PG-R23 Curriculum
With effective from 2023-24

Mechanical - CAD/CAM

Scheme of Instruction and Syllabi of
M.E I to IV Semester of
Two Year Degree Course

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(An Autonomous Institute | Affiliated to Osmania University)
Accreditated by NBA & NAAC (A++)
Kokapet Village, Gandipet Mandal, Hyderabad -500075, Telanagana.
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Scheme of Instruction and Syllabi

Master of Engineering

A TWO YEAR (I-IV) PG PROGRAM

in

CAD/CAM

(AICTE Model Curriculum with effect from AY 2023-24)

(R–23 Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous Institution under UGC, Affiliated to Osmania University)

Department of Mechanical Engineering

Accredited with NAAC- (A++)

Chaitanya Bharathi (Post), Gandipet, Hyderabad–500075

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

OUR MOTTO: SWAYAM TEJASWIN BHAVA

VISION and MISSION of the INSTITUTE

Vision

To be the center of excellence in technical education and research

Mission

To address the emerging needs through quality technical education and advanced research

VISION and MISSION of the DEPT. of Mechanical Engineering

Vision

To be the destination for aspiring young minds to become globally competitive, enlightened, innovative, immediate contributors to the industry and successful in higher studies in the field of mechanical engineering.

Mission

1. To impart quality and innovative education in mechanical engineering with basic and specialized Training, internships to meet the current and emerging needs of the industry.
2. To prepare the students for successful professional career by inculcating ethical, entrepreneurial and leadership qualities.
3. To foster Research and Development environment by disseminating knowledge and technology by involving the students in publications, sponsored projects and consultancy.

DEPARTMENT OF MECHANICAL ENGINEERING

Program Educational Objectives of M.E (CAD/CAM) Program

PE01 Graduates will become professional contributors in the industry related to the area of CAD/CAM.

PE02 Graduates will excel in Research, Development and Consultancy.

PE03 Graduates will become Entrepreneurs in CAD/CAM industry.

Program Outcomes of M.E (CAD/CAM) Program

PO1 An ability to independently carry out research /investigation and development work to solve practical problems

PO2 An ability to write and present a substantial technical report/document

PO3 Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4 Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice

PO5 Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO6 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technology

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – I

S.No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	23MEC101	Computer Aided Modeling and Design	3	--	--	3	40	60	3
2	23MEC102	Digital Manufacturing	3	--	--	3	40	60	3
3		Programme Elective – I	3	--	--	3	40	60	3
4		Programme Elective - II	3	--	--	3	40	60	3
	23MEM103	Research Methodology and IPR	2	--	--	3	40	60	2
6		Audit Course - 1	2	--	--	2	--	50	Non-Credit
PRACTICALS									
7	23MEC103	Advanced Computer Aided Design Lab	--	--	3	--	50	--	1.5
8	23MEC104	Digital Manufacturing Lab	--	--	3	--	50	--	1.5
TOTAL			**16**	**--**	**6**	**17**	**300**	**350**	**17**
Clock Hours Per Week = 22									

L: Lecture D: Drawing T: Tutorial P: Practical/Mini Project with Seminar/Dissertation

CIE - Continuous Internal Evaluation SEE – Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – II

S.No	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	23MEC105	Finite Element Techniques	3	--	--	3	40	60	3
2	23MEC106	Mechanical Design and Analysis	3	--	--	3	40	60	3
3	23MEC107	Mechanics of Composite Materials	3	--	--	3	40	60	3
4		Program Elective - III	3	--	--	3	40	60	3
5		Program Elective - IV	3	--	--	3	40	60	3
PRACTICALS									
6	23MEC108	Computer Aided Engineering Lab	--	--	3	--	50	--	1.5
7	23MEC109	Computer Aided Mechanical Design and Analysis Lab	--	--	3	--	50	--	1.5
8	23MEC110	Mini Project with Seminar	--	--	2	--	50	--	1
TOTAL			**15**	**--**	**8**	**15**	**350**	**300**	**19**
Clock Hours Per Week = 23									

L: Lecture D: Drawing T: Tutorial P: Practical/Mini Project with Seminar/Dissertation

CIE - Continuous Internal Evaluation SEE – Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	MaximumMarks		
			L	T	P/D		CIE	SEE	
THEORY									
1		Program Elective -V	3	--	--	3	40	60	3
2		Open Elective	3	--	--	3	40	60	3
3		Audit Course-2	2	--	--	2	--	50	Non - Credit
DISSERTATION									
3	23MEC111	Industrial Project / Dissertation Phase I	--	--	20	--	100	--	10
TOTAL			**8**	**--**	**20**	**8**	**180**	**170**	**16**
Clock Hours Per Week = 28									

L: Lecture D: Drawing T: Tutorial P: Practical/Mini Project with Seminar/Dissertation

CIE - Continuous Internal Evaluation SEE – Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – IV

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
DISSERTATION									
1	23MEC112	Industrial Project / Dissertation Phase - II	--	--	32	Viva voce	100	100	16
TOTAL			**--**	**--**	**32**	**--**	**100**	**100**	**16**
Clock Hours Per Week = 32									

L: Lecture D: Drawing T: Tutorial P: Practical/Mini Project with Seminar/Dissertation

CIE - Continuous Internal Evaluation SEE – Semester End Examination

List of Subjects for ME (CAD/CAM) Course with specialization in CAD/CAM

S.No.	Course Code	Title of the Course
Program Core Courses		
1	23MEC101	Computer Aided Modeling and Design
2	23MEC102	Digital Manufacturing
3	23MEC105	Finite Element Techniques
4	23MEC106	Mechanical Design and Analysis
5	23MEC107	Mechanics of Composite Materials
Practical Courses / Mini Project with Seminar/ Dissertation		
6	23MEC103	Advanced Computer Aided Design Lab
7	23MEC104	Digital Manufacturing Lab
8	23MEC108	Computer Aided Engineering Lab
9	23MEC109	Computer Aided Mechanical Design and Analysis Lab
10	23MEC110	Mini Project with Seminar
11	23MEC111	Industrial Project / Dissertation Phase – I
12	23MEC112	Industrial Project / Dissertation Phase – II
Program Elective Courses		
Program Elective – I Courses		
1	23MEE101	Advanced Machine Design
2	23MEE102	Vibration Analysis and Condition Monitoring
3	23MEE103	Optimization Techniques
		Program Elective – II Courses
4	23MEE104	Computer Integrated Manufacturing
5	23MEE105	Design for Manufacturing and Assembly
6	23MEE106	Industrial Robotics
Program Elective – III Courses		
7	23MEE206	Computational Fluid Dynamics
8	23MEE107	Smart Materials and Structures
9	23MEE108	Fracture Mechanics
Program Elective – IV Courses		
10	23MEE109	Multibody Dynamics
11	23MEE110	Tribology in Design
12	23MEE111	Failure Analysis and Design

Program Elective – V Courses		
13	23MEE112	Advanced FiniteElement Method
14	23MEE113	Automation in Manufacturing
15	23MEE114	Product Design andProcess Planning
		Mandatory Course
1	23MEM103	Research Methodology and IPR
Audit Courses		
1	23CEA101	Disaster Mitigation and Management
2	23EEA101	Sanskrit for Technical Knowledge
3	23ECA101	Value Education
4	23ADA101	Pedagogy Studies
5	23EGA101	English for Research Paper Writing
6	23EGA102	Constitution of India
7	23EGA103	Stress Management by Yoga
8	23EGA104	Personality Development through Life's Enlightenment Skills
Open Elective Courses		
1	23CEO101	Cost Management of Engineering Projects
2	23EEO101	Waste to Energy
3	23CSO101	Business Analytics
Service Courses Offered by Mechanical Engineering Department		
1	23MEO101	Industrial Safety
2	23MEO102	Introduction to Optimization Techniques
3	23MEO103	Composite Materials
4	23MEO104	Alternative energy sources
5	23MEO105	Computational methods

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – I

S.No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	23MEC101	Computer Aided Modeling and Design	3	--	--	3	40	60	3
2	23MEC102	Digital Manufacturing	3	--	--	3	40	60	3
3		Programme Elective – I	3	--	--	3	40	60	3
4		Programme Elective - II	3	--	--	3	40	60	3
	23MEM103	Research Methodology and IPR	2	--	--	3	40	60	2
6		Audit Course - 1	2	--	--	2	--	50	Non-Credit
PRACTICALS									
7	23MEC103	Advanced Computer Aided Design Lab	--	--	3	--	50	--	1.5
8	23MEC104	Digital Manufacturing Lab	--	--	3	--	50	--	1.5
TOTAL			**16**	**--**	**6**	**17**	**300**	**350**	**17**
Clock Hours Per Week = 22									

L: Lecture D: Drawing T: Tutorial P: Practical/Mini Project with Seminar/Dissertation

CIE - Continuous Internal Evaluation SEE – Semester End Examination

Program Elective – I (3/3)				**Program Elective – II (3/3)**	
S No	**Subject Code**	**Name of the Subject**	**S No**	**Subject Code**	**Name of the Subject**
1	23MEE101	Advanced Machine Design	1	23ME E104	Computer integrated Manufacturing
2	23MEE102	Vibration Analysis and Condition Monitoring	2	23ME E105	Design for Manufacturing and Assembly
3	23MEE103	Optimization Techniques	3	23ME E106	Industrial Robotics

Audit Course – 1					
S.No	**Subject Code**	**Name of the Subject**	**S No**	**Subject Code**	**Name of the Subject**
1	23CEA101	Disaster Mitigation and Management	5	23EGA101	English for Research Paper Writing
2	23EEA101	Sanskrit for Technical Knowledge	6	23EGA102	Constitution of India
3	23ECA101	Value Education	7	23EGA103	Stress Management by Yoga
4	23ADA101	Pedagogy Studies	8	23EGA104	Personality Development through Life's Enlightenment Skills

23MEC101

COMPUTER AIDED MODELING AND DESIGN

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:
1. Provide the basics of computer aided design.
2. Familiarize the student with the knowledge on design process.
3. Explain the uses of wireframe and surface entities.
4. Familiarize the student various geometric transformations.
5. Understand various advanced modeling concepts.

COURSE OUTCOMES: After successful completion of the course the students will be able to
1. Understand the design process, visualize models through graphics standards and apply principles of computer graphics like geometric transformations, windowing and clipping.
2. Recognize various wireframe entities and model them.
3. Apply surface modelling techniques for generating various parts
4. Differentiate various solid modelling techniques
5. Understand various advanced modelling concepts like parametric and variational modelling, feature based design, interference detection

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	2	1	1	3
CO2	2	1	2	1	1	-
CO3	3	2	3	1	-	1
CO4	3	2	3	1	1	1
CO5	3	1	3	1	-	3

UNIT - I

Introduction: Criteria for selection of CAD workstations, Design process, Design criteria, Geometric modelling, Entities, 2d and 3d primitives,Computer Aided Design, Iterative Design, CAD process

Geometric Transformations: 2d Translation, Scaling, Rotation, Reflection and shearing, Homogeneous Coordinates, Rotation and Scaling about arbitrary points, 3D transformations, Windowing - View ports - Clipping transformations

Graphics Standards: GKS, IGES, PDES and their relevance

UNIT – II

Modeling of Curves: Curve representation, Analytic curves- Lines, and Circles, Ellipse, and Conics, Synthetic curves – Cubic, Bezier, B-Splines, and Non Uniform Rational B-Splines. Curve Manipulations,

UNIT- III

Surface Modeling: Surface representation, Analytic Surfaces: Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Synthetic Surface:Cubic, Bezier, B-spline, Coons surface.

UNIT - IV

Solid Modeling Techniques: Boundary Representation (B-rep) & Constructive Solid Geometry (CSG), Graph Based Models, Boolean Models, Primitive Instancing, Cell Decomposition & Spatial Occupancy Enumeration

UNIT - V

Advanced Modeling Concepts: Feature Based Modeling, Assembly Modeling, Conceptual Design and Top down design, Parametric and Variational Modeling, Feature recognition, Design by Features, Computer Aided Design of Mechanical parts and Interference Detection by Motion analysis

TEXT BOOKS:

1. Ibrahim Zeid, “CAD/CAM Theory and Practice”, Mc Graw Hill, 1998.
2. Foley, Van Dam, Feiner and Hughes, “Computer Graphics Principles and Practice”, 2 /e., Addison Wesley, 2000.

SUGGESTED READING:

1. E. Michael, “Geometric Modelling”, John Wiley & Sons, 1995.
2. Hill Jr, F.S.,“Computer Graphics using open GL”, Pearson Education, 2003.

23MEC102

DIGITAL MANUFACTURING

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the importance of digital Manufacturing in the current scenario.
2. Make students Gain the knowledge of Cyber-physical systems and functionality
3. Provide the Comparison and applications of Subtractive and Additive Manufacturing Processes.
4. Provide concepts of Product life cycle, Product data management system and Management information systems
5. Familiarize the Reverse Engineering concepts Digital thread and Digital twin

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand the concept of digital manufacturing, technology and its potential in modern manufacturing process.
2. Recognize the role of cyber physical systems in digital manufacturing
3. Compare and select the subtractive and additive manufacturing processes for a given application.
4. Analyze the role of product life cycle and database management systems in manufacturing systems.
5. Understand the concepts of reverse engineering, digital thread and digital twins.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	1	-	1	2
CO2	2	-	2	-	2	2
CO3	2	-	2	-	1	2
CO4	2	1	2	1	2	2
CO5	2	1	2	1	2	2

UNIT – I

Introduction to digital manufacturing: Introduction to industrial revolutions, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, digital manufacturing and its Global scenario. Impact on manufacturing careers, Operation Mode of Digital Manufacturing System, , Merits and demerits of digital Manufacturing systems.

UNIT – II

Cyber Physical Systems: Introduction. Sensing and Actuation. Next Generation Sensors, , Augmented Reality and Virtual Reality, Role of artificial Intelligence and Big Data analytics in manufacturing. Need of cyber security in Industry 4.0, Basics of Industrial IoT and its scope

UNIT – III

Subtractive and Additive Manufacturing: Introduction, Comparison on the basis of application. Hardware : input devices, types of motors, encoders, drive mechanisms and controllers.

Additive Manufacturing Processes: Steriolithograhy, Fused deposition modelling, selective laser melting, direct metal deposition, sheet lamination

UNIT –IV

Product database management systems: Types, Management information system, Manufacturing data preparation, Shop-floor control, Automatic identification systems (sensors, trackers)

Product life cycle management: Introduction, Types of Product Data, Product life cycle management (PLM) systems, integrated information systems in product lifecycle, Features of PLM System, System architecture, Product information models, Functionality of the PLM Systems.

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UNIT – V

Reverse engineering: Introduction, need of Reverse engineering process and basics steps involved. Application domain. Reverse engineering hardware and software.3D object scanning, Solid reconstruction from point cloud and tessellated data, downstream applications.

Digital design: Definition, Introduction, data storage and sharing in digital threads, Type of digital twins, tools and components of digital twins.

TEXT BOOKS:

1. Fundamentals of Digital Manufacturing Science, by Z.Zhou,S.Xie, D. Chen, Springer, 2012.
2. Ibrahim Zeid and Sivasubramanian R, "CAD/CAM - Theory and Practice",
3. Tata McGraw Hill Education, 2011.

SUGGESTED READING:

1. Vinesh Raja and Kiran J Fernandes, "Reverse Engineering- An Industrial Perspective", Springer-Verlag, 2008.
2. Antti Saaksvuori and AnselmiImmonen, "Product Lifecycle Management", Springer, 2004

23MEE101

ADVANCED MACHINE DESIGN

(Programme Elective – I)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the Failure theories of engineering components
2. Provide the Fatigue life estimation by S-N approach
3. Make students understand the LEFM approach
4. Explain fatigue from variable amplitude loading
5. Explain surface failure

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Predict failure of engineering components using failure theories
2. Identify and explain the types of fractures of engineered materials and their characteristic features
3. Understand LEFM approach
4. Estimate life of components using stress life and strain life
5. Categorize different types of surface failure

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3	1	1	3
CO2	3	3	3	1	1	-
CO3	3	3	3	1	-	1
CO4	3	3	3	1	1	1
CO5	3	3	3	1	-	3

UNIT - I

Introduction: Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples. Fatigue of Materials: Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features

UNIT - II

Stress-Life (S-N) Approach: S-N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behavior, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach. Strain-Life(å-N)approach: Monotonic stress-strain behavior, Strain controlled test methods, Cyclic stress-strain behavior, Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by å-N approach

UNIT- III

LEFM Approach: LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects. Notches and their effects: Concentrations and gradients in stress and strain, S-N approach for notched membranes, mean stress effects and Haigh diagrams, Notch strain analysis and the strain – life approach. Neuber's rule.

UNIT - IV

Fatigue from Variable Amplitude Loading: Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.

UNIT- V

Surface Failure: Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatiguestrength.

TEXT BOOKS:

1. Ralph I. Stephens, Ali Fatemi, Robert and Henry O. Fuchs, "Metal Fatigue in Engineering", John Wiley NewYork Second edition. 2001.
2. Jack. A. Collins, "Failure of Materials in Mechanical Design", John Wiley, NewYork1992.
3. Robert L. Norton, "Machine Design", Pearson Education India, 2000

SUGGESTED READING:

1. S. Suresh, "Fatigue of Materials", Cambridge University Press, 1998.
2. Julie. A. Benantine, "Fundamentals of Metal Fatigue Analysis", Prentice Hall,1990.
3. "Fatigue and Fracture", ASM Hand Book, Vol 19, 2002.

23MEE102

VIBRATION ANALYSIS AND CONDITION MONITORING

(Programme Elective – I)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Make students understand importance of vibrations in mechanical design of machine parts that operate under vibratory conditions.
2. Make students able to write differential equation of motion of vibratory system and understand free and forced modes of vibration.
3. Familiarize the linear vibratory models of dynamic systems of varying complexity (SDOF, MDOF).
4. Provide the understanding of the various condition monitoring techniques available in the literature.
5. Prove the information of various devices available to record, interpret and understand the vibration data.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand the causes of vibration and types of vibration and acoustics.
2. Determine the behavior of two degrees freedom systems
3. Analyze the multi degree freedom systems
4. Determine the methods that can be utilize for condition monitoring of various systems
5. Understand the various special vibration measuring techniques

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	-	2	-	-	3
CO2	2	-	2	-	-	3
CO3	2	-	2	-	-	3
CO4	3	-	3	-	-	3
CO5	3	-	3	-	-	3

UNIT-I

Causes and effects of vibration. Vibrations of Single Degree of freedom systems. Free, Damped and Forced vibrations, Fundamentals of Acoustics**:** Noise measuring units: decibels, frequency analysis bandwidths.

UNIT-II

Two Degree of freedom systems. Bending vibrations of two degree of freedom systems, Steady state and transient characteristics of vibration, vibration absorber and vibration isolation.

UNIT-III

Multi degree of freedom systems: Dunkerley method, Rayleigh method, Stodola method and Holzers method. Modal analysis**.**

UNIT-IV

Introduction to Condition Monitoring, Failure types, investigation and occurrences. Causes of failure, Vibration measuring instruments, vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers. Condition Monitoring through vibration analysis. Frequency analysis, Filters, Vibration signature of active systems, vibration limits and standards.

UNIT-V

Contaminant analysis, SOAP and other contaminant monitoring techniques. Special vibration measuring techniques - Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring, Cepstrum analysis, Modal analysis, critical speed analysis, Shaft –orbit &position analysis.

TEXT BOOKS:

1. Rao S. S Mechanical Vibrations, 5 Edition, Prentice Hall, 2011
2. V.P. Singh, Mechanical vibrations, Dhanpat Rai Publications, 2015
3. Collacott, R.A., Mechanical Fault Diagnosis and Condition Monitoring, Chapman & Hall, London,1982.

SUGGESTED READING:

1. J S Rao, Vibration condition monitoring of machines, CRC Press, 2000
2. Nakra, B.C. Yadava, G.S. and Thuested, L., Vibration Measurement and Analysis, National Productivity Council, New Delhi, 1989.
3. William T.Thomson "Theory of Vibration with Application", 5th edition, Pearson education 2008

23MEE103

OPTIMIZATION TECHNIQUES

(Programme Elective – I)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide knowledge for the formulation of LPP models
2. Provide in depth understanding of Transportation and Assignment techniques
3. Familiarize the procedure of Project Management along with CPMand PERT techniques
4. Make the students understand the concepts of queuing theory and inventory models
5. Make the students understand sequencing techniques and game theory

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Formulate a linear programming problem (LPP) and Integer Programming
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply Nonlinear programming
5. Apply queuing. sequencing models and game theory in industries

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	2	1	3	3
CO2	2	1	2	1	3	2
CO3	1	1	2	1	3	2
CO4	1	1	2	1	3	3
CO5	2	1	2	1	3	3

UNIT - I

Operations Research: Definition, scope, Models, Linear programming problems, Formulation, Graphical Method, Simplex Method, and Duality in simplex.

Integer Programming: Modelling optimization problems using binary variables; solution of integer programming problems: cutting plane method and branch -and – bound method

UNIT - II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT- III

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities,

Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, free float, independent float and Total float, crashing of network.

UNIT – IV

Non-linear Programming: Convex and concave functions, theory of unconstrained optimization ,Necessary and sufficient conditions for extrema ; theory of constrained optimization : Lagrangean method , Kuhn -Tucker conditions.

UNIT - V

Queuing Theory: Kendols Notation, single server models, Inventory control - deterministic inventory models - Probabilistic inventory control models.

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two Machines, processing 'n' jobs through three machines. Game Theory – definition saddle point Principle of Dominance.

TEXT BOOKS:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982
3. J.C. Pant, "Introduction to Optimization: Operations Research", Jain Brothers, Delhi,2008

SUGGESTED READING:

1. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
2. Pannerselvam, "Operations Research", Prentice Hall of India 2010
3. Harvey M Wagner,"Principles of Operations Research", Prentice Hall of India2010

23MEE104

COMPUTER INTEGRATED MANUFACTURING

(Programme Elective – II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the students' knowledge of the role of computers in manufacturing.
2. Provide an in-depth understanding of manufacturing and database systems.
3. Provide an understanding of the market needs and design the product.
4. Understand the students need of networking in the manufacturing industries.
5. Make students develop CIM systems for current manufacturing scenario by using advanced manufacturing concepts

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Select the modern tools and techniques for development of a product.
2. Use appropriate database systems for manufacturing a product and store the same for future use.
3. Apply the latest technology of manufacturing systems and software for the development of a product.
4. Use modern manufacturing techniques and tools including principles of networking.
5. Apply the concepts of lean manufacturing and Agile manufacturing.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	2	-	2	2
CO2	2	-	2	1	2	2
CO3	2	1	2	-	2	2
CO4	2	-	2	-	2	2
CO5	2	1	1	1	1	2

UNIT - I

Basic Concepts of CIM: The meaning of Manufacturing, Types of Manufacturing; CIM Definition, Elements of CIM, CIM wheel, concept or technology, Evolution of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Fundamentals of Communication: Communications Matrix. Product Development Cycle, Concurrent Engineering: Definition, Sequential Engineering Versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of concurrent Engineering, Framework for integration of Life-cycle phases in CE, Concurrent Engineering Techniques, Integrated Product Development (IPD), Product Life-Cycle Management (PLM), and Collaborative Product Development.

UNIT - II

Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete). Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

UNIT- III

Product Design: Needs of the market, Design and Engineering, The design Process, Design for Manufacturability (DFM): Component Design, Design for Assembly. Computer-Aided Process Planning: Basic Steps in developing a process plan, Variant and Generative Process Planning, Feature Recognition in Computer-Aided Process Planning. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP –II), Cellular Manufacturing: Design of Cellular Manufacturing Systems, Cell Formation Approaches: Machine–Component Group Analysis, Similarity Coefficients-Based Approaches. Evaluation of Cell Design. Shop-floor Control: Data Logging and Acquisition, Automated Data Collection, Programmable Logic Controllers, Sensor Technology. Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility,

Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout; Operational Problems of FMS. FMS benefits

UNIT – IV

Introduction to Networking: Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration.

CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.

UNIT - V

Lean Manufacturing: Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web Based Manufacturing systems. Concepts of e-Manufacturing.

TEXT BOOKS:

1. S.Kant Vajpayee: “Principles of Computer Integrated Manufacturing”, Prentice HallIndia.
2. Nanua Singh: “Systems Approach to Computer Integrated Design and Manufacturing” , John Wiley.

SUGGESTED READING:

1. P.Radhakrishnan, S.Subramanyam: “CAD/CAM/CIM”, New Ag e International
2. Alavudeen, Venkateshwaran:“Computer Integrated Manufacturing”, Prentice HallIndia.

23MEE105

DESIGN FOR MANUFACTURING AND ASSEMBLY

(Programme Elective – II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Make students understand the need for design of a product
2. Understand the selection of material on the basis of manufacturing process
3. Familiarize various fabrication procedures
4. Reduce the manufacturing / process time
5. Make design according to ergonomics

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand the product development cycle
2. Know the manufacturing issues that must be considered in the mechanical engineering design process
3. Know the effect of manufacturing process and assembly operations on the product
4. Know the principles of assembly to minimize the assembly time
5. Be familiar with tools and methods to facilitate development of manufacturing mechanical designs

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	1	3	2	3	2
CO2	2	1	2	1	2	1
CO3	1	1	2	1	1	1
CO4	3	2	2	2	2	3
CO5	2	1	3	2	2	3

UNIT - I

Introduction: Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes

UNIT - II

Properties of Engineering Materials: Selection of Materials – I, Selection of Materials – II, Case Studies – I, Selection of Shapes, Co-selection of Materialsand Shapes, Case Studies – II

UNIT- III

Selection of Manufacturing Processes: Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Co- selection of Materials and Processes, Case- Studies – III

UNIT - IV

Design for Assembly: Review of Assembly Processes, Design for Welding – I, Design for Welding – II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case- Studies – IV

Geometric Dimensioning & Tolerances: Introduction, Basic concepts and applications, Method of representation

UNIT - V

Design for Reliability: Failure Mode and Effect Analysis and Quality, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization

TEXT BOOKS:

1. M F Ashby and K Johnson, "Materials and Design - The art and science of material selection in product design", Butterworth- Heinemann, 03.
2. G Dieter, Engineering "Design - a materials and processing approach", McGrawHill,NY,

SUGGESTED READING:

1. T H Courtney, "Mechanical Behavior of Materials", McGraw Hill, NY, 00.
2. G Boothroyd, P Dewhurst and W Knight, "Product design for manufacture and assembly", John Wiley, NY: Marcel Dekkar, 1994.

23MEE106

INDUSTRIAL ROBOTICS

(Programme Elective– II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:

1. Familiarize the principle of working of a robot , types and specifications
2. Provide understanding of Transformations, various types of representations, kinematics ofrobots
3. Provide understanding of Singularities, Jacobian and trajectory planning of a robot to preparethe robot for various tasks
4. Make students understand Design, working of sensors and controllers for finding position andorientation of various industrial robots
5. Provide understanding of Robot vision for image acquisition and processing and plan for various tasks and programming

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Principle of working of a robot, types and prepare specifications forvarious requirements.
2. Transformations, kinematics of robots to find out the position and orientation.
3. Singularities, avoiding singularities while designing, find jacobian and trajectory planning of a robot to prepare the robot for various tasks
4. dynamic analysis using various formulations and design the robots
5. Working of sensors and controllers for finding position and orientation, analyze robot vision for image acquisition and processing and plan for various tasks and programming.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	3	2	3	2
CO2	3	1	2	1	2	1
CO3	2	1	2	1	1	1
CO4	3	2	2	2	2	3
CO5	2	1	3	2	2	3

UNIT - I

Overview of Robot Subsystems: Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping, Pneumatic, hydraulic and electrical actuators, applications of robots, specifications and requirements of different industrial robots.

UNIT – II

Direct Kinematics: Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics

UNIT- III

Inverse Kinematics: Inverse Kinematics, inverse orientation, inverse locations, Singularities, Jacobian, Trajectory Planning: joint interpolation, task space interpolation, executing user specified tasks,

Sensor based motion planning: The Bug Algorithm, The Tangent Bug Algorithm, and The Incremental Voronoi Graph

UNIT - IV

Analysis of RP and RR Type Robots: Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangean and Newton-Euler formulations of RR and RP type planar robots, ,Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, force feedback, hybrid control

UNIT - V

Sensors and Controllers: Sensors and controllers: Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser rangefinder.

Robot Vision: Image processing fundamentals for robotic applications, image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features

TEXT BOOKS:

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wileyand sons, 2008.

SUGGESTED READING:

1. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, "Robotics, control, sensing, Vision and Intelligence", McGraw Hill International, 1987
2. Steve LaValle, "Planning Algorithms", Cambridge Univ. Press, NewYork, 2006.

23MEM103

RESEARCH METHODOLOGY AND IPR

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

COURSE OBJECTIVES: This course aims to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs.
3. Collect the data by various methods: observation, interview, questionnaires.
4. Analyze problem by statistical techniques: ANOVA, F-test, and Chi-square.
5. Understand apply for patent and copyrights.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	2	1	2	2	3
CO2	3	3	3	2	2	2
CO3	3	2	2	1	2	1
CO4	3	1	2	2	3	2
CO5	3	3	3	3	3	3

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey Report writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT- III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normalpopulation, use of Chi-square, ANOVA, Ftest, z-test

UNIT - V

Patents and Copyright: Patent: Macro economic impact of the patent system,Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright? How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of IntellectualProperty Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

TEXT BOOKS:

1. C.R Kothari, "Research Methodology, Methods & Technique"; NewAge International Publishers, 2004
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers , 2011
3. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004.

SUGGESTED READING:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd , 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India2000.
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010.

23CEA101

DISASTER MITIGATION AND MANAGEMENT
(Audit Course I and II - Common to all branches)

Instruction	2L Hours per week
Duration	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	Pass / Fail

COURSE OBJECTIVES: This course aims to

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases in a disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

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

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	1	-	1	2
CO2	3	3	1	-	1	2
CO3	2	3	1	-	1	2
CO4	3	3	1	-	1	2
CO5	3	2	1	-	1	2

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster-Natural and manmade; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT- II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management,

structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT- III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorismdisastersandbiologicaldisasters;RadiologicalEmergenciesandcase studies;Casestudiesrelatedtomajorpowerbreakdowns,fireaccidents,traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multistoried buildings.

UNIT- IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economic, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT- V:

Concept of Disaster Policies and legislation for disaster risk reduction

Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local in situations, NGOs and other stakeholders;, DRR programmers in India and the activities of National Disaster Management Authority.

TEXT BOOKS:

1. Pradeep Sahni*," Disaster Risk Reduction in South Asia*", Prentice Hall, 2003.
2. B. K. Singh,*" Handbook of Disaster Management*: *techniques &Guidelines*", Rajat Publication, 2008.
3. Ministry of Home Affairs". *Government of India, "National disaster management plan, Part I and II",*
4. K. K. Ghosh," *Disaster Management",* APH Publishing Corporation, 2006.

SUGGESTED READING:

1. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

23EEA101

SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

Course Outcomes: Upon completion of this course, students will be able to:

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	-	1	1	1	1	1
CO2	2	2	1	2	1	1
CO3	2	2	1	1	1	1
CO4	2	2	1	1	1	1
CO5	1	2	1	1	1	1

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of speech-Morphology-creation of new words- significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie- Madhava's sine and cosine theory (origination of Taylor's series).

The measurements ystem-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and ElectronicsEngineering):

Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages- computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

TEXT BOOKS:

1. M Krishnamachariar, "History of Classical Sanskrit Literature", TTD Press, 1937.
2. M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students", Motilal Banarsidass Publishers, ISBN-13: 978- 8120801783, 2015

SUGGESTED READING:

1. Kapail Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN- 10: 8171880649, 1994.
2. "Pride of India", Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007.
3. Shri RamaVerma, "Vedas the source of ultimate science", Nag publishers, ISBN:81-7081-618-1,2005

23ECA101

VALUE EDUCATION

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

Prerequisite: Knowledge about universal human values.

COURSE OBJECTIVES: This course aims to

1. Understand Value Education, self-development and National development.
2. Imbibe good human values and Morals in students.
3. Let the should know about the importance of character.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need for and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	1	1	3	1	2
CO2	1	1	1	3	1	2
CO3	1	1	1	3	1	2
CO4	1	1	1	3	1	2
CO5	1	1	1	3	1	2

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Human Values, Indian concept of humanism, Values for self-development, Social values, Individual attitudes, Work ethics, Moral and non- moral behavior, Standards and Principles based on religion, Culture and Tradition.

UNIT-II

Value Cultivation, and Self-Management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual Outlook and Social Values: Personality and Behavior Development, Scientific attitude and Spiritual (soul) outlook, Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, Forgiveness, Dignity of labor, True friendship, Universal brotherhood and religious tolerance., Happiness Vs Suffering, Love for truth, Aware of self-destructive habits, Appreciation and co-operation.

UNIT-IV

Values in Holy Books : Self-management, Good health and internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

All religions and same message: Mind your mind, Self-control**,** Concept of soul;, Science of Reincarnation, Character and Conduct, Concept of Dharma, Cause and Effect based Karma Theory;, The qualities of Devine and Devilish;,Satwic, Rajasic and Tamasic gunas.

Text Book:

1. Chakroborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.

SUGGESTED READING:

1. Jaya DayalGoyandaka, “Srimad Bhagavad Gita”, with Sanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017

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23ADA101

PEDAGOGY STUDIES

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

COURSE OBJECTIVES: This course aims to

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Illustrate the pedagogical practices followed by teachers in developingcountries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educationalresearch and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers tolearning.
5. Understand Research gaps and learn the future directions.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	1	1	-	1	2
CO2	1	1	1	-	1	2
CO3	2	2	2	-	1	2
CO4	1	1	1	-	1	2
CO5	2	2	2	-	1	2

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teachereducation - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal andinformal classrooms in developing countries - Curriculum, Teacher education.

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogictheory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum andassessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy- Teacher education - Curriculum and assessment – Dissemination and researchimpact.

TEXT BOOKS:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan PrimarySchools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

SUGGESTED READING:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.
4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

23EGA101

ENGLISH FOR RESEARCH PAPER WRITING

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Writing to express on science and technological concepts with good taste for research and development.

COURSE OBJECTIVES: This course aims to:

1. Motivate learners for academic writing and thus encourage them for continuous professional updating and up-gradation.
2. Facilitate a practical understanding of the multiple purposes of Writing Research Papers and help them infer the benefits and limitations of research in science and technology.
3. Brainstorm and develop the content, formulating a structure and illustrating the format of writing a research paper.
4. Survey and select a theme/topic for a thorough reading and to writing a research paper.
5. Understand to implement the intricacies of writing and publishing a research paper.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Improve work performance and efficiency, illustrate the nuances of research paper writing and draw conclusions on professional usefulness.
2. Classify different types of research papers and organize the format and citation of sources.
3. Explore various formats of APA, MLA and IEEE and set up for writing a research paper.
4. Draft paragraphs and write theme based thesis statements in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO 1	1	2	1	-	3	2	1	1	-
CO 2	1	1	1	-	1	2	-	-	-
CO 3	2	2	2	1	1	1	-	-	-
CO 4	2	2	1	1	2	2	1	1	1
CO 5	3	3	1	2	2	2	1	1	1

UNIT - I

Academic Writing: Meaning & Definition of a research paper; Purpose of a research paper - Scope, Benefits, Limitations and outcomes for professional development, An introduction to methods and Approaches of Research.

UNIT - II

Research Paper Format: Title - Abstract - Introduction - Discussion - Findings - Conclusion - Style of Indentation - Font size/Font types - Indexing - Citation of sources.

UNIT - III

Process of Writing a Research Paper, Writing to Draft a Format, Develop Content, Adapting, Reviewing, Paraphrasing& Plagiarism Checks.

UNIT - IV

Choosing a topic - Thesis Statement - Outline - Organizing notes - Language of Research - Word order, Paragraphs - Writing first draft-Revising/Editing - The final draft and proof reading. Understanding APA, MLA, IEEE formats.

UNIT - V

Research Paper Publication Reputed Journals –Paid, Free and peer reviewed journals, National/International - ISSN No, No. of volumes, Scopus Index/UGC Journals. Getting Papers Published.

TEXT BOOKS:

1. Kothari, C. R. and Gaurav, Garg, "Research Methodology Methods and Techniques", 4thEdition, New Age International Publishers, New Delhi, 2019.
2. Ellison, Carroll. "Writing Research Papers", McGraw Hill's Concise Guide, 2010.
3. Lipson, Charles. "Cite Right: A Quick Guide to Citation Styles-- MLA, APA, Chicago, the Sciences, Professions, and More", 2nd Edition,. University of Chicago Press. Chicago, 2018.

SUGGESTED READING:

1. Day, Robert A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. Girden, E. R. "MLA Handbook for Writers of Research Papers", 7th Edition, East West Press Pvt. Ltd, New Delhi, 2009
3. Bailey, Stephen. "Academic Writing: A Handbook for International Students", Routledge, 2018

Online Resources:

1. https://onlin://onlinecourses.nptel.ac.in/noc 18_mg13/preview
2. https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

Writing Tools:

1. https://owl.purdue.edu/owl_exercises/index.html - The Owl writing lab
2. https://www.turnitin.com/login_page.asp?lang=en_us – Turn tin software

23EGA102

CONSTITUTION OF INDIA

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Knowledge on basics of the Constitution and the Government.

COURSE OBJECTIVES: This course aims to:

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	-	1	1	1
CO 2	2	1	-	1	1	1
CO 3	2	1	-	1	1	1
CO 4	2	1	-	1	1	1
CO 5	2	-	-	1	1	1

UNIT-I

History of making of the Indian constitutions - History, Drafting Committee (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features.

UNIT-II

Contours of Constitutional Rights and Duties - Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III

Organs of Governance - Parliament: Composition, Qualifications, Powers and Functions

Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions.

UNIT-IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role.

Block level: Organizational Hierarchy (Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women**.**

TEXT BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Busi, S. N., Dr. B. R. Ambedkar, Framing of Indian Constitution'', 1st Edition, Ava Publishers, New Delhi, 2015.
3. Jain, M. P., "Indian Constitution Law", 7th Edition, Lexis Nexis, New Delhi, 2014.
4. Basu, D.D. "Introduction to the Constitution of India", Lexis Nexis, New Delhi., 2015.

SUGGESTED READING:

1. Bhargava, Rajeev. (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.
2. NCERT, Indian Constitution at Work, 1st Edition, Government of India, New Delhi 2006, reprinted in 2022.
3. Ravindra Sastry, V. (ed.), Indian Government & Politics, 2nd edition, Telugu Akademy, 2018.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

23EGA103

STRESS MANAGEMENT BY YOGA

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. Creating awareness about different types of stress and the role ofyoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental,emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	1	-	1	1	1
CO2	1	-	-	1	1	1
CO3	1	-	-	1	1	1
CO4	1	1	-	1	1	1
CO5	1	1	-	1	1	1

UNIT I

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT II

Meaning and definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT III

Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar.

UNIT V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT).

SUGGESTED READING:

1. Janardhan, Swami, "Yogic Asanas for Group Training - Part-I": Yogabhyasi Mandal, Nagpur.
2. Vivikananda, Swami, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.

3. Nagendra H.R and R. Nagaratna, “Yoga Perspective in Stress Management”, Swami Vivekananda Yoga Prakashan, Bangalore.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

23EGA104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Awareness on Personality Development.

COURSE OBJECTIVES: This course aims to:

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awake wisdom among themselves.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO 1	1	1	-	1	1	1	-	1	-
CO 2	1	-	-	1	1	1	-	1	-
CO 3	1	-	-	1	1	1	-	1	-
CO 4	1	1	-	1	1	1	-	1	-
CO 5	1	1	-	1	1	1	-	1	-

UNIT - I

Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue).

UNIT – II

Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75& 78 (do's) - Approach to day to day works and duties.

UNIT - III

Introduction to Bhagavadgeetha for Personality Development – Shrimad BhagawadGeeta: Chapter 2– Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48.

UNIT - IV

Statements of basic knowledge – Shrimad BhagawadGeeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad BhagawatGeeta.

UNIT - V

Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

TextBooks:

1. Gopinath, P., "Bhartrihari's Three Satakam(Niti-sringar-vairagya)", Rashtriya Sanskrit Sansthanam, New Delhi, 2018.

2. Swarupananda, Swami, “Srimad Bhagavad Geeta”, Advaita Ashram (Publication Dept), Kolkata, 2017.

Online Resources:

1. http://nptel.ac.in/downloads/109104115/

23MEC103

ADVANCED COMPUTER AIDED DESIGN LAB

Instruction	3 Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Make students generate the part models using cad software.
2. Make students generate the surface models using cad software.
3. Prepare students with advanced modeling concepts using CAD software.
4. Make students create automated drawing and apply proper annotations on them.
5. Make students generate the assembly models using cad software

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Generate complex components in the part module and
2. Assembly of the components using suitable constraints.
3. Generate engineering drawings.
4. Apply size, form and positional tolerance on the drawing
5. Apply surface modeling techniques using CAD

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	2	-	1	2
CO2	2	1	2	-	1	2
CO3	2	1	2	-	1	2
CO4	2	1	2	-	1	2
CO5	2	2	2	1	1	2

List of Experiments:

1. Sketch based Part modeling of components.
2. Feature based Modeling of components.
3. Assembly modeling of components using different constraints
4. Drafting – standard views, dimensioning, layouts, GD&T, Bill of materials, exploded views.
5. Assembly modeling of components of drill jig and study of assembly interference
6. Surface modeling of a soap bottle with its plastic tool design
7. Surface modeling of a mobile phone case
8. Surface modeling of automobile outer surface
9. Surface reconstruction from cloud point data from reverse engineering tools.
10. Solid modeling, assembly and drafting with GD&T of a tool post
11. Solid modeling, assembly and drafting with GD&T of a Gate Valve
12. CAD model preparation of an aerofoil for FE/CFD analysis.

Note: Out of the above 12 experiments, any 10 experiments must be carried out.

Suggested Reading :

1. Solidworks Essentials, “Solidworks” By Dassault Systems

23MEC104

DIGITAL MANUFACTURING LAB

Instruction	3 Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Introduce to the students the additive manufacturing machines
2. Impart knowledge about various materials used for the digital fabrication
3. Demonstrate rapid tooling concept
4. Demonstrate reverse engineering process
5. Impart knowledge about tool path generation

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Compare different Additive and subtractive manufacturing process and select a process for a particular application
2. Perform preprocessing and post processing for 3D printing.
3. Create 3D model by reverse Engineering.
4. Generate tool path data for a given component
5. Perform DFA analysis for a simple assembly.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	2	-	1	2
CO2	2	-	2	-	1	2
CO3	1	-	2	-	2	2
CO4	3	-	2	-	1	2
CO5	2	1	2	1	1	2

List of the Experiments

1. 3D modelling using Solid works software.
2. Convert the CAD model into an STL file and perform Preprocessing.
3. Modeling and 3D printing of a Drill jig.
4. To perform the post processing operations
5. Modeling and printing of a water bottle die
6. 3D printing the parts of a connecting Rod and assemble them
7. 3D Printing of a component using Resin based printer.
8. Reverse engineering: From 3D scanner to model validation (solid works).
9. Part program for the generation of Crane Hook using CAM software
10. Pocket Milling operations using CNC Machine
11. Step turning & Taper Turning operations using CNC Lathe
12. Perform DFA analysis for a simple assembly.

Note: Out of the above 12 experiments, any 10 experiments can be carried out.

TEXT BOOKS:

1. Gibson, DW. Rosen and B.Stucker; "Additive manufacturing methodologies: Rapid prototyping to direct digital manufacturing ", Springer, 2010.
2. Product Design for Manufacture and Assembly, Geoffrey Boothroyd, Peter Dewhurst, Winston Knight, 2nd Edition, Marcel Dekker, New York,

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – II

S.No	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	23MEC105	Finite Element Techniques	3	--	--	3	40	60	3
2	23MEC106	Mechanical Design and Analysis	3	--	--	3	40	60	3
3	23MEC107	Mechanics of Composite Materials	3	--	--	3	40	60	3
4		Program Elective - III	3	--	--	3	40	60	3
5		Program Elective - IV	3	--	--	3	40	60	3
PRACTICALS									
6	23MEC108	Computer Aided Engineering Lab	--	--	3	--	50	--	1.5
7	23MEC109	Computer Aided Mechanical Design and Analysis Lab	--	--	3	--	50	--	1.5
8	23MEC110	Mini Project with Seminar	--	--	2	--	50	--	1
TOTAL			**15**	**--**	**8**	**15**	**350**	**300**	**19**
Clock Hours Per Week = 23									

L: Lecture D: Drawing T: Tutorial P: Practical/Mini Project with Seminar/Dissertation
CIE - Continuous Internal Evaluation SEE – Semester End Examination

Programme Elective – III (3/3)			**Programme Elective – IV (3/3)**		
SNO	**Subject Code**	**Name of the Subject**	**SNO**	**Subject Code**	**Name of the Subject**
1	23MEE206	Computational Fluid Dynamics	1	23MEE109	Multibody Dynamics
2	23MEE107	Smart Materials and Structures	2	23MEE110	Tribology in Design
3	23MEE108	Fracture Mechanics	3	23MEE111	Failure Analysis and Design

23MEC105

FINITE ELEMENT TECHNIQUES

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Make students understand finite element analysis fundamentals and formulations
2. Familiarize with the formulation the axial, truss, beam and 2D problems
3. Familiarize with the formulation of the heat conduction and dynamics problems, understand the use of numerical integration and Gauss quadrature
4. Understand the convergence requirements and 3D problems
5. Perform engineering simulations using finite element analysis software(ANSYS)

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Apply FE method for solving field problems using virtual work and potential energy formulations
2. Analyze linear problems like axial, truss and beam, torsional analysis of circular shaft
3. Analyze 2D structural problems using CST element and analyze the axi-symmetric problems with triangular elements. Write shape functions for 4 node quadrilateral, isoparametric elements and apply numerical integration and Gaussian quadrature to solve the problems.
4. Evaluate the eigen values and eigen vectors for stepped bar, formulate 3 D elements, check for convergence requirements
5. Solve linear 1 D and 2 D heat conduction and convection heat transfer problems, Use of Fea software ANSYS for engineering solutions.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	1	2	2	3
CO2	3	2	2	3	2	2
CO3	3	2	2	1	2	2
CO4	3	2	2	2	2	2
CO5	3	2	3	3	3	3

UNIT - I

Introduction to Finite Element Method of Solving Field Problems: Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strainrelations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. **Potential Energy Approach**: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.

UNIT - II

Analysis of Trusses: Analysis of plane truss with number of unknowns not exceeding two at each node.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element

Analysis of Frames: Analysis of frames with two translations and a rotationaldegree of freedom at each node.

UNIT- III

Two Dimensional Stress Analysis: Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundaryconditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy

UNIT - IV

Steady State Heat Transfer Analysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.

Time Dependent Field Problems: Application to one dimensional heat flow in a rod.

Dynamic Analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors.

Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT - V

Three Dimensional Problems in Stress Analysis: 3D elements: Introduction to tetrahedron and brick elements.

Introduction to thin and thick plates

Introduction to non-linear formulation through FE.

TEXT BOOKS:

1. R. Tirupathi, Chandrupatla and A.D Ashok,"Introduction of Finite Element in Engineering", Prentice Hall of India, 2004
2. S.S. Rao,"The Finite Element Methods in Engineering", 2/e Pergamon Press, 2001.
3. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill,2003

SUGGESTED READING:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, John Wiley andsons,2009
2. K..JBathe,"Finiteelementprocedures", 2/e,Prentice Hall of India,2007
3. D.L. Logan, "First course in finite element method", (5/e). Mason, OH: SouthWestern, Cengage Learning, 2011.

23MEC106

MECHANICAL DESIGN AND ANALYSIS

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Make the students develop the necessary skills to understand and analyze problems in pressure vessels
2. Achieve fundamental understanding of the theory of bending of flat plates with various loading and boundary conditions
3. Explain design principles of a component and structures using fracture mechanics approaches
4. Enable the importance of vibrations in mechanical design to understand the basic concepts of matrix algebra and understand thedifferent mode extraction methods in vibrations
5. Make the student understand the fundamental concepts various algorithms used for dynamic analysis

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Apply knowledge of mathematics, sciences and computations insolving the stresses & strains in pressure vessels
2. Demonstrate the ability to identify, formulate and solve problems fora given flat plate bending applications
3. Design a system or a component to meet the desired needs of fracturemechanics
4. Understand, solve various Eigen value and Eigen vectors and will understand different mode extraction methods to calculate frequencies
5. Understand methods in solving single degree freedom dynamicanalysis problems

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	2	-	1	1
CO2	2	2	2	1	1	-
CO3	2	1	1	1	-	1
CO4	2	2	1	-	1	1
CO5	2	2	2	1	-	-

UNIT - I

Design of Pressure Vessels: Introduction and selection of materials for pressure vessels, stresses in thick walled cylindrical pressure vessels subjected to both internal and external pressures, shrink fit stresses in built up cylinders, auto frettage of thick cylinders, thermal stresses and their significance.

UNIT - II

Stresses in Flat Plates: Introduction, Bending of plate in one direction, bending of plate in two perpendicular directions, Thermal stresses in plates, bending of circular plates of constant thickness, bending of uniformly loaded plates of constant thickness

UNIT- III

Fracture Mechanics: Introduction, Modes of fracture failure Griffith Analysis, Energy release rate, Stress Intensity Factor: SIF‘s for edge and center line crack, Fracture toughness, Elastic plastic analysis through J-integral method: Relevance and scope, Definition of J-integral, Path independence, Strain Energy Release Rate Vs J-integral

UNIT - IV

Eigen Value Problems: Properties of Eigen values and Eigen Vectors, Torsional, Longitudinal vibration, lateral vibration, Sturm sequence method. Subspace iteration and Lanczo‘s method, Component mode synthesis

UNIT - V

Dynamic Analysis: Direct integration method, Central difference method, Wilson- q method, Newmark method, Mode superposition, Single degree of freedom system response, Rayleigh damping. (Note: The related algorithms and codes to be practiced by students)

TEXT BOOKS:

1. John, V. Harvey, "Pressure Vessel Design: Nuclear and Chemical Applications", Affiliated East West Press Pvt. Ltd., 1969.
2. Prasanth Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, NewDelhi-1999.
3. David.V .Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2003.

SUGGESTED READING:

1. G.Ramamurti, "Computer Aided Mechanical Design and Analysis", Tata Mc Graw Hill-1992.
2. J. Bathe, "Finite Element Procedures", Prentice Hall of India-1996.

23MEC107

MECHANICS OF COMPOSITE MATERIALS

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the basics of composite materials, types of reinforcements, advantages & disadvantages, applications of composite materials..
2. Make students understand the evaluation of material properties using micro-mechanics approach and semi-empirical relations.
3. Provide understanding of analysis of laminates using classical laminate plate theory.
4. Provide understanding of Failure analysis of an orthotropic lamina.
5. Familiarize the concepts of analysis of composite beams and plates for simple cases.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand different types of composites, advantages, disadvantages applications and their fabrication methods.
2. Characterize a UD lamina using micromechanics.
3. Analyze a given laminate for strains and stress using Classical Lamination Theory.
4. Decide the failure of a UD lamina according to different criterion.
5. Design simple composite beams and plates.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	2	1	1	2
CO2	2	1	1	1	-	1
CO3	1	2	1	1	-	1
CO4	3	2	1	1	1	-
CO5	2	1	2	1	1	1

UNIT - I

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. Hand-layup, pultrusion, filament winding, RTM processes of fabrication.

UNIT - II

Micromechanics of lamina and mechanical properties: Prediction of elastic constants, thermal properties, moisture properties using mechanics of materials approach. Halpin-Tsai equations for elastic constants. Mechanism of load transfer from matrix to fiber.

UNIT- III

Macro-mechanical Analysis: Introduction, Hooke's law for different types of materials, Hooke's law for 2D UD lamina, relationship between compliance and stiffness matrix to engineering elastic constants of a lamina, engineering constants of an angle lamina. Laminate code, stress-strain relationships for a laminate using CLT, force and moment resultants related to mid-plane strains and curvatures.

UNIT - IV

Strength and fracture: Tensile and compressive strengths of unidirectional fiber composites, fracture modes in composites: single and multiple fractures, de-bonding, fiber pullout and de-lamination. Interlaminar stresses and edge effects.

Strength of an orthotropic lamina: Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength.

UNIT - V

Composite Beams: comparison of CLT to Isotropic beam theory, effective axial and flexural rigidities of rectangular composite beams. Governing equations of thin –plate theory: equations of equilibrium for symmetric laminates and specially orthotropic laminate. Levy –Navier solution applied to specially orthotropic laminates.

TEXT BOOKS:

1. R.M. Jones. Mechanics of Composite Materials. 2 nd ed. CRC press. 2018.
2. B.D. Agarwal et.al. Analysis and performance of fiber composites. 3rd ed. Wiley Sons, 2013.
3. P.K. Mallick. Fiber Reinforced Composites Materials, Manufacturing, and Design. 3rd ed. Taylor & Francis, 2007.

SUGGESTED READING:

1. Madhujit Mukhopadhyay. Mechanics of Composite Materials and Structures. Universities Press, 2022.
2. Ever J Barbero. Introduction to composite materials design.3rd ed. CRC Press, 2018.
3. M.W. Hyer. Stress Analysis of Fibre Reinforced Composite Materials DEStech Publications, Inc, 2009

23MEE206

COMPUTATIONAL FLUID DYNAMICS

(Programme Elective – III)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Basic equations and concept of CFD
2. Concept of PDEs and finite difference methods
3. Various types of grid generation and errors in numerical solution
4. Crank-Nihcolson, Implicit and Explicit methods& Jacobi, Gauss Seidel and ADI methods
5. Importance of FVM

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Derive CFD governing equations and turbulence models
2. Apply elliptical, parabolic and hyperbolic pdes and forward, backward and center difference methods
3. Understand errors, stability, consistency and develop O,H and C grid generated models
4. Evaluate the use of Crank-Nihcolson, Implicit and Explicit methods and analyze problem by Jacobi, Gauss Seidel and ADI methods
5. Solve conduction and convection problems using FVM.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	3	1	2	2
CO2	3	1	3	1	2	2
CO3	3	1	3	1	2	3
CO4	3	1	3	1	2	3
CO5	3	1	3	1	2	3

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT- III

Classification of PDEs: Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference

UNIT - IV

Finite Difference Solutions: Finite difference solutions - Crank Nicholson, Implicit and Explicit, ADI - Jacobi, Gauss Seidel, and solution for Viscous incompressible flow using Stream function – Vorticity method

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for
Diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm

TEXT BOOKS:

1. John D Anderson, “Computational Fluid Dynamics”, Mc Graw Hill, Inc., 2015.
2. H.K.Versteeg and Malala Shekara, “Introduction to Finite Volume Method”, Pearson, 2015

SUGGESTED READING:

1. K. Muralidhar and T. Sundararajan, “Computational Fluid flow and Heat transfer”, Narosa Publishing House, 2003.
2. S.V.Patankar, “Numerical Heat transfer and Fluid flow”, Hemisphere Publishing Company, New York, 1980.

23MEE107

SMART MATERIALS AND STRUCTURES

(Programme Elective – III)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the basics of smart materials.
2. Make students analyze Constitutive Relationships.
3. Understand the Mathematical modeling for response of piezo beam.
4. Understand High-Band Width, Low Strain Smart Sensors.
2. Apply the smart materials to engineering problems.

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

1. Understand basics of smart materials.
2. Analyze direct and reverse effect of piezo.
3. Understand and Evaluate Principles of piezo, Magnetostrictive materials, SMA.
4. Analyze design of piezoelectric materials
5. Understand High-Band Width, Low Strain Smart Sensors and Intelligent Devices

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	2	1	1	1
CO2	3	1	2	1	1	-
CO3	3	1	2	1	-	1
CO4	3	1	2	1	1	1
CO5	3	1	2	1	-	-

Unit-I.

Overview of Smart Materials: Piezoelectric Materials : Introduction to Smart Material , What is a Smart Material, Applications of Smart Material, Applications of Smart Material ,Smart systems using Smart Material Materials, Smart Actuators, Direct and Reverse Effects, Piezoelectric Materials, History of Piezoelectricity, Piezoelectric Materials, Piezoelectric Materials, Piezoceramic Actuator, Constitutive Relationship, Piezoceramic Polymers &Composites Composites Bimorphs & Piezostacks.

Unit II.

Magnetostrictive Smart Materials & Active Smart Polymer: What is Magnetostriction, Some Examples, A Brief History of Magnetostrictive Material Materials, What are the different effects of Magnetostriction? The Constitutive Relationship, Actuators Developed using Terfenol D, Sensors Developed using Terfenol-D., Magnetostrictive Composites. What is Active Smart Polymer Classifications of Electro active Polymers , The Constitutive Relationship, Actuators Developed using EAP, Sensors Developed using EAP, Future of IPMC Ionic Polymer Metal Composite (IPMC), Actuators Developed using IPMC Actuators Developed using IPMC , Sensors Developed using IPMC, Future of IPMC What is Shape Memory Effect? Metallic alloys that show Shape Metallic alloys that show Shape Memory Effect, The Constitutive Relationship , Actuators Developed using SMA, Sensors Developed using SMA, Future of SMA.

Unit III:

Modelling of Piezoelectric Material: Piezoelectric Property, Crystal structure Crystal Structure, Constitutive Relationship, Active Strain Evaluation, Piezoelectric Coefficients, A Comparison of Properties, Comparison of Properties, Actuators Developed using Piezoelectric Material induced Strain Actuation (ISA), Uniform Strain Model, Static Equilibrium Configuration against ,Uniform Strain Uniform Strain Configuration against Bending Strain, ISA – Euler-Bernoulli Model , ISA Model for Magnetostrictive Model for Magnetostrictive Mini Actuator, Active Fibre Composite Actuation.

Unit IV

High-Band Width, Low Strain Smart Sensors: Piezoelectric Actuators – Piezoceramic Unimorph and Bimorphsp, Amplified Piezoactuators Piezoelectric Composites– Piezoelectric Composites – Piezo-transducres, Electrostrictive (PMN) Actuators, Magnetostrictive Actuators, Magnetostrictive Actuators , Terfenol-D Actutaors as MMA, Terfenol D Composites, Delamination Sensing and Vibration Control using Magnetostrictive Control using Magnetostrictive Materials, Piezoelectric Inchworm Devices ¬Piezoelectric Fuel Injectors , Ultrasonic Motors.

Unit V

Intelligent Devices based on Smart Materials: Piezoelectric Inchworm Devices, Inchworm devices for Actuation, Sizes and Specifications, Inchworm Devices for Locomotion, Unimorph Thunder, Rainbow Actuators, Rainbow and Thunder Actuation, Active Elasto-dynamic Motion, A Case history of Sensor Application, Introduction to MEMS Devices, MEMS based Accelerometers.

Text Books:

1. Brian Culshaw, Smart Structures and Materials, Artech House, 2000
2. Gauenzi, P., Smart Structures, Wiley, 2009

SUGGESTED READING:

1. Cady, W. G., Piezoelectricity, Dover Publication
2. https://nptel.ac.in/courses/112104173.

23MEE108

FRACTURE MECHANICS

(Programme Elective – III)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Make students understand the Classification of fracture
2. Provide the importance of crack tip
3. Demonstrate the experimental setup while performing standard test
4. Give the students understanding of About R curve
5. Familiarize with the Fatigue crack propagation.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Analyze the fracture mechanism
2. Gain familiarity with the different modes of failure under the presence of crack
3. Establish specimen size in accordance with the standard procedures
4. Distinguish between Plane stress fracture toughness and Plane strain fracture toughness.
5. Accomplish the relationship between crack propagation and stress intensity factor.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	2	1	-	2
CO2	2	2	2	-	-	2
CO3	2	2	2	-	-	2
CO4	2	2	2	-	1	1
CO5	2	2	2	-	1	1

UNIT - I

Introduction: Crack in a structure – Griffith criterion

Mechanism of Fracture and Crack Growth: cleavage fracture – ductile fracture fatigue cracking – service failure analysis

UNIT - II

Elastic Crack Tip Stress Field: Solution to crack problems – effect of finite size stress intensity factor – special cases

Crack Tip Plastic Zone: Irwin plastic zone correction – actual shape of plasticzone

UNIT- III

Energy Principle: Energy release rate – criterion for crack growth – J integral

Plane Strain Fracture Toughness: Standard test – size requirement – nonlinearity

UNIT - IV

Plane Stress and Transitional Behavior: concept of plane stress – R curveconcept – thickness effect – plane stress testing

Elastic Plastic Fracture: crack tip opening displacement.

UNIT - V

Fatigue Crack Propagation: Crack growth and stress intensity factor – factors affecting crack propagation – variable amplitude service loading and its numerical retardation model

TEXT BOOKS:

1. David Broek ,"Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers , The Hague – 1984.
2. Prashant Kumar., "Elements of fracture mechanics", Mc Graw Hill Education (India) Private Limited, New Delhi - 2014.

SUGGESTED READING:

1. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", 3/e, Taylor and Francis Group, 2005.
2. R.N.L.Smith, "Basic Fracture Mechanics", Butterworth Heinemann Publications, 1991.
3. K. Ramesh," e-Book on Engineering Fracture Mechanics", IIT Madras, 2007. URL:http://apm.iitm.ac.in/smlab/kramesh/book_4.htm
4. K. R.Y. Simha, "Fracture Mechanics for Modern Engineering Design", Universities Press (India) Limited, 2001

23MEE109

MULTIBODY DYNAMICS

(Programme Elective – IV)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: This course aims to

1. Provide to students explanation of equations of motions in 3D for a multibody system
2. Make students understand implementation and demonstration methods for formulation of motion equations in interconnected bodies
3. Understand the Constrained differential equations.
4. Familiarize Static and dynamic analysis in a multibody system
5. Understanding of Modeling and simulation of multibody dynamic systems

Course Outcomes: Upon completion of this course, students will be able to:

1. Derive equations of motion for interconnected bodies in multi-body systems with three dimensional motions.
2. Implement and analyze methods of formulating equations of motion for interconnected bodies.
3. Write programs to solve constrained differential equations for analyzing multi-body systems.
4. Simulate and analyze all types of static and dynamic behaviors of the multi-body systems including the kineto-static analysis.
5. Lead team projects in academic research or the industry that require modeling and simulation of multi-body systems

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	2	1	-	2
CO2	2	2	2	-	-	2
CO3	2	2	2	-	-	2
CO4	2	2	2	-	1	1
CO5	2	2	2	-	1	1

UNIT - I

Introduction: The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairs are considered together with other 2 degrees-of- freedom types of constraints.

UNIT - II

Basic Principles for Analysis of Multi-body Systems: The automatic assembly of the systems of equations for position, velocity and acceleration analysis. Iterative solution of systems of non linear equations. Geometry of masses. The principle of virtual work and Lagrange's equations

UNIT- III

Dynamics Of Planar Systems: Dynamics of planar systems. Systematic computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for actuator-spring-damper element. Simple applications of inverse and forward dynamic analysis. Numerical integration of first-order initial value problems. The method of Baumgarte for the solution of mixed differential-algebraic equations of motion. The use of coordinates partitioning, QR and SVD decomposition for the orthogonalization of constraints.

UNIT - IV

Kinematics of Rigid Bodies in Space: Reference frames for the location of a body in space. Euler angles and Euler parameters. The formula of Rodrigues. Screw motion in space. Velocity, acceleration and angular velocity. Relationship between the angular velocity vector and the time derivatives of Euler parameters.

UNIT - V

Kinematic Analysis of Spatial Systems: Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical). Equations of motion of constrained spatial systems.

TEXT BOOKS:

1. J. Wittenburg, J., "Dynamics of Systems of Rigid Bodies", B.G.Teubner, Stuttgart, 1977.
2. T.R. Kane and D.A. Levinson,"Dynamics: Theory and Applications", McGraw-Hill Book Co., 1985.
3. P.E. Nikravesh, "Computer Aided Analysis of Mechanical Systems", Prentice-Hall Inc., Englewood Cliffs, J,1988.
4. R.E. Roberson, and R. Schwertassek,"Dynamics of Multibody Systems", Springer-Verlag,Berlin,1988.

SUGGESTED READING:

1. R.K.Turton, "Principles of Turbomachinery", E & F N Spon Publishers, London & New York.
2. Dennis G. Shepherd, "Principles of Turbomachines", Macmillan, 20

23MEE110

TRIBOLOGY IN DESIGN

(Programme Elective – IV)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the material properties which influence the tribological characteristics of surfaces
2. Elucidate the Concepts of wear
3. Explain the lubrication aspects of machine components.
4. Provide the analytical behavior of different types bearings
5. Provide concepts of Design of bearings based on analytical /theoretical approach.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand surface topography and model a rough engineering surface.
2. Understand friction and wear aspects of machine.
3. Decide upon lubricants and lubrication regimes for different operating conditions.
4. Understand Hertz contact and rough surface contact.
5. Select material/surface properties based on the tribological requirements

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	2	1	-	2
CO2	2	2	2	-	-	2
CO3	2	2	2	-	-	2
CO4	2	2	2	-	1	1
CO5	2	2	2	-	1	1

UNIT - I

Topography of Surfaces: Surface features -Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact

UNIT - II

Wear: Types of wear – Mechanism of various types of wear – Laws of wear – Theoretical wear models-Wear of Metals and Nonmetals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements –Laser methods – instrumentation - International standards in friction and wear measurements.

UNIT- III

Lubricants and Properties: Lubricants and their physical properties- Viscosity and other properties of oils – Additives-and selection of Lubricants- Lubricants standards ISO, SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication- Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

UNIT - IV

Reynolds and Sommerfield boundary conditions: Reynolds Equation - Assumptions and limitations-One and two dimensional Reynolds Equation- Reynolds and Sommerfield boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing-Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

UNIT- V

Rolling Contact Bearings: Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings.

TEXT BOOKS:

1. E. Rabinowicz. "Friction and Wearof materials", John Willey &Sons, UK,1995
2. A Cameron,"Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981
3. J. Halling, "Principles of Tribology" , Mac Millan – 1984.

SUGGESTED READING:

1. Kenneth C Ludema and Layo Ajay, "Friction, wear , lubrication", A textbook in Tribology, 2e, CRC Press, Taylor and Francis Group, 2019
2. Ross Beckett,"Engineering Tribology", Larsenand Keller Education, 2017.
3. Stachon Iak, Andrew W Batchelor, "Engineering Tribology", 4e, Butterworth – Heinemann, 2015.

23MEE111

FAILURE ANALYSIS AND DESIGN

(Programme Elective – IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the design methodology and various aspects involved in design process
2. Explain the Creative and inventive problem solving techniques
3. Learn the different types of design processes, concepts of reliable and robust design
4. Explain the concept of buckling of cylinders under various loading conditions
5. Provide the fundamentals of fracture, fracture types and concepts of fatigue crack growth, fatigue life prediction and various stress theories of failure, crack propagation concepts under combined loading, fracture toughness of weld metals.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Apply the concepts of design processes
2. Provide solutions by inventive problem solving techniques
3. Develop reliable and robust design
4. Analyze the behavior of buckling of cylinders under various loading conditions
5. Predict the fracture behavior under static and fatigue loads, apply the crack propagation concepts, fracture toughness of weld metals

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	2	3	1	2	2
CO2	2	2	3	2	2	2
CO3	1	1	3	2	1	2
CO4	3	1	3	2	1	2
CO5	2	1	3	2	1	2

UNIT - I

Importance of design: The design process-Considerations of Good Design –Morphology of Design – Organization for design– Computer Aided Engineering – Concurrent Engineering – Product and process cycles – Market Identification – Competition Bench marking. Identification of customer needs- customer requirements-Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics.

UNIT - II

Creativity and Problem Solving: Creativity methods-Theory of Inventive Problem Solving(TRIZ)– Conceptual decomposition-Generating design concepts- Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture-Configuration Design- Parametric Design. Role of models in design Mathematical Modeling – Simulation – Design for Reliability –Introduction to Robust Design-Failure mode Effect Analysis.

UNIT- III

Buckling Phenomenon: Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT - IV

Theories of Failure: Failure analysis and determination of stress patterns from plastic flow observations – Dynamic loading– Fracture types in tension—Fatigue crack growth– Fatigue life prediction- Cumulative fatigue damage-Stress theory of pressure vessels-Thermal stress fatigue

UNIT - V

Applications of Fracture Mechanics: Introduction –Through cracks emanating from holes –Corner cracks at holes – Cracks approaching holes-Combined loading-Fatigue crack growth binder- Mixed mode loading-Fracture toughness of weld metals-Service failure analysis

TEXT BOOKS:

1. Dieter and E. George, "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.
2. David Broek, "Elementary Engineering Fracture Mechanics", Fifth off and Noerdhoff International Publisher, 1978.
3. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.

SUGGESTED READING:

1. G. Pahl and W. Beitz,,"Engineering Design", Springer – Verlag, NY. 1984.
2. 2. Prashant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
3. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.

23MEC108

COMPUTER AIDED ENGINEERING LAB

Instruction	3 Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Model one and two-dimensional elements in ANSYS
2. Understand vibration, harmonic and transient analysis.
3. Carry out buckling analysis.
4. Analyze forming and sheet metal operations by FEA.
5. Model crack element

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Apply basics of Theory of Elasticity to continuum problems.
2. Analyze 1D, 2D and 3D structures for linear static analysis.
3. Analyze the buckling phenomena of the structures.
4. Estimate fracture toughness of the cracked components.
5. Analyze fluid flow problems.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	2	1	-	2
CO2	2	2	2	1	-	2
CO3	2	2	2	1	-	2
CO4	2	2	2	1	1	1
CO5	2	2	2	1	1	1

List of Exercises:

1. Introduction to Finite Element Analysis Software
2. Statically indeterminate reaction force analysis and determination of Beam stresses and Deflection
3. Static analysis of a corner bracket
4. Analysis of cylindrical shell under pressure
5. Bending of a circular plate using axisymmetric shell element.
6. Vibration analysis of a simply supported beam
7. Harmonic analysis of plates and shells
8. Transient analysis of vehicle crash
9. Buckling analysis of shells
10. Stress intensity factor in cracked plates
11. Laminar Flow over Flat plate
12. Study of compressible flow through a nozzle

Note: Out of the above 12 experiments, any **ten (10)** experiments have to becarried out.

TEXT BOOKS:

1. R. Tirupathi, Chandrupatla and B.D. Ashok, “Introduction of Finite Element in Engineering”, Prentice Hall of India, 2004
2. David.V.Hutton, “Fundamentals of Finite Element Analysis”, Tata McGrawHill,2003

SUGGESTED READING:

1. Robert Cook , “Concepts and applications of finite element analysis”, 4/e, John Wiley and sons, 2009
2. S.S. Rao, ,”The Finite Element Methods in Engineering”, 2 /e, Pergamon Press, 2001

23MEC109

COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS LAB

Instruction	3 Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to:

1. Familiarize the MATLAB environment and commands.
2. Make the students able to do simple calculations using MATLAB.
3. Carry out simple numerical computations and analyses using MATLAB.
4. Represent mathematical object as data structure.
5. Provide the ability to formulate mechanical engineering problems in a mathematical form and appropriate for subsequent computational treatment.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand main features of the MATLAB syntax and various commands used.
2. Use the MATLAB GUI effectively.
3. Translate mathematical methods to MATLAB code.
4. Formulate and solve systems of linear equations by Gaussian elimination.
5. Write simple programs in MATLAB to solve scientific and mathematical problems. Tabulate results and represent data visually.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3	3	1	-	2
CO2	2	3	3	1	-	2
CO3	1	3	3	1	-	1
CO4	2	3	3	1	1	2
CO5	1	3	3	1	1	1

List of Exercises:

1. MATLAB basics: Arithmetic operations, elementary math build in functions, Arrays, random number generation polynomials, system of linear equations, and programming in MATLAB.
2. Determine the Eigen values and Eigen vectors of given matrices.
3. Using Gaussian elimination/ Choksi factorization system of linear equations.
4. Using Jacobi/ Gauss siedel method to find the solutions to equations/matrices.
5. Using the sturm sequence property to find the internal of the smallest Eigen value of a matrix of sixe 5 X 5.
6. Plot the shrink fit stresses in buildup cylinders.
7. Plot the slope and deflections of bending of circular plate of constant thickness.
8. Plot the variation of SIF and strain energy release of a plate with an edge crack subjected to a tensile load.
9. Plot the variation of dynamic response of a 2 DOF system using Newmark and mode superposition methods.
10. Plot variation of dynamic response of a 1dof system for rectangle pulse force.

TEXT BOOKS:

1. Rao. V. Dukkipati, " MATLAB an introduction with applications" new age international publications-2010

23MEC110

MINI PROJECT WITH SEMINAR

Instruction	2 Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to:

1. The mini-project shall contain a clear statement of the research objectives, background of work,
2. literature review, techniques used, prospective deliverables, and detailed discussion on results,
3. conclusions and references.
4. Expose and practice of searching and referring the required literature.
5. Provide a good initiation for the student(s) towards R&D.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	3	1	-	1
CO2	3	1	3	1	-	1
CO3	3	1	3	1	-	2
CO4	3	2	3	1	1	1
CO5	3	3	2	1	1	2

Guidelines:

1. As part of the curriculum in the II- semester of the program each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Each student will be allotted to a faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have interdisciplinary/ industry relevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
6. All the investigations are clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks:50		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	MaximumMarks		
			L	T	P/D		CIE	SEE	
THEORY									
1		Program Elective -V	3	--	--	3	40	60	3
2		Open Elective	3	--	--	3	40	60	3
3		Audit Course-2	2	--	--	2	--	50	Non - Credit
DISSERTATION									
3	23MEC111	Industrial Project / Dissertation Phase I	--	--	20	--	100	--	10
TOTAL			**8**	**--**	**20**	**8**	**180**	**170**	**16**
Clock Hours Per Week = 28									

L: Lecture D: Drawing T: Tutorial P: Practical/Mini Project with Seminar/Dissertation

CIE - Continuous Internal Evaluation SEE – Semester End Examination

Program Elective – V (3/3)				**Open Elective (3/3)**	
SNO	**Subj. Code**	**Name of the Subject**	**S NO**	**Subj. Code**	**Name of the Subject**
1	23ME E112	Advanced FiniteElement Method	1	23CEO101	Cost Management of Engineering Projects
2	23ME E113	Automation in Manufacturing	2	23EEO101	Waste to Energy
3	23ME E114	Product Design andProcess Planning	3	23CSO101	Business Analytics

Audit Course – 2					
SNo	**Subject Code**	**Name of the Subject**	**SNo**	**Subject Code**	**Name of the Subject**
1	23CEA101	Disaster Mitigation and Management	5	23EGA101	English for Research Paper Writing
2	23EEA101	Sanskrit for Technical knowledge	6	23EGA102	Constitution of India
3	23ECA101	Value Education	7	23EGA103	Stress Management by Yoga
4	23ADA101	Pedagogy Studies	8	23EGA104	Personality Development through Life's Enlightenment Skills

23MEE112

ADVANCED FINITE ELEMENT METHOD

(Programme Elective - V)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:

1. Provide the understanding of FE formulation for isoparametric elements.
2. Learn the Validation of isoparametric elements.
3. Provide the understanding of parameters to be checked to get solution.
4. Learn the formulation of curved shells.
5. Learn the formulation of non-linear problems.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Demonstrate understanding of FE formulation for isoparametric element.
2. Understand to evaluate the stresses in the elements.
3. Model effectively and checks the parameters to get the converged solutionand verify the solutions.
4. Demonstrate use of FE formulation to shell elements and analyse for bucklingloads.
5. Solve nonlinear problems with a FE formulation.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3	3	1	-	2
CO2	2	3	3	1	-	2
CO3	1	3	3	1	-	1
CO4	2	3	3	1	1	2
CO5	1	3	3	1	1	1

UNIT – I

Isoparametric Elements-I: Bar element, Bilinear quadrilateral element (Q4), Quadraticquadrilaterals (Q8, Q9), Hexahedral isoparametric elements, Numerical integration.

UNIT - II

Isoparametric Element-II: Incompatible modes (nodeless dof), Static condensation, Choices in Numerical integration, Selective integration and substitution, Load considerations (edge, surface traction), Body forces and initial stresses, Stress calculation (stress at Gauss points), Extrapolation calculations, Effect of element geometry, Validity of isoparametric elements, Patch test.

UNIT- III

Modelling Considerations and Software Use: Introduction, Physical behaviour versus element behaviour, Thin-walled construction, Element shapes and interconnection, Test cases and pilot studies, Material properties, Loads and reactions, Connections in structures, Boundary conditions, Repetitive symmetry, Stress considerations and substructures, Common mistakes, Checking the model and result.

UNIT – IV

Shell Elements Formulation: Three and four nodes shell elements, Curved isoparametric shell elements, Evaluation of stiffness and stresses in the shells, Stress stiffness and buckling of shells.

UNIT – V

Non-Linear Analysis: Introduction to nonlinear analysis Material Nonlinearity-Plasticity-Creep-Visoplasticity-Non-linear constitutive problem in solid mechanics

Geometrical nonlinearity Large deflection and instability-Iteration solution of nonlinear equations; General incremental nonlinear equation-Lagrange description of motion-Deformation gradient tensor.

TEXT BOOKS:

1. Robert D.cook, David S.Malkus, Micheal E.Plesha, Robert J.Witt., Concepts and applications of finite element analysis, 4th edition, John wiley and sons, INC 2002.
2. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India Private Limited,New Delhi,1996

SUGGESTED READING:

1. O. C. Zienkiewicz and R. L. Taylor, Finite Element Method: Volume 2 Solid Mechanics, 5th edition, Butterworth-Heinemann, Oxford.
2. J. C. Simo and T. J. R. Hughes, Computational Inelasticity, Springer- Verlag NewYork, Inc., New York, 1998
3. T. Belytschko and W. K. Liu and B. Moran, Nonlinear Finite Elements for Continua and Structures, John Wiley & Sons Ltd., Engla23ME E104

23MEE113

AUTOMATION IN MANUFACTURING

(Programme Elective – V)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide the basic concepts of automation & its significance in manufacturingindustries.
2. Understand automated flowlines.
3. Conceptualize & design following assembly line balancing.
4. Understand about automated material handling systems
5. Elucidate the effective design and appropriate tests & inspection systems

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Conceptualize and design automated flow lines.
2. Implement line balancing concepts in production and assembly lines
3. Understand and develop automated material handling system suitablefor plant operations.
4. Design, implement and use and appropriate automated inspectionfacility.
5. Design and develop an automated production system formanufacturing a product using futuristic technologies.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	2	1	-	2
CO2	2	1	3	1	-	1
CO3	2	1	3	1	-	2
CO4	2	1	3	1	1	2
CO5	1	1	2	1	1	2

UNIT - I

Introduction: Definition of automation, Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break-Even Analysis, Unit cost of production, Cost of Manufacturing Lead time andWork-in-process.

UNIT - II

Analysis of Automated Flow Lines: Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, Automationfor Machining Operations, Design and Fabrication Considerations. General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines.

UNIT- III

Assembly Systems and Line Balancing: The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Computerized Line Balancing Methods, Other ways to improve the Line Balancing, Flexible Manual Assembly Lines.

Automated Assembly Systems*:* Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines,Analysis of a Single Station AssemblyMachine.

UNIT - IV

Automated Materials Handling: The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/ Retrieval Systems, Carousel Storage Systems, Work-in-process Storage, Interfacing
Handling and Storage with Manufacturing.

UNIT - V

Automated Inspection and Testing: Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. Modeling Automated Manufacturing Systems: Role of Performance Modeling, Performance Measures, Performance Modeling Tools: Simulation Models, Analytical Models. The Future Automated Factory: Trends in Manufacturing, The Future Automated Factory, Human Workers in the Future Automated Factory,The social impact.

TEXT BOOKS:

1. Mikell P.Grover, Automation, "Production Systems and Computer Integrated Manufacturing", Pearson Education Asia, 2012.
2. Nanua Singh, "Systems Approach to Computer-Integrated Design and Manufacturing", Wiley India Pvt Ltd, New York, 1995.

SUGGESTED READING:

1. C.Ray Asfahl, "Robots and Manufacturing Automation", John Wiley and Sons New York, 1995.
2. Stephen J. Derby, "Design of Automatic Machinery", Special Indian Edition, Marcel Decker, New York, Yesdee publishing Pvt. Ltd, Chennai, 1998
3. N.Viswanadham and Y.Narahari, "Performance Modeling of AutomatedManufacturing Systems", Prentice Hall India Pvt. Ltd, 1980.

23MEE114

PRODUCT DESIGN AND PROCESS PLANNING

(Programme Elective - V)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60Marks
CIE	40Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide basic concepts of Product design and Process planning.
2. Elucidate Reliability, IPR and value analysis.
3. Provide an understanding of conceptual design rules for few manufacturing techniques.
4. Facilitate the understanding ergonomical principles and advanced productivity techniques.
5. Provide the student with knowledge of role of computers in design and manufacturing.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Design and process of a product.
2. Implement reliability techniques, IPR and value engineering.
3. Understand and develop appropriate manufacturing techniques.
4. Implement Ergonomical concepts and productivity techniques.
5. Use computers in product design and process planning.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3	1	-	2
CO2	2	3	2	1	-	1
CO3	1	3	2	1	-	1
CO4	3	3	2	1	1	3
CO5	2	3	3	1	1	3

UNIT - I

Product Design and Process Design Functions: Selection of a right product, Essential factors of product design, Morphology of design, Sources of new ideas for products, Evaluation of new product ideas, Product innovation procedure, Flow chart, Qualifications of product design engineer, Criteria for success/failure of a product, Value of appearance, Colours and laws of appearance

UNIT - II

New Product Development: Product reliability, Mortality Curve, Reliability systems,Manufacturing reliability and quality control,

Patents: Definitions, Classes of patents, Applying for patents, Trademarks and copyrights.

Cost and quality sensitivity of products, Elements of cost of a product, Costing methods, Cost reduction and cost control activities, Economic analysis, Break even analysis charts, Value engineering in product design, Creativity aspects and techniques, Procedures of value analysis, Cost reduction, material and process selection.

UNIT- III

Various Manufacturing Processes: Degree of accuracy and finish obtainable, Process capability studies, Methods of improving tolerances, Product design rules for casting, Forging, Machining, Sheet metal and welding, Physical properties of engineering materials and their importance on products, Selection of plastics, Rubber and ceramics for product design.

UNIT - IV

Industrial Ergonomics: Man-machine considerations, Ease of maintenance, Ergonomic considerations in product design, Anthropometry, Design of controls, Man-machine information exchange, Process sheet detail and their importance, Advanced techniques for higher productivity, Just-in-time and Kanban System, Modern approaches to product design, Quality function development, Rapid prototyping.

UNIT - V

Role of Computer in Product Design: Management of manufacturing, Creation of manufacturing data base, Computer Integrated Manufacturing, Communication network, Production flow analysis, Group Technology, Computer aided product design and process, Planning, Integrating product design, Manufacture and production control.

TEXT BOOKS:

1. B.W. Niebel and A.B. Draper., Product Design and Process Engineering, McGraw Hill, Kogalkusha Ltd., Tokyo, 1974.
2. A.K. Chitale and Gupta, R.C., Product Design and Manufacturing, PHI, NewDelhi, 2004.

SUGGESTED READING:

1. M. Mahajan., Industrial Engineering and Production Management, Dhanpath Rai& Co., 2000.
2. Bhaskaran Gopalakrishnan, Product Design and Process Planning, Chapman andHall, New York, 1994

23CEO101

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To enable the students to understand the concepts of Project management.
2. To provide knowledge on concepts of Project Planning and scheduling.
3. To create an awareness on Project Monitoring and Cost Analysis
4. To provide adequate knowledge to the students on Recourse Management Costing-variance Analysis
5. To train the students with the concepts of Budgetary Control for cost management and to provide a basic platform on Quantitative techniques for cost management.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and leveling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniquesfor optimizing project cost.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	-	-	2	1	1
CO2	1	-	-	2	2	1
CO3	1	-	-	2	2	1
CO4	1	-	-	2	1	1
CO5	1	1	1	2	2	1

UNIT- I:

Project Management: Introduction to project managements, Stakeholders, Roles, Responsibilities and functional relationships, Principles of project management, Objectives and project management system, Project team, Organization, roles and responsibilities, Concepts of project planning, Monitoring, Staffing, Scheduling and controlling.

UNIT-II:

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT-III:

Project Monitoring and Cost Analysis: introduction-Cost concepts in decision- making; Relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost, Project direct and indirect costs.

UNIT- IV:

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and leveling, Total Quality Management andTheory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis

Standard Costing and Variance Analysis: Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector. Just-in-time approach, Material Requirement

UNIT- V:

Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets,Measurement of Divisional profitability pricing decisions including transfer pricing. **Quantitative techniques for cost management**: Linear Programming, PERT/CPM,Transportation Assignment problems, Simulation, Learning Curve Theory.

TEXT BOOKS:

1. Charles T Horngren., Cost Accounting A Managerial Emphasis, 14thedition, Pearson Education, 2012,
2. Charles T. Horngren and George Foster., Advanced ManagementAccounting, 6th revised edition, Prentice Hall, 1987.

SUGGESTED READING:

1. K. K Chitkara., Construction Project Management: Planning,scheduling and controlling, Tata McGraw Hill Education, 2004.
2. Kumar Neeraj Jha., Construction Project Management Theory andPractice, 2nd edition, Pearson Education India, 2015.
3. Robert S Kaplan and Anthony A. Atkinson, Management & CostAccounting, 2nd edition, Pearson, 1996.

23EEO101

WASTE TO ENERGY

(Open Elective)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: Course aims to

1. To know the various forms of waste
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand the concept of conservation of waste
2. Identify the different forms ofwastage
3. Chose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	-	-	2	1	1
CO2	1	-	-	2	2	1
CO3	1	-	-	2	2	1
CO4	1	-	-	2	1	1
CO5	1	1	1	2	2	1

UNIT - I

Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, Gasifiers,Digestors

UNIT – II

Biomass Pyrolysis: Pyrolysis, Types, Slow, Fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, Yields and applications.

UNIT – III

Biomass Gasification: Gasifiers, Fixed bed system, Downdraft and updraft gasifiers, Fluidized bed gasifiers, Design, Construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

UNIT–IV

Biomass Combustion: Biomass stoves, Improved chullahs, Types, Some exotic designs, Fixed bed combustors, Types, Inclined grate combustors, Fluidizedbed combustors, Design, Construction and operation, Operation of all the above biomass combustors.

UNIT – V

Biogas: Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, Direct combustion, Biomass gasification, Pyrolysis and liquefaction, Biochemical conversion, Anaerobic digestion, Types of biogas plants, Applications, Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

TEXT BOOKS:

1. V.Ashok.,NonConventional Energy, Desai, Wiley Eastern Ltd., 1990.
2. K.C. Khandelwal and S.S. Mahdi., Biogas Technology – A Practical Hand Book, Vol. I & II, TataMcGraw Hill Publishing Co. Ltd., 1983.

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Suggested Readings:

1. D.S. Challal., Food, Feed and Fuel from Biomass, IBH Publishing Co. Pvt. Ltd.,1991.
2. C. Y. WereKo-Brobby and E. B. Hagan, Biomass Conversion and Technology, John Wiley & Sons, 1996.

23CSO101

BUSINESS ANALYTICS

Open Elective – VI

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Basic of programming, basic mathematics**.**

COURSE OBJECTIVES: This course aims to

1. Understanding the basic concepts of business analytics and applications.
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics.
3. Prepare the students to model business data using various data mining, decision making methods.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve stated objectives.
3. Interpret various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques.
5. Model the business data using various business analytical methods and techniques.
6. Create viable solutions to decision making problems.

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PEO1	PEO2	PEO3
CO1	3	2	2	1	1	-	-
CO2	3	3	2	1	-	3	3
CO3	3	3	3	1	-	-	-
CO4	3	3	3	1	-	-	-
CO5	3	3	3	1	-	-	-
CO6	3	3	3	1	-	-	-

UNIT - I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT - II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization.

UNIT - III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT - IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. Clustering: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, Prescriptive Analytics- Linear Programming (LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process,cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox.

Textbooks:

1. U Dinesh Kumar, “Business Analytics”, Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, “Business analytics Principles, Concepts, and Applications with SAS”, Associate Publishers, 2015

Suggested Readings:

1. S. Christian Albright, Wayne L. Winston, “Business Analytics - Data Analysis and decision Making”,5th Edition, Cengage, 2015.

23CEA101

DISASTER MITIGATION AND MANAGEMENT

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3	1	-	1	2
CO2	3	3	1	-	1	2
CO3	2	3	1	-	1	2
CO4	3	3	1	-	1	2
CO5	3	2	1	-	1	2

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man- made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Casestudies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi- storeyed buildings.

UNIT- IV:

Disaster Impacts: Disasterimpacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT- V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response- water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster ManagementAuthority.

TEXT BOOKS:

1. Pradeep Sahni, “Disaster Risk Reduction in South Asia”, Prentice Hall, 2003.
2. B. K. Singh,”Handbook of Disaster Management: techniques & Guidelines”, Rajat Publication, 2008.

SUGGESTED READING:

1. Ministry of Home Affairs, “Government of India, “National disaster management plan, Part I and II”
2. K. K. Ghosh,”Disaster Management”, APH Publishing Corporation, 2006.
3. “Hazards, Disasters and your community: Abooklet for students and the community”, Ministry of home affairs.

Online Resources:

1. http://www.indiaenvironmentportal.org.in/files/file disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/(National Disaster management in India, Ministry of Home Affairs

23EE A101

SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

Course Outcomes:

Upon completion of this course, students will be able to:

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	-	1	1	1	1	1
CO2	2	2	1	2	1	1
CO3	2	2	1	1	1	1
CO4	2	2	1	1	1	1
CO5	1	2	1	1	1	1

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of speech-Morphology-creation of new words- significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/ Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie- Madhava's sine and cosine theory (origination of Taylor's series).

Themeasurementsystem-time-mass-length-temp,Matterelasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and ElectronicsEngineering):

Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages- computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

TEXT BOOKS:

1. M Krishnamachariar, "History of Classical Sanskrit Literature", TTD
2. Press, 1937.
3. M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students", Motilal Banarsidass Publishers, ISBN-13: 978- 8120801783, 2015

SUGGESTED READING:

1. Kapail Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN- 10: 8171880649, 1994.
2. "Pride of India", Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007.
3. Shri RamaVerma, "Vedas the source of ultimate science", Nag publishers, ISBN:81-7081-618-1,2005

23ECA101

VALUE EDUCATION

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

Prerequisite: Knowledge about universal human values.

COURSE OBJECTIVES: This course aims to:
1. Understand Value Education, self-development and National development.
2. Imbibe good human values and Morals in students.
3. Let the should know about the importance of character.

COURSE OUTCOMES: After successful completion of the course the students will be able to
1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need for and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of anindividual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	1	1	3	1	2
CO2	1	1	1	3	1	2
CO3	1	1	1	3	1	2
CO4	1	1	1	3	1	2
CO5	1	1	1	3	1	2

UNIT-I
Human Values, Ethics and Morals: Concept of Values, Human Values, Indian concept of humanism, Values for self-development, Social values, Individual attitudes, Work ethics, Moral and non- moral behavior, Standards and Principles based on religion, Culture and Tradition.

UNIT-II
Value Cultivation, and Self-Management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III
Spiritual Outlook and Social Values: Personality and Behavior Development, Scientific attitude and Spiritual (soul) outlook, Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, Forgiveness, Dignity of labor, True friendship, Universal brotherhood and religious tolerance., Happiness Vs Suffering, Love for truth, Aware of self-destructive habits, Appreciation and co-operation.

UNIT-IV
Values in Holy Books: Self-management, Good health and internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V
All religions and same message: Mind your mind, Self-control**,** Concept of soul;, Science of Reincarnation, Character and Conduct, Concept of Dharma, Cause and Effect based Karma Theory;, The qualities of Devine and Devilish;,Satwic, Rajasic and Tamasic gunas.

TEXT BOOK:

1. Chakroborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.

SUGGESTED READING:

1. Jaya DayalGoyandaka, “Srimad Bhagavad Gita”, with Sanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

23ADA101

PEDAGOGY STUDIES

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

Course Objectives: This course aims to

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	1	1	-	1	2
CO2	1	1	1	-	1	2
CO3	2	2	2	-	1	2
CO4	1	1	1	-	1	2
CO5	2	2	2	-	1	2

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: Alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy- Teacher education - Curriculum and assessment – Dissemination and researchimpact.

TEXT BOOKS:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journalof Curriculum Studies, 36 (3): 361 – 379, 2004.

SUGGESTED READING:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID,2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.
4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

23EGA101

ENGLISH FOR RESEARCH PAPER WRITING

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Writing to express on science and technological concepts with good taste for research and development.

COURSE OBJECTIVES: This course aims to:

1. Motivate learners for academic writing and thus encourage them for continuous professional updating and up-gradation.
2. Facilitate a practical understanding of the multiple purposes of Writing Research Papers and help them infer the benefits and limitations of research in science and technology.
3. Brainstorm and develop the content, formulating a structure and illustrating the format of writing a research paper.
4. Survey and select a theme/topic for a thorough reading and to writing a research paper.
5. Understand to implement the intricacies of writing and publishing a research paper.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Improve work performance and efficiency, illustrate the nuances of research paper writing and draw conclusions on professional usefulness.
2. Classify different types of research papers and organize the format and citation of sources.
3. Explore various formats of APA, MLA and IEEE and set up for writing a research paper.
4. Draft paragraphs and write theme based thesis statements in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	2	1	-	3	2
CO 2	1	1	1	-	1	2
CO 3	2	2	2	1	1	1
CO 4	2	2	1	1	2	2
CO 5	3	3	1	2	2	2

UNIT - I

Academic Writing: Meaning & Definition of a research paper; Purpose of a research paper - Scope, Benefits, Limitations and outcomes for professional development, An introduction to methods and Approaches of Research.

UNIT - II

Research Paper Format: Title - Abstract - Introduction - Discussion - Findings - Conclusion - Style of Indentation - Font size/Font types - Indexing - Citation of sources.

UNIT - III

Process of Writing a Research Paper, Writing to Draft a Format, Develop Content, Adapting, Reviewing, Paraphrasing& Plagiarism Checks.

UNIT - IV

Choosing a topic - Thesis Statement - Outline - Organizing notes - Language of Research - Word order, Paragraphs - Writing first draft-Revising/Editing - The final draft and proof reading. Understanding APA, MLA, IEEE formats.

UNIT - V

Research Paper Publication Reputed Journals –Paid, Free and peer reviewed journals, National/International - ISSN No, No. of volumes, Scopus Index/UGC Journals. Getting Papers Published.

TEXT BOOKS:

1. Kothari, C. R. and Gaurav, Garg, "Research Methodology Methods and Techniques", 4thEdition, New Age International Publishers, New Delhi, 2019.
2. Ellison, Carroll. "Writing Research Papers", McGraw Hill's Concise Guide, 2010.
3. Lipson, Charles. "Cite Right: A Quick Guide to Citation Styles-- MLA, APA, Chicago, the Sciences, Professions, and More", 2nd Edition,. University of Chicago Press. Chicago, 2018.

SUGGESTED READING:

1. Day, Robert A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. Girden, E. R. "MLA Handbook for Writers of Research Papers", 7th Edition, East West Press Pvt. Ltd, New Delhi, 2009
3. Bailey, Stephen. "Academic Writing: A Handbook for International Students", Routledge, 2018

Online Resources:

1. https://onlin://onlinecourses.nptel.ac.in/noc 18_mg13/preview
2. https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

Writing Tools:

1. https://owl.purdue.edu/owl_exercises/index.html - The Owl writing lab
2. https://www.turnitin.com/login_page.asp?lang=en_us – Turn tin software

23EGA102

CONSTITUTION OF INDIA

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Knowledge on basics of the Constitution and the Government.

COURSE OBJECTIVES: This course aims to:

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO 1	2	1	-	1	1	1	-	1	-
CO 2	2	1	-	1	1	1	-	1	-
CO 3	2	1	-	1	1	1	-	1	-
CO 4	2	1	-	1	1	1	-	2	-
CO 5	2	-	-	1	1	1	-	2	-

UNIT-I

History of making of the Indian constitutions - History, Drafting Committee (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features.

UNIT-II

Contours of Constitutional Rights and Duties - Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III

Organs of Governance - Parliament : Composition, Qualifications, Powers and Functions

Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions.

UNIT-IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: ZillaPanchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role.

Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women**.**

TEXT BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Busi, S. N., Dr. B. R. Ambedkar, Framing of Indian Constitution'', 1st Edition, Ava Publishers, New Delhi, 2015.
3. Jain, M. P., "Indian Constitution Law", 7th Edition, Lexis Nexis, New Delhi, 2014.
4. Basu, D.D. "Introduction to the Constitution of India", Lexis Nexis, New Delhi., 2015.

SUGGESTED READING:

1. Bhargava, Rajeev. (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.
2. NCERT, Indian Constitution at Work, 1st Edition, Government of India, New Delhi 2006, reprinted in 2022.
3. Ravindra Sastry, V. (ed.), Indian Government & Politics, 2nd edition, Telugu Akademy, 2018.

Online Resources:

2. http://www.nptel.ac.in/courses/103107084/Script.pdf

23EGA103

STRESS MANAGEMENT BY YOGA

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

COURSE OBJECTIVES: This course aims to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	1	-	1	1	1
CO2	1	-	-	1	1	1
CO3	1	-	-	1	1	1
CO4	1	1	-	1	1	1
CO5	1	1	-	1	1	1

UNIT - I

Meaning and Definition of Yoga- Historical perspective of Yoga- Principles ofAstanga Yoga by Patanjali.

UNIT - II

Meaning and Definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT- III

Concept of Stress According to Yoga - Stress assessment methods - Role ofAsana, Pranayama and Meditation in the management of stress

UNIT - IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

UNIT - V

Pranayama- Anulom and Vilom Pranayama- Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation Techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique(DRT)

TEXT BOOKS:

1. "Yogic Asanas for Group Training - Part-I": Janardhan SwamiYogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.

SUGGESTED READING:

1. Nagendra H.R nad Nagaratna R, “Yoga Perspective in Stress Management”, Swami Vivekananda Yoga Prakashan, Bangalore,

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

23EGA104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Awareness on Personality Development.

COURSE OBJECTIVES: This course aims to:

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awake wisdom among themselves.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO 1	1	1	-	1	1	1	-	1	-
CO 2	1	-	-	1	1	1	-	1	-
CO 3	1	-	-	1	1	1	-	1	-
CO 4	1	1	-	1	1	1	-	1	-
CO 5	1	1	-	1	1	1	-	1	-

UNIT - I

Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue).

UNIT – II

Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75& 78 (do's) - Approach to day to day works and duties.

UNIT - III

Introduction to Bhagavadgeetha for Personality Development – Shrimad BhagawadGeeta: Chapter 2– Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48.

UNIT - IV

Statements of basic knowledge – Shrimad BhagawadGeeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad BhagawatGeeta.

UNIT - V

Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

TextBooks:

3. Gopinath, P., "Bhartrihari's Three Satakam(Niti-sringar-vairagya)", Rashtriya Sanskrit Sansthanam, New Delhi, 2018.
4. Swarupananda, Swami, "Srimad Bhagavad Geeta", Advaita Ashram (Publication Dept), Kolkata, 2017.

Online Resources:

3. http://nptel.ac.in/downloads/109104115/

23MEC111

INDUSTRIAL PROJECT / DISSERTATION PHASE - I

Instruction	20	Hours per week
Duration of SEE		---
SEE		--
CIE		100 Marks
Credits		10

COURSE OBJECTIVES: This course aims to:

1. Orient the students to carry out literature survey and identify the problem statement.
2. Make the student devise a methodology on his own.
3. Facilitate the student to explore different software/hardware techniques.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/ internationalrefereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3	3	1	2
CO2	3	3	3	3	2	3
CO3	3	3	3	3	2	3
CO4	3	3	2	3	1	3
CO5	2	2	2	3	2	2

Guidelines:

1. The Project work will preferably be a problem with research potential and shouldinvolve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.
3. The CIE shall include reviews and the preparation of report consisting of a detailedproblem statement and a literature review.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The work has to be presented in front of the committee which consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
6. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks:100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
DepartmentCommittee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note: Department committee has to assess the progress of the student for every two weeks.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

SEMESTER – IV

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
DISSERTATION									
1	23MEC112	Industrial Project / Dissertation Phase - II	--	--	32	Viva voce	100	100	16
TOTAL			**--**	**--**	**32**	**--**	**100**	**100**	**16**
Clock Hours Per Week = 32									

L: Lecture **D: Drawing** **T: Tutorial** **P: Practical/Mini Project with Seminar/Dissertation**

CIE - Continuous Internal Evaluation **SEE – Semester End Examination**

Service Courses Offered by Mechanical Engineering Department

Open Elective (5/5)		
S.NO.	**Subj. Code**	**Name of the Subject**
1	23MEO 101	Industrial Safety
2	23MEO 102	Introduction to Optimization Techniques
3	23MEO 103	Composite Materials
4	23MEO 104	Alternative energy sources
5	23MEO 105	Computational methods

23MEC112

INDUSTRIAL PROJECT / DISSERTATION PHASE - II

Instruction	32 Hours per week
Duration of SEE	Viva-Voce
SEE	100 Marks
CIE	100 Marks
Credits	16

COURSE OBJECTIVES: This course aims to

1. Orient the students towards scientific research, problem solving, design, generation/collection and analysis of data.
2. Make the student to realize the objectives and fulfil the aim of the project.
3. Enhance the technical writing skills and encourage to publish the findings.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing setups/equipment and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3	3	1	2
CO2	3	3	3	3	2	3
CO3	3	3	3	3	2	3
CO4	3	3	2	3	1	3
CO5	2	2	2	3	2	2

Guidelines:

1. It is a continuation of Project work started in semester III.
2. The student has to submit the report in prescribed format and also present a seminar.
3. The dissertation should be presented in standard format as provided by the department.
4. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
5. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person) guide/co-guide.
6. The candidate has to be in regular contact with his/her guide/co- guide.

Guidelines for awarding marks in SEE (Semester End Examination): Max. Marks: 100

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks:100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Department Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report standard format
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner (s) together	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project 1. Innovations 2. Applications 3. Live Research Projects 4. Scope for future study 5. Application to society
	20	Viva-Voce

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AICTE Model Curriculum with Effect from the AY 2023 – 2024)

M.E. (CAD/CAM)

Service Courses Offered by Mechanical Engineering Department

Open Elective (5/5)		
SNO	**Subj. Code**	**Name of the Subject**
1	23MEO101	Industrial Safety
2	23MEO102	Introduction to Optimization Techniques
3	23MEO103	Composite Materials
4	23MEO104	Alternative energy sources
5	23MEO105	Computational methods

23MEO101

INDUSTRIAL SAFETY

(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Familiarize the cause for industrial accidents and preventive steps to be taken.
2. Elucidate ffundamental concepts of Maintenance Engineering.
3. Explain about wear and corrosion along with preventive steps to be taken
4. Provide basic concepts and importance of fault tracing.
5. Provide steps involved in carrying out periodic and preventive maintenance of various equipment used in industry

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Identify the causes for industrial accidents and suggest preventive measures.
2. Identify the basic tools and requirements of different maintenance procedures.
3. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
4. Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.
5. Apply periodic and preventive maintenance techniques as required for industrial equipment like motors, pumps and air compressors and machine tools etc

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3	3	2	2
CO2	3	3	3	2	2	3
CO3	3	1	3	2	1	3
CO4	3	1	3	2	1	3
CO5	3	2	3	3	3	3

UNIT - I

Industrial Safety: Accident, Causes, Types, Results and control, Mechanical and electrical hazards, Types, Causes and preventive steps/procedure, Describe salient points of factories act 1948 for health and safety, Wash rooms, Drinking water layouts, Light, Cleanliness, Fire, Guarding, Pressure vessels, Safety color codes, Fire prevention and firefighting, Equipment andmethods.

UNIT – II

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life ofequipment.

UNIT – III

Wear and Corrosion and their Prevention: Wear, Types, Causes, Effects, Wear reduction methods, Lubricants, Types and applications, Lubrication methods, General sketch, Working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, Corrosion prevention methods.

UNIT–IV

Fault Tracing: Fault tracing, Concept and importance, Decision tree concept, Need and applications, Sequence of fault finding activities, Show as decision tree, Draw decision tree for problems in machine tools, Hydraulic, Pneumatic, Automotive, Thermal and electrical equipment's like any one machine tool, Pump, Air compressor,

Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT – V

Periodic and Preventive Maintenance: Periodic inspection, Concept and need, Degreasing, Cleaning and repairing schemes, Overhauling of mechanical components, Overhauling of electrical motor, Common troubles and remedies of electric motor, Repair complexities and its use, Definition, Need, Steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance, Repair cycle concept and importance

TEXT BOOKS:

1. H. P. Garg, Maintenance Engineering, S. Chand and Company
2. Audels, Pump-hydraulic Compressors, McGraw Hill Publication

Suggested Readings:

1. Higgins & Morrow, Maintenance Engineering Handbook, Da Information Services.
2. Winterkorn, Hans, Foundation Engineering Handbook, Chapman & Hall London

23MEO102

INTRODUCTION TO OPTIMIZATION TECHNIQUES

(Open Elective)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Come to know the formulation of LPP models
2. Understand the Transportation and Assignment techniques
3. Come to know the procedure of Project Management along with CPM and PERT techniques
4. Understand the concepts of queuing theory and inventory models
5. Understand sequencing techniques

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queuing and inventory concepts in industrial applications
5. Apply sequencing models in industries

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	3	1	2	2
CO2	3	1	3	1	2	2
CO3	1	1	3	2	3	2
CO4	2	1	3	2	2	3
CO5	2	1	3	2	2	3

UNIT - I

Operations Research: Definition, Scope, Models, Linear programming problems (LPP), Formulation, Graphical Method, and Simplex Method

UNIT - II

Transportation Models: Finding an initial feasible solution, North West corner method, Least cost method, Vogel's approximation method, Finding the optimal solution, Special cases in transportation problems, Unbalanced transportation problem, Degeneracy in transportation, Profit maximization in transportation.

UNIT- III

Project Management: Definition, Procedure and objectives of project management, Differences between PERT and CPM, Rules for drawing network diagram, Scheduling the activities, Fulkerson's rule, Earliest and latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, Duration of the project, Free float, Independent float and total float

UNIT - IV

Queuing Theory and Inventory:: Kendols notation, Single server models, Inventory control, Deterministic inventory models, Probabilistic inventory control models.

UNIT - V

Sequencing Models: Introduction, Objectives, General assumptions, Processing 'n' jobs through two machines, Processing 'n' jobs through three machines

TEXT BOOKS:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

SUGGESTED READING:

1. Hitler Libermann, Operations Research, McGraw Hill Pub, 2009
2. Harvey M Wagner, Principles of Operations Research, Prentice Hall of India,2010

23MEO103

COMPOSITE MATERIALS

(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Provide concepts of Composite materials and their constituents.
2. Explain the Classification of the reinforcements and evaluate the behaviour of composites.
3. Provide Fabrication methods of metal matrix composites.
4. Explain manufacturing of Polymer matrix composites.
5. Elucidate Failure mechanisms in composite materials.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Classify and characterize the composite materials.
2. Describe types of reinforcements and their properties.
3. Understand different fabrication methods of metal matrix composites.
4. Understand different fabrication methods of polymer matrix composites.
5. Decide the failure of composite materials.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	3	1	1	3
CO2	3	1	3	1	1	3
CO3	3	2	3	1	1	3
CO4	3	2	3	1	1	3
CO5	3	1	3	1	1	3

UNIT - I

Introduction: Definition, Classification and characteristics of composite materials, Advantages and application of composites, Functional requirements of reinforcement and matrix, Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II

Reinforcements: Preparation, Layup, Curing, Properties and applications of glass fibers, Carbon fibers, Kevlar fibers and boron fibers, Properties and applications of whiskers, Particle reinforcements, Mechanical behavior of composites, Rule of mixtures, Inverse rule of mixtures, Isostrain and isostress conditions.

UNIT – III

Manufacturing of Metal Matrix Composites: Casting, Solid state diffusion technique, Cladding, Hot isostatic pressing, Properties and applications, Manufacturing of ceramic matrix composites, Liquid metal infiltration, Liquid phase sintering, Manufacturing of Carbon, Carbon composites, Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV

Manufacturing of Polymer Matrix Composites: Preparation of moulding compounds and prepegs, Hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding, Properties and applications.

UNIT – V

Strength: Lamina failure criteria, Strength ratio, Maximum stress criteria, Maximum strain criteria, Interacting failure criteria, Hygrothermal failure, Laminate first play failure, Insight strength

TEXT BOOKS:

1. K.K.Chawla, "Composite Materials- Science and Engineering", 4th edition, Springer Verlag, 2019.
2. WD Callister, Jr., Adapted by R. Balasubramaniam , "Materials Science and Engineering, An introduction".,

Suggested Readings:

1. Deborah D.L. Chung, "Composite Materials Science and Applications" 2nd edition, Springer Verlag, 2010.
2. Sanjay K. Mazumdar, "Composites Manufacturing- materials, product and process engineering", 1st edition, CRC press, 2002.
3. Daniel Gay, "Composite Materials Design and Applications" 3rd edition, CRC press, 2015.

23MEO104

ALTERNATIVE ENERGY SOURCES

(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Elucidate need and importance of non-conventional energy resources
2. Explain extent of solar energy which can be utilized as energy resource
3. Explain concept of wind energy and its merits and demerits
4. Provide operating principles of geothermal energy and bio-energy
5. Explain merits and demerits of tidal energy, wave energy and OTEC

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the need for renewable energy sources in the context of environmental issues.
2. Apply the principles of solar energy for domestic and industrial usages.
3. Understand the working principle of wind power plants along with merits and demerits.
4. Describe the concepts of geothermal energy sources and biomass as a source of energy.
5. Explain the principles and impact of wave, tidal and OTEC plants on the environment.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	3	2	2	1
CO2	3	2	3	1	1	2
CO3	3	3	3	1	2	2
CO4	3	2	3	1	1	2
CO5	3	2	2	1	2	3

UNIT-I

Energy Sources: Energy characteristics, forms of energy, energy chain (route), energy sectors, Indian energy scenario, energy pricing in India, energy and environment, energy security, energy conservation and its importance, energy strategy for future, classification of energy sources, availability of conventional and non-conventional (renewable) energy sources, classification of RES - solar, wind, geothermal, bio-mass, ocean tidal, ocean wave and ocean thermal energy conversion (OTEC), advantages and limitations of conventional and renewable energy sources.

UNIT-II

Solar Energy: Solar radiation, solar thermal collectors, working of flat plate and concentrating (focusing) solar collectors and their limitations, comparison of flat plate and focusing collectors, applications of solar collectors - water heating, space heating, low temperature power generation, solar cookers, water pumping, SODIS, solar thermal power plant, advantages and limitations of solar energy systems, PV materials, PV cells and their manufacturing, space based solar power (SBSP), solar satellite system, advantages and disadvantages of SBSP.

UNIT-III

Wind Energy: Sources of wind, merits and demerits of wind energy, site selection for wind energy conversion system, wind turbine (wind mill), classification of wind mills, working principle horizontal axis and vertical axis windmills, horizontal vs vertical axis windmills, power extracted from the wind, effect of velocity on power generation, new developments and problems in operating large wind power generators.

UNIT-IV

Geothermal Energy: Layers in earth, resources of geothermal energy, hydrothermal, petrothermal and geopressureresources, advantages, disadvantages, applications and environmental effects of geothermal energy sources.

Biomass Energy: Resources, biogas and its composition, process of biogas generation, wet process and dry process, raw materials available for biogas fermentation, economical, social, environmental and health benefits of biogas utilization, selection of site and constructional techniques of a biogas plant, working of KVIC, Pragathi design, Janata and Deenbandu biogas plants, common operational problems, causes and remedies relating to abiogas plant.

UNIT V

Tidal power: Tidal systems, site selection for tidal power plant, schematic layout of tidal power house, principle ofoperation of single basin and double basin tidal plants, advantages and disadvantages of tidal power.

Wave energy - Differences between tides and waves, advantages and disadvantages of wave power, problemsassociated with wave energy collection, working principle of wave energy conversion devices.

Ocean thermal energy conversion (OTEC) - OTEC power plants, location, open cycle and closed cycle OTECplants, advantages, limitations and applications of OTEC, environmental impact of OTEC plants.

TEXT BOOKS:

1. S. Hasan Saeed and D.K. Sharma, –Non Conventional Energy Resources‖, S.K. Kataria & Sons, New Delhi, 2017.
2. Dr. R.K. Singal, –Non Conventional Energy Resources‖, S.K. Kataria & Sons, New Delhi, 2005.

Reference books:

1. K. M. Mittal, –Non-Conventional Energy Systems‖, Wheeler Publishing Co. Ltd, New Delhi, 2003.
2. Shali Habibulla, –Non-Conventional Energy Sources‖, State Institute of Vocational Education, Hyderabad, 2005.
3. G.D. Rai, –Non Conventional Energy Sources‖, Khanna Publishers, New Delhi, 2011.

23MEO105

COMPUTATIONAL METHODS

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Teach basic equations and concept of CFD.
2. Explain concept of PDEs and finite difference methods.
3. Explain Crank-Nihcolson, Implicit and Explicit methods & Jacobi, Gauss Seidel and ADI methods.
4. Provide various types of grid generation and errors in numerical solution.
5. Elucidate importance of FVM.

COURSE OUTCOMES: After successful completion of the course the students will be able to

1. Derive CFD governing equations and turbulence models.
2. Apply different PDEs and know the importance of Taylor series of expansion.
3. Solve simultaneous linear equations with various methods.
4. Understand errors, stability, consistency and develop O,H and C grid generated models.
5. Utilize FVM for heat transfer problems.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	3	1	2	2
CO2	3	1	3	1	2	2
CO3	3	1	3	1	2	3
CO4	3	1	3	1	2	3
CO5	3	1	3	1	2	3

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Classification of PDEs: Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference, explicit, Implicit and Crank Nicholson.

UNIT- III

Finite Difference Solutions: Solution of simultaneous linear equations: Jacobi, Gauss Seidel, TDMA, ADI, solution for viscous incompressible flow using Vorticity Stream function method, MAC method.

UNIT - IV

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for diffusion equation, convection diffusion equation, Staggered grids SIMPLE and SIMPLE R algorithms.

TEXT BOOKS:

1. P.S. Ghoshdastidar, Computational Fluid Dynamics and Heat Transfer, Cengage, 2017.
2. John D. Anderson, "Computational Fluid Dynamics", Mc Graw Hill Inc., 2018.

3. H. K. Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015.

SUGGESTED READING:

1. K. Muralidhar and T. Sundararajan T., "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003.
2. S.V. Patankar, "Numerical Heat transfer and Fluid flow", Hemisphere Publishing Company, New York, 1980.

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