Micromachining Technologies: Silicon as a Material for Micromachining, Silicon wafer preparation, thin-film deposition techniques, Lithography, Etching, Silicon micro machining:surface micromachining, bulk micromachining. Specialized Materials for Microsystems..	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-4	
Electronics Circuits for Micro and Smart Systems. Semiconductor devices: Diode, Schottky diode,Tunnel diode,BJT ,MOSFET,CMOS circuits ,Electronics Amplifiers ,Op-Amp based circuits .	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5	
Implementation of Controllers for MEMS & Case Studies of Integrated Microsystems. Design Methodology, PID controller, Circuit Implementation, Digital controller, Microcontroller & PLC. Case Studies of Integrated Microsystems: BEL pressure sensor, design considerations, performance parameters, and Smart Structure in vibration control.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:
CO1: Have knowledge of Smart Materials, Sensors &Actuators ,Microsystems.
CO2: Understand the Working Methodology of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

First test at the end of 5th week of the semester

Second test at the end of the 10th week of the semester

Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

First assignment at the end of 4th week of the semester

Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

The question paper will have ten questions. Each question is set for 20 marks.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Micro and Smart Systems	G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat, V.K.Aatre	Wiley India	2010
Reference Books				
1	Design and Development Methodogies, Smart Material Systems and MEMS	V. Varadan, K. J. Vinoy, S. Goplakrishnan	Wiley India	
2	MEMS	Nitaigour Premchand Mahalik,	TMH	2007
3	MEMS & Microsystems Design and Manufacture	Tai-Ran Hsu	Tata Mc-Graw-Hill	
4	Mechanical Vibrations and Noise engineering	Amberkar A.G.	PHI	

E- Learning
• VTU, E- learning

Web links and Video Lectures (e-Resources):

-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

Smart Manufacturing Lab 2			
Course Code	21SML66	CIE Marks	
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	
Credits	01	Exam Hours	

Course objectives:

The objective of this course is to impart students to the fundamentals of various 3D Printing Techniques for application to various industrial needs.

Sl.NO	Experiments
1	Modeling of Metal Parts in CAD Software.
2	Body/head scanning using Sense 3D Scanner.
3	Object Scanning using EinScan 3D Scanner.
4	Slicing of corrected STL files in SLM RP Tools Software.
5	Process Parameters (laser power, scan speed, hatch width, hatch space, etc.,) Optimization in PSW Software for fabrication on SLM RP Machine.
6	Laser path generation in DMDCAM Software for fabrication on LENS Machine.
7	Laser path generation in UG CAM Software for fabrication on Microstereolithography (MSL) RP machine.
8	Fabrication of Metal parts on SLM RP Machine.
	Demonstration Experiments (For CIE)
9	Fabrication of Metal parts on LENS RP Machine.
10	Building and testing a low-cost desktop 3D printer.
11	Post-processing of Fabricated metal parts by Wire EDM.
12	Post-processing of Fabricated metal parts by Shot-peening, polishing, etc., to improve the surface quality of the produced parts.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- .Model complex geometry of engineering components.
- Make use of point cloud data to reconstruct industrial and medical components.
- Evaluate the process parameters of SLM and LENS metal AM machines to improve the quality of the parts produced.
- Improve surface finish of fabricated components by post-processing techniques.
- Construct low cost desktop 3D Printer and test for performance.

Assessment Details (both CIE and SEE)

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered

to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

-

VII Semester

Geometric Modeling for CAD & Computer Graphics			
Course Code	**21SM71**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

Students will be able to:

- Know the overview of how computers can assist in mechanical component design
- Understand the meaning of Geometric Modelling & Computer Graphics and its application in design of components
- Use 2D & 3D transformations for effective viewing
- Mathematically represent curves, surfaces & solids
- Understand various drawing algorithms
- Understand how realistic image can be formed

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1 **8 Hours**

Geometric Modelling: Introduction and scope; **Computer Graphics:** Introduction & scope

Transformations : Representation of points, Transformations: Rotation, Reflection, Scaling, Shearing, Combined Transformations, Translations and Homogeneous Coordinates, A geometric interpretation of homogeneous coordinates, Over all scaling, Points at infinity, Rotation about an arbitrary point, Reflection through an arbitrary line, Rotation about an axis parallel to coordinate axis, Rotation about an arbitrary axis in space, Reflection through an arbitrary plane.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2 **8 Hours**

Types and Mathematical Representation of Curves: Curve representation, Explicit, Implicit and parametric representation. Nonparametric and parametric representation of Lines, Circles, Ellipse, Parabola, Hyperbola, Conics. Parametric representation of synthetic curve, Hermite cubic splines, Bezier curves: Blending function, Properties, generation, B-spline curves- Cox-deBoor recursive formula, Properties, Open uniform basis functions, Non-uniform basis functions, Periodic B-spline curve.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3 **8 Hours**

Types and Mathematical Representation Solids: Solid entities: Block, Cylinder, Cone, Sphere, Wedge, Torus, Solid representation, Fundamentals of solid modeling, Set theory, Regularized set operations, Set membership classification, Half spaces, Basic elements, Building operations, Boundary representation and Constructive solid geometry, Basic elements, Building operations.

Scan Conversion and Clipping: Representation of points, lines, Drawing Algorithms: DD algorithm, Bresenham's integer line algorithm, Bresenham's circle algorithm, Polygon filling algorithms: Scan conversion, Seed filling, Scan line algorithm. Viewing transformation, Clipping - Points, lines, Text, Polygon, Cohen-Sutherland line clipping, Sutherland-Hodgmen algorithm.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4 **8 Hours**

Visual Realism: Introduction, Hidden line removal, Visibility of object views, Visibility techniques: Minimax test, Containment test, Surface test, Silhouttes, Homogeneity test, Sorting, Coherence, Hidden surface removal- Z-buffer algorithm, Warnock's algorithm, Hidden solid removal - ray tracing algorithm, Shading, Shading models, Diffuse reflection, Specular reflection, Ambient light, Shading of surfaces: Constant shading, Gourand shading, Phong shading, Shading enhancements, Shading Solids, Ray tracing for CSG, Z-buffer algorithm for B-rep and CSG

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	**8 Hours**
Applications: Colouring- RGB, CMY, HSV, HSL colour models, Data Exchange: Evolution of Data exchange, IGES, PDES, Animation: Conventional animation-key frame, In between, Line testing, Painting, Filming, Computer animation, Entertainment and Engineering Animation, Animation system hardware, Software architecture, Animation types, Frame buffer, Colour table, Zoom- pan-scroll, Cross bar, Real time play back, Animation techniques- key frame, Skelton. Path of motion and p-curves.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Design free form surfaces for the given application

- Develop solid model of any given component
- Recognize how a visual image can be an effective means of communication
- Acquire and develop the skills needed to creatively solve visual communication problems.
- Understand, develop and employ visual hierarchy using images and text.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	CAD/CAM-Theory and Practice	IbrahamZeid	McGraw Hill,	2006
2	Mathematical Elements for Computer Graphics	David Rogers & Alan Adams	Tata McGraw Hill	2002
Reference Books				
1	Computer Graphics- Schaum's Outline	Xiang Z, Plastock, R. A	McGraw Hill	2007
2	Computer Graphics- Principles and Practice-	Foley, van Dam, Feiner and	Addison Wesley	1996
3	Computer Graphics	Sinha A N., Udai A D	Tata McGraw Hill	2008
4	Computer Graphics with OpenGL Version	Donald Hearn & Pauline Baker	Pearson Education	3rd /4th Edition, 2011
5	Interactive Computer Graphics- A Top Down approach with OpenGL	Edward Angel	Pearson Education	5th Edition, 2008

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VII Semester

Control Engineering			
Course Code	**21ME72**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	02	Exam Hours	03

Course objectives:

- Understand the basic concepts & mathematical modelling of systems.
- Modelling of mechanical, hydraulic, pneumatic and electrical systems.
- Representation of system elements by blocks and its reduction.
- Transient and steady state response analysis of a system.
- Frequency response analysis using polar plot.
- Frequency response analysis using bode plot.
- Analysis of system using root locus plots.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	**8 Hours**
Introduction: Concept of automatic controls, Open loop and closed loop systems, Concepts of feedback, requirements of an ideal control system, Types of controllers-Proportional, Integral, Differential, Proportional & Integral, Proportional Differential and Proportional Integral Differential controllers.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	**8 Hours**
Modelling of Physical Systems: Mathematical Models of Mechanical, Electrical, Thermal, Hydraulic and Pneumatic Systems. **Analogous Systems:** Direct and inverse analogues for mechanical, thermal and fluid systems. **Block diagram Algebra**: General representation of a feedback control system, transfer functions, rules of block diagram algebra, reduction of block diagram to obtain closed loop transfer function. Signal flow graphs, Mason's gain formula.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	**8 Hours**
Steady state operation: Steady state analysis for general block diagram for a control system, steady state characteristics, equilibrium in a system. **Time Response of feedback control systems**: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Routh's stability criterion for a control system.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	**8 Hours**
Root Locus Plots: Root locus method: Significance of Root locus, angle and magnitude conditions, breakaway points, angles of departure and arrival, construction of Root locus using general rules and steps, Lead and Lag compensation	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	**8 Hours**
Frequency Domain Analysis: Relationship between time and frequency response, Polar plot, Bode Plot, Nyquist plot and Nyquist stability criterion, Relative Stability, Phase and Gain Margins	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Recognize control system and its types, control actions.
2. Determine the system governing equations for physical models (Electrical, Thermal, Mechanical, Electro Mechanical).
3. Calculate the gain of the system using block diagram and signal flow graph.
4. Illustrate the response of 1st and 2nd order systems.
5. Determine the stability of transfer functions in complex domain and frequency domain.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

J Nagrath and M Gopal, 'Control Systems Engineering', New Age International(P) Limited, Publishers, Fifth edition, 2005, ISBN: 81 - 224 - 2008-7.

Reference Books:

- K Ogata, 'Modern Control Engineering', Pearson Education Asia/ PHI, 4th Edition, 2002. ISBN 978 - 81 - 203 - 4010 - 7.
- Benjamin C. Kuo, 'Automatic Control Systems', John Wiley India Pvt. Ltd., 8th Edition, 2008.
- Joseph J Distefano III et al., 'Feedback and Control System', Schaum's Outline series, TMH, 2nd Edition, 2007.

Web links and Video Lectures (e-Resources):
•
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning •

VII Semester

Management Information Systems			
Course Code	21SM731	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	

\Course objectives:

To provide students with basic concepts in information system and the benefits with these systems in modern society. Differentiate between data, information, and knowledge. To understand systems definition, systems requirements, and information needed for decision maker. To identify several methods to enhance and develop information systems and to manage the information system recourses.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	**8 Hours**
Introduction and Organizational Systems: Definition, importance, evolution, computers and MIS organizational structures, Logical foundation, future of MIS. Nature and Characteristics of organizations.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	**8 Hours**
Information Systems and Communication Technology: Organizational and information system structures, information, data information, management and information systems. Information support for functional areas, impact of business and information systems, organizing information systems, absorption of MIS in organizations.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	**8 Hours**
Database Technology: Data base and enterprise management, File processing systems and data base systems, Database Approach and its architecture, DBMS, Models, RDBMS, SQL, 4GL, Data Administration, Current development in databases.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	**8 Hours**
Decision Support Systems: Definition, Evolution of DSS, DSS issues, Structure Constructions-approaches, Generators, Tools, Software and Cost benefits.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	**8 Hours**
Expert Systems and Artificial Intelligence: Basic Concepts, Structure development, Benefits and Limitations.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Explain the importance of determining information system requirements for all management levels by describing the differences between various types of information systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. L .S. Sadagopan,"Management Information Systems," Prentice Hall of India New Delhi, 1997, ISBN: 9788120311800.

References

1. Davis G.B and M.Olson, " Management Information Systems," McGraw Hill New York, 2nd Edition, 1985, ISBN: 9780070158283.
2. O'brienJ .A Jr., "Management Information Systems" McMillan, New York, 1995.
3. Date C.J, "An Introduction to Database Systems," Pearson, 8th Edition, 22nd July 2003, ISBN: 978-0321197849.

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VII Semester

Tribology and Bearing Design			
Course Code	21SM732	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To educate the students on the importance of friction, the related theories/laws of sliding and rolling friction and the effect of viscosity of lubricants.
- To expose the students to the consequences of wear, wear mechanisms, wear theories and analysis of wear problems.
- To make the students understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
- To expose the students to the factors influencing the selection of bearing materials for different sliding applications.
- To introduce the concepts of surface engineering and its importance in tribology.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	**8 Hours**
Introduction to tribology: Historical background, practical importance, and subsequent use in the field. Lubricants: Types and specific field of applications. Properties of lubricants, viscosity, its measurement, effect of temperature and pressure on viscosity, lubrication types, standard grades of lubricants, and selection of lubricants.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	**8 Hours**
Friction: Origin, friction theories, measurement methods, friction of metals and non-metals. Wear: Classification and mechanisms of wear, delamination theory, debris analysis, testing methods and standards. Related case studies.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	**8 Hours**
Hydrodynamic journal bearings: Friction forces and power loss in a lightly loaded journal bearing, Petroff's equation, mechanism of pressure development in an oil film, and Reynold's equation in 2D. Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's number and it's significance; partial bearings, end leakages in journal bearing, numerical examples.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	
Plane slider bearings with fixed/pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a fixed/pivoted shoe bearing, center of pressure, numerical examples. Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, numerical examples. Introduction to Hydrostatic journal bearings.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	
Bearing Materials: Commonly used bearings materials, and properties of typical bearing materials. Advantages and disadvantages of bearing materials. Introduction to Surface engineering: Concept and scope of surface engineering. Surface modification – transformation hardening, surface melting, thermo chemical processes. Surface Coating – plating, fusion processes, vapor phase processes. Selection of coating for wear and corrosion resistance.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1: Understand the fundamentals of tribology and associated parameters.

CO2: Apply concepts of tribology for the performance analysis and design of components experiencing relative motion

CO3: Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.

CO4: Select proper bearing materials and lubricants for a given tribological application.

CO5: Apply the principles of surface engineering for different applications of tribology.

VII Semester

Total Quality Management			
Course Code	21SM733	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- Understand various approaches to TQM
- Understand the characteristics of quality leader and his role.
- Develop feedback and suggestion systems for quality management.
- Enhance the knowledge in Tools and Techniques of quality management.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	**8 Hours**
Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM. Quality Management Systems: Introduction, benefits of ISO registration, ISO 9000 series of standards, ISO 9001 requirements.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	**8 Hours**
Leadership: Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	**8 Hours**
Customer Satisfaction and Customer Involvement: Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, case studies. Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee involvement, case studies.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	**8 Hours**
Continuous Process Improvement: process, the Juran trilogy, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies. **Statistical Process Control:** Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	**8 Hours**
Sustainable Cooling Technologies: **Total Productive Maintenance (TPM):** Definition, Types of Maintenance, Steps in introduction of TPM in an organization, Pillars of TPM – 5S, Jishu Hozen, Quality Maintenance, Planned Maintenance. Quality by Design (QbD): Definition, Key components of QbD, Role of QbD in Pharmaceutical Industry, Benefits and Challenges of QbD. Environmental Management Systems (EMS): Definition, Basic EMS, EMS under ISO 14001, Costs and Benefits of EMS.	

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:
CO1: Explain the various approaches of TQM
CO2: Infer the customer perception of quality
CO3: Analyse customer needs and perceptions to design feedback systems.
CO4: Apply statistical tools for continuous improvement of systems
CO5: Apply the tools and technique for effective implementation of TQM.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Total Quality Management	Dale H. Besterfield	Pearson Education India,	Edition 03. ISBN: 8129702606,
2	Total Quality Management for Engineers	M. Zairi	Wood head Publishing	ISBN:185573 024 3
Reference Books				
1	Managing for Quality and Performance Excellence	James R. Evans and William M Lindsay	Cengage Learning	9th edition
2	Four revolutions in management	Shoji Shiba, Alan Graham, David Walden	Oregon	1990
3	Organizational Excellence through TQM	H. Lal	New age Publications	2008
4	Engineering Optimization Methods and Applications	A Ravindran, K, M. Ragsdell	Willey India Private Limited	2nd Edition,2006
5	Introduction to Operations Research- Concepts and Cases	F.S. Hillier. G.J. Lieberman	Tata McGraw Hill	9 th Edition, 2010

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VII Semester

Flexible Manufacturing Systems			
Course Code	21SM734	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To Introduce the concepts of planning, scheduling and FMS
- To understand group technology concepts and justification.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	**8 Hours**
PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS: Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	**8 Hours**
COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS: Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	**8 Hours**
FMS SIMULATION AND DATA BASE: Application of simulation – model of FMS– simulation software – limitation – manufacturing data systems – data flow – FMS database systems – planning for FMS database	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	**8 Hours**
GROUP TECHNOLOGY AND JUSTIFICATION OF FMS: Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge based system for group technology – economic justification of FMS	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	**8 Hours**
APPLICATIONS OF FMS AND FACTORY OF THE FUTURE FMS: Application in machining, sheet metal fabrication, prismatic component production – aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1 Explain the concepts of Planning, Scheduling and control of Flexible Manufacturing systems

CO2 Perform Planning, Scheduling and control of Flexible Manufacturing systems

CO3 Apply flexible manufacturing system to perform simulation on software's use of group technology to product classification

CO4 Apply the concept of artificial intelligence and expert systems in FMS

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Handbook of flexible manufacturing systems	Jha, N.K	Academic Press Inc.	1991.
Reference Books				
1	CAD/CAM/CIM	Radhakrishnan P. and Subramanyan S	Wiley Eastern Ltd., New Age International Ltd	1994
2	"Flexible manufacturing systems: recent development	Raouf, A. and Ben-Daya, M., Editors	Elsevier Science	1995
3	"Automation, Production Systems and Computer Integrated Manufacturing	Groover M.P	Prentice Hall of India Pvt., New Delhi	1996
4	Manufacturing Engineering and Technology	Kalpakjian	Addison-Wesley Publishing Co.	1995

Web links and Video Lectures (e-Resources):

• .
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning •

VII Semester

Design for Manufacturing			
Course Code	21SM741	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To educate students on factors to be considered in designing parts and components with focus on manufacturability.
- To expose the students to dimensional tolerances, geometric tolerances and true position tolerance techniques in manufacture.
- To impart the knowledge on design considerations for designing components produced using various machining operations like turning, drilling, milling, grinding etc.
- To educate the students on design rules and recommendations for processes like casting, welding, forgings powder metallurgy and injection moulding.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1 **8 Hours**

Introduction: Definition, need for DFM, DFM approach for cost reduction, general design guide lines of DFM, advantages and disadvantages, application of DFM in industries, Design for Quality Manufacturability, DFQM approach, designing for economical production. Design for Excellence (DFX).

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2 **8 Hours**

True positional theory: Comparison between coordinate and true position method of feature location. True position tolerance- virtual size concept, concepts of datum and changing datum, floating and fixed fasteners, projected tolerance zone and functional gages. Concept of Zero true position tolerance. Simple problems on true position tolerancing.

Selective Assembly: Interchangeable part manufacture and selective assembly. Deciding the number of groups -model-1: group tolerance of mating parts equal, model- 2: total and group tolerances of shaft equal. Control of axial play-introducing secondary machining operations, and laminated shims; examples.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3 **8 Hours**

Datum Features: Functional datum, datum for manufacturing, changing the datum; examples.

Component Design: Design features to facilitate machining: drills, milling cutters, keyways, Doweling procedures, counter sunk screws, Reduction of machined area, simplification by separation, simplification by amalgamation, Design for machinability, Design for economy, Design for clampability, Design for accessibility.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4 **8 Hours**

Design of components with casting considerations: Pattern, mould, and parting line. Cored holes and machined holes. Identifying the possible and probable parting lines. Castings requiring special sand cores. Designing to obviate sand cores.

Welding considerations: Advantages of weldments over other design concepts, design requirements and rules, redesign of components for welding;.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5 **8 Hours**

Forging considerations -requirements and rules-redesign of components for forging and case studies.

Design of components for powder metallurgy- requirements and rules-case studies.

Design of components for injection moulding- requirements and rules-case studies.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :
At the end of the course, the student will be able to:
CO1: Select proper materials and manufacturing processes for designing products/components by applying the relevant principles for ease and economic production.
CO2: Identify faulty design factors leading to increased costs in producing mechanical components.
CO3: Apply appropriate design tolerances – dimensional, geometric and true position tolerances for the production processes of mechanical components.
CO4: Apply the concepts related to reducing machined areas, simplification by amalgamation and separation, clampability, accessibility etc., in the design of mechanical components.
CO5: Analyse the design of castings, weldments, forgings, powder metallurgy components and suggest design modifications to reduce the cost.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Designing for Manufacture	Peck H	Pitman Publications	1983
2	Engineering Design: A Materials and processing Approach	Dieter, G.E.	McGraw Hill Co.Ltd	2000

3	Handbook of Products Design for Manufacturing: A Practical Guide to Low-cost Production	Bralla, James G.	McGraw Hill, New York	1986
Reference Books				
1	Engineering Design	Eggert, R.J	Pearson Education, Inc., New Jersey	2005
2	Engineering Design	Matousek , R	Blackie and Son Limited, Glasgow	1967
3	Engineering Design for Manufacture	Kalandar Saheb, S.D and Prabhakar, O.	ISPE	1999
4	Design for Economical Production	Trucks, H.E.	Mich., Dearborn, SME	2nd ed.,1987
5	Processes and Materials of Manufacture	Linberg, Roy A.	Allyn and Bacon, Boston, U.S.A.	4th ed., 1990

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VII Semester

Lean Manufacturing			
Course Code	21SM742	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To enable students to design a globally competitive manufacturing organization using lean manufacturing principles;
- To develop the skills to implement lean manufacturing in industry and manage the change process to achieve continuous improvement of efficiency and productivity.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	**8 Hours**
Framework of Toyota Production System: Just in time production system. JIT Logic -Pull system Japanese approach to production elimination of waste - JIT implementation requirements JIT application for job shops, Case studies. **Adaptable Kanban System:** Kanban rules, supplier Kanban and sequence schedule used by supplier, Monthly information & daily information.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	**8 Hours**
The rise of mass production: The rise & fall of Mass Production Mass production, work force, organization, tools, product –logical limits of Mass production, Sloan as a necessary compliment to Ford. Case study:- Rouge Production Plant. **The rise of lean production:** - Birth place, concrete example, company as community, Final assembly plant, product development and engineering.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	**8 Hours**
Reduction of setup times- Concepts and Techniques: Setup Concepts, practical procedures for reducing setup time. **Standardization of operations:** Machine layout, multi-function workers and job rotation. Improvement activities to reduce work force and increase worker morale -foundation for improvements **Text Book 1 :** Chapter 8, Chapter 9, Chapter 10, Chapter 11, Chapter 12 **Additional Interests:** Use any lean Six Sigma Statistical Analysis tool and learn to analyze data using 7QC tools.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	**8 Hours**
House of Lean -5S's and Waste Walks, Visual Management, Value Stream Mapping-Understanding the current state and designing the future state **Managing lean enterprise:** - Finance, Career ladders, geographic spread and advantages of global enterprise. **Additional Interests:** Develop VSM Current and Future state diagram using Microsoft Visio or Similar Software Package.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	**8 Hours**
Six sigma concepts: History, definitions, Statistical definitions, quality levels, Technical aspects, Six sigma for all: benefits to organizations, customers, suppliers and employers, Design for Six Sigma, DMAIC principles, DMADV principles, merits and demerits.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

• Identify how a production line can be run efficiently

• Reflect upon the critical skills and evaluate their own performance

• Relate concepts such as 'Just in Time manufacturing' and 'Lean manufacturing to the context of an assembly line.\

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Toyota Production System -An integrated approach to Just in Time	Yasuhiro Monden	- Engineering aild Management Press -Institute of Industrial Engineers	1983
2	The Machine that changed the World. The Story of Lean 100 Production	James P Womack, Daniel T Jones, and Daniel Roos	Harper Perennial edition published	1991

3	Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy	Masaaki Imai	Second Edition Hardcover	2012
4	Value Stream Mapping : How to Visualize Work and Align Leadership for Organizational Transformation	Karen Martin , Mike Osterling		2016
Reference Books				
1	The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer	Jeffrey K. Liker	Toyota	
2	Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA	Mike Rother and John Shook		1ST Edition

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VII Semester

Block Chain			
Course Code	21SM743	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- Define and Explain the fundamentals of Blockchain.
- Illustrate the technologies of block chain.
- Describe the models of block chain.
- Analyze and demonstrate the Ethereum.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1 **8 Hours**

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2 **8 Hours**

Decentralization and Cryptography:
Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations.
Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3 **8 Hours**

Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin paymentsB: Alternative Coins Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4 **8 Hours**

Smart Contracts and Ethereum 101:
Smart Contracts: Definition, Ricardian contracts.
Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereumblockchain, Precompiled contracts.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Alternative Blockchains: Blockchains
Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance,

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Define and Explain the fundamentals of Blockchain
- Illustrate the technologies of blockchain
- Describe the models of blockchain
- Analyze and demonstrate the Ethereum
- Analyze and demonstrate Hyperledger fabric

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5,2017

Reference Books:

1. Blockchain Technology (Concepts and applications), Kumar saurabh, Ashutosh saxena,Wiley, 2020
2. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, EdwardFelten,2016
3. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress,First Edition, 2017
4. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'ReillyMedia, First Edition, 2014

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

VII Semester

Cyber Security			
Course Code	21SM744	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. Learn about cybercrime, legal perspectives and understand different types of cyber attacks.
2. Understand security challenges presented by mobile devices and information systems access in the cybercrime world and get an overview of tools and methods used in cybercrime.
3. Understand the fundamental concepts in cyber forensics.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Module-1	**8 Hours**
INTRODUCTION TO CYBERCRIME Introduction, Cybercrime definition and origins of the word, Cybercrime and information security, who are Cybercriminals, Classifications of cybercrimes, Cybercrime: The legal perspectives, Cybercrimes: An Indian perspective, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	**8 Hours**
CYBERCRIME : MOBILE AND WIRELESS DEVICES Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	**8 Hours**
PHISHING AND IDENTITY THEFT: Introduction, Phishing, Identity Theft (ID Theft).	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	**8 Hours**
UNDERSTANDING COMPUTER FORENSICS Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	**8 Hours**
FORENSICS OF HAND HELD DEVICES Introduction, Understanding cell phone working characteristics, Hand-held devices and digital forensics, Toolkits for handheld device forensics, forensics of iPods and digital music devices, Techno legal challenges with evidence from handheld devices, Organizational guidelines on cell phone forensics.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :
1. Describe cybercrime, legal perspectives and Identify different types of cyber attacks.
2. Analyze security challenges presented by mobile devices and information systems access in the cybercrime world and Use tools and methods used in cybercrime.
3. Demonstrate phishing, identity theft and Illustrate the challenges faced in punishing the cybercriminals.
4. Summarize the fundamental concepts in cyber forensics.

5. Implement tools used for the forensics of hand-held devices and Develop data privacy and security best practices essential for organizations.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Book:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, 2014.

Reference Books:

1. Nina Godbole, Information Systems Security, Wiley India, New Delhi.
2. Kennetch J. Knapp, Cyber Security & Global Information Assurance Information Science Publishing.
3. William Stallings, Cryptography and Network Security, Pearson Publication.

Web links and Video Lectures (e-Resources):

- .

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-