DKTE Society's
TEXTILE & ENGINEERING INSTITUTE
(An Autonomous Institute)
Rajwada, Ichalkaranji 416115

DEPARTMENT: MECHANICAL ENGINEERING

CURRICULUM

Mechanical Engineering Program

Third Year

With Effect From

2022-23

Promoting Excellence in
Teaching, Learning & Research

Teaching and Evaluation Scheme for year 2022-23

Third Year B. Tech.(Semester – V) In Mechanical Engineering

Sr. No.	Course Code	Course Title	Course Category	Teaching scheme				Course Credits	Evaluation scheme					
									Theory			Practical		TOTAL
				L	T	P	Contact Hrs/wk		CIE		SEE	CIE	SEE	
									SE-I	SE-II				
1	MEL351	Theory of Machine – II	PCC	3	-	-	3	3	25	25	50	-	-	100
2	MEL352	Heat & Mass Transfer	PCC	3	-	-	3	3	25	25	50	-	-	100
3	MEL353	Machine Design – I	PCC	3	-	-	3	3	25	25	50	-	-	100
4	MEL354	Control Engineering	PCC	3	-	-	3	3	25	25	50	-	-	100
5	MEL355	Tool Engineering	PCC	3	-	-	3	3	25	25	50	-	-	100
6	MEP356	Theory of Machine – II Lab	PCC	-	-	2	2	2	-	-	-	50	50	100
7	MEP357	Heat & Mass Transfer Lab	PCC	-	-	2	2	1	-	-	-	50		50
8	MEP358	Tool Engineering Lab	PCC	-	-	2	2	2	-	-	-	50	50	100
9	MEP359	Control Engineering Lab	PCC	-	-	2	2	1	-	-	-	50	-	50
10	MEP360	Machine Shop Practice-II Lab	PCC	-	-	2	2	2	-	-	-	50	50	100
11	MEP361	Machine Design – I Lab	PCC	-	-	2	2	1	-	-	-	50	-	50
12	MEDELI	CDIO Project I (Regular / RE)	PST	-	-	2	2	1	-	-	-	50	-	50
				15	**0**	**14**	**29**	**25**	**125**	**125**	**250**	**350**	**150**	**1000**

MED362	CDIO Project I (Regular)	MED363	CDIO Project (RE)

L-Lecture, T-Tutorial, P-Practical

SE-I :Semester Examination-I
SE-II : Semester Examination-II

CIE – Continuous In Semester Evaluation
SEE – Semester End Examination

Course Category	HSMC (Hum. & Social Sc.,Mgt)	BSC (Basic Sc.)	ESC Engg. Sc.)	PCC (Prof. Core Courses)	PEC (Prof. Elect.Courses)	OEC (Open Elct. Courses)	MC (Mandatory Courses)	PST (Project / Seminar / Ind. Training)
Credits	--	--	--	24	--	--	--	1
Cumulative Sum	3	18	27	60	--	2	--	1

Progressive Total Credits: 86 + 25 = 111

Teaching and Evaluation Scheme for year 2022-23

Third Year B. Tech.(Semester – VI) In Mechanical Engineering

Sr. No.	Course Code	Course Title	Course Category	Teaching scheme				Course Credits	Evaluation scheme					
									Theory			Practical		TOTAL
				L	T	P	Contact Hrs/wk		CIE		SEE	CIE	SEE	
									SE-I	SE-II				
1	MEL364	Machine Design – II	PCC	3	-	-	3	3	25	25	50	-	-	100
2	MEL365	Programming & Computational Methods	PCC	3	-	-	3	3	25	25	50	-	-	100
3	MEL366	Engines and air conditioning	PCC	3	-	-	3	3	25	25	50	-	-	100
4	MELOE	Open Elective	OEC	3	-	-	3	3	25	25	50	-	-	100
5	MEL367	Psychology of Stress, Health and Well-Being	HSMC	2	-	-	2	2	25	25	50	-	-	100
6	MEP368	Machine Design – II Lab	PCC	-	-	2	2	2	-	-	-	50	50	100
7	MEP369	Programming & Computational Methods Lab	PCC	-	-	2	2	1	-	-	-	50	-	50
8	MEP370	Engines and Air Conditioning Lab	PCC	-	-	2	2	2	-	-	-	50	50	100
9	MEP371	Industrial Fluid Power Lab	PCC	-	-	2	2	1	-	-	-	50	-	50
10	MEP372	CNC Lab	PCC	-	-	2	2	1	-	-	-	50	-	50
11	MEP373	Software Training	PCC	-	-	2	2	1	-	-	-	50	-	50
12	MED374	Project (Winter Industrial Training)	PST	-	-	1	1	1	-	-	-	50	-	50
13	MEP375	Psychology of Stress, Health and Well-Being	HSMC	-	-	2	2	1	-	-	-	50	-	50
14	MED375	CDIO project II	PST	-	-	2	2	1	-	-	-	50	-	50
				14	**0**	**17**	**31**	**25**	**125**	**125**	**250**	**450**	**100**	**1050**

MED362	CDIO Project I (Regular)	MED363	CDIO Project (RE)

L-Lecture,
T-Tutorial,
P-Practical

SE-I :Semester Examination-I
SE-II : Semester Examination-II

CIE – Continuous In Semester Evaluation
SEE – Semester End Examination

Course Category	HSMC (Hum. & Social Sc.,Mgt)	BSC (Basic Sc.)	ESC Engg. Sc.)	PCC (Prof. Core Courses)	PEC (Prof. Elect.Courses)	OEC (Open Elct. Courses)	MC (Mandatory Courses)	PST (Project / Seminar / Ind. Training)
Credits	1	2	--	17	--	3	--	2
Cumulative Sum	3	18	28	59	--	2	--	1

Progressive Total Credits: 25 + 111 = 136

Third Year B. Tech. Semester V
MEL351: THEORY OF MACHINE-II

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites - Elements of Mechanics, Theory of Machines-I

Course Objective:

1 Understand the kinematics and dynamics of machine.
2 Acquire the elementary knowledge of gears, balancing of machines, gyroscopes.
3 Introduce students to single degree freedom vibrations
4 Understand and apply the knowledge to mechanical vibrations

Course Outcomes:

1 Describe the different mechanical systems using principles of kinematics and dynamics.
2 Examine mathematical models of simple system using basic principles of mechanical vibrations.
3 Design power transmission systems including gears.
4 Fulfill Practical requirements like finding natural frequency and avoidance of resonance by modifying system frequency
5 Apply the principles of balancing to various applications for minimizing vibration problems

Course Content

Unit 1 **Toothed Gearing:** **7 Hrs.**
Geometry of motion, Gear geometry, Types of gear profile- involute and cycloidal, Theory of Spur, Helical & Spiral gears, Interference in involute tooth gears and methods for its prevention, Path of contact, Contact ratio, Efficiency and centre distance of spiral gears.

Unit 2 **Gear Trains:** **6 Hrs.**
Types of Gear trains- Simple, Compound, Reverted, Epicyclic gear train, Tabular method for finding the speeds of elements in epicyclic gear train, Differential gear box. Equivalent mass and Moment of Inertia applied to gear trains.

Unit 3 **Gyroscope:** **6 Hrs.**
Gyroscopic couple, spinning and Precessional motion, gyroscopic couple and its effect on – i) Aero plane ii) Ship iii) Four Wheeler iv) Two Wheeler.

Unit 4 **Balancing**: **6 Hrs.**
Static and Dynamic balancing of rotary and reciprocating masses. Primary and Secondary forces and couples. Direct and Reverse cranks. Balancing of Single cylinder, Multi cylinder-Inline and V- Engines for four-wheeler.

Unit 5 **Fundamentals of Vibrations and Single degree of freedom systems**: **8 Hrs.**
Basic concepts and definitions, vibration measuring parameters- Displacement, Velocity and acceleration, Free and forced vibrations, Equivalent Springs. Types of damping. Free vibrations with and without

damping (Rectilinear, Torsional & Transverse), degree of damping.
Logarithmic decrement, equivalent viscous damping, Coulomb damping.

Unit 6	**Forced vibrations:** Forced vibration with viscous damping, magnification factor, frequency response curves, vibration isolation and transmissibility, forced vibrations due to support excitation. Critical speed of shaft with and without damping..	**6 Hrs.**

Text Books:

1. "Theory of Machines", Rattan S.S. Tata McGraw Hill, 3rd Edition.
2. "Theory of Machines", Dr. V.P.Singh, Dhanpat Rai Publications.
3. "Mechanical Vibrations" - G. K. Grover. Nem Chand And Bross, Roorkee.

Reference Books:

1. "Theory of Machines and Mechanisms" Shigley, Tata McGraw Hill.
2. "Theory of machines" Thomas Beven Pearson Education, 3rd Edition.
3. "Kinematics, Dynamics and Design of Machinery", Walidron, Wiley India Publi., 2nd Edition.
4 "Kinematics, Dynamics of Machinery", Wilson, Sadler, Pearson Education.
5. "Mechanical Vibrations" 4th ed- S. S. Rao - Pearson Education
6. "Fundamentals of Mechanical Vibration" - S. Graham Kelly - Tata McGraw Hill .
7. Vibration Analysis - P. Srineevasan - Tata McGraw Hill
8. "Theory of Machines", Ballaney, Khanna Publication.

Third Year B. Tech. Semester V
MEL352: HEAT & MASS TRANSFER

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites - Applied Thermodynamics, Fluid Mechanics and Mathematics

Course Objective:

1 To understand - what is heat transfer, what governs the rate of heat transfer and importance of heat transfer?
2 To study the importance of heat transfer.
3 To study three major modes of heat transfer viz., conduction, Convection and radiation.
4 To study in addition to these three main modes of heat transfer, students will also learn the phenomena of heat transfer during phase change (boiling and condensation heat transfer).
5 To Study the basic principles of heat exchanger analysis and thermal design.

Course Outcomes:

At the end of the course students will be able to

1 Formulate basic equations for heat transfer problems.
2 Apply heat transfer principles to design and evaluate performance of complex thermal systems.
3 Calculate the effectiveness and rating of heat exchangers.
4 Calculate heat transfer by radiation between objects with simple geometries.
5 Calculate and evaluate the impact of boundary conditions on the solutions of heat transfer problems.

Course Content

Unit 1 Introduction to Heat and Mass Transfer: **7 Hrs.**

Basic Concepts Modes of heat transfer. Basic laws of heat transfer, Introduction to combined modes of heat transfer, Thermal conductivity and its variation with temperature for various Engineering. Materials (Description only). Nano fluids. Introduction to mass transfer: Modes of mass transfer, Analogy between heat, mass and momentum transfer, Fick's law of diffusion, various dimensionless numbers. Derivation of Generalized differential equation of Heat Conduction in Cartesian coordinates, its reduction to Fourier, Laplace and Poisson's equations. Generalized Heat conduction equation in cylindrical and spherical coordinates (no derivation).

One dimensional steady state heat conduction without heat generation: Reduction of Generalized differential equation of Heat Conduction to one dimension (1D), Heat conduction through plane wall, cylinder, sphere; electrical analogy; concept of thermal resistance and conductance, composite slab, composite cylinder and composite sphere, critical radius of insulation for cylinder and sphere. Economic thickness of insulation, Numerical problems.

Unit 2	**Heat Conduction with Heat Generation and Unsteady State Heat Conduction:** One dimensional steady state heat conduction with heat generation One dimensional steady state heat conduction with uniform heat generation for plane wall cylinder, and sphere. One dimensional unsteady state heat conduction Lumped Heat capacity Analysis, Biot and Fourier number and their significance, (Numerical based on Lumped Heat capacity Analysis).Use of Hiesler and Grober Charts (No numerical based on Hiesler and Grober Charts), Numerical problems.	**6 Hrs.**
Unit 3	**Extended Surfaces:** Boundary and Initial conditions, Temperature boundary conditions, heat flux boundary condition, convection boundary condition and radiation boundary condition. Heat transfer through extended surfaces Types and applications of fins, Heat transfer from rectangular and pin fins. Fin effectiveness and efficiency, Error estimation in temperature measurement in thermo well.	**6 Hrs.**
Unit 4	**Convection:** **Fundamentals of convection –** Mechanism of natural and forced convection. Concept of Hydrodynamic and thermal boundary layer, Local and average convective coefficient for laminar and turbulent flow for flat plate and pipe. **Forced convection –** Dimensional analysis, Physical significance of dimension less numbers, Reynolds analogy for laminar flow, Correlations for forced convection over flat plate and closed conduits, Numerical problems. Natural or free convection Dimensional analysis, Physical significance of dimensionless numbers, correlations for natural convection over vertical plate cylinder sphere and flow patterns, Numerical problems.	**7 Hrs.**
Unit 5	**Radiation:** Nature of thermal radiation, absorptive, reflectivity, transmissivity, emissive power and emissivity, spectral and total concept, blackbody, graybody, and white body Kirchoff's law, Wein's law and Planck's law, and deduction of Stefan Boltzmann law. Lambert cosine rule, Intensity of radiation. Energy exchange by radiation between two black surfaces with non-absorbing medium in between and in absence of reradiating surfaces. Shape factor and its characteristics. Energy exchange by radiation between two gray surfaces without absorbing medium, concept of radiosity and irradiation. Radiation network method, network for two surfaces which see each other and nothing else, radiation shields, Numerical problems.	**6 Hrs.**
Unit 6	**Heat Exchangers and Phase Change Phenomenon** Classification and types of Heat exchangers, Fouling factor, and Overall heat transfer coefficient, Heat Exchanger Analysis using LMTD and NTU methods for parallel and counter flow, Design consideration of Heat exchangers and introduction to design standards like TEMA, Numerical problems. **Boiling and Condensation (Descriptive treatment only)** Types of boiling, Pool boiling and Forced convection boiling, Nusselt's theory of condensation for vertical plate, Condensation correlations for practical applications, Film wise and drop wise condensation, promoters, Numerical problem based on Nusselt's plate theory on condensation.	**6 Hrs.**

Text Books:

1. "A Text Book on Heat Transfer", Dr. S. P. Sukhatme, Orient Longman Publication Hyderabad.
2. "Heat and Mass Transfer", S.C. Arrora and S. Dokoundwar, Dhanpat Rai and Sons, Delhi.

Reference Books

1. "Fundamentals of Heat and Mass Transfer", C.P. Kothandaraman.
2. "Heat Transfer" Chapman A.J., Tata McGraw Hill Book Company, New York.
3. "Fundamentals of Heat and Mass Transfer", Frank P. Incropera, David P. Dewitt, Wiley India, 5th Edition.
4. "Heat Transfer", J.P. Holman, Tata McGraw Hill Book Company, New York, 2nd Edition
5. "Heat and Mass Transfer", R.K. Rajput, S. Chand and Company Ltd., New Delhi., 5th Edition.
6. "Heat and Mass Transfer", Dr.D. S. Kumar, S.K. Kataria and Sons, Delhi.

Third Year B. Tech. Semester V
MEL353: MACHINE DESIGN – I

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites- Elements of Mechanics, Strength of Mechanical Elements, Theory of Machine-I.

Course Objective:

1 Study basic principles of machine design.
2 Understand the principals involved in evaluating the dimensions of a component to satisfy functional and strength requirements.
3 To study the concept of Aesthetics, Ergonomics consideration in product design.
4 Study and select bearings used for mechanical systems.
5 Learn use of catalogues and design data book.

Course Outcomes:

At the end of the course students will be able to
1 Apply basic principles of machine design.
2 Design machine elements on the basis of strength concept.
3 Use design data books, Manufacturer's catalogue and standard practices.
4 Incorporate aesthetics, ergonomics & creativity consideration in industrial product design.

Course Content

Unit 1 Fundamentals of Machine Design **6 Hrs.**

Concept of Machine design, Types of loads, Factor of safety- its selection and significance, theories of elastic failure and their applications, Basic procedure of design of machine elements, Factors governing selection of Engineering materials.

Unit 2 Design of Joints and Machine Elements **9 Hrs.**

Design of machine elements under static loading- Knuckle joint, Turn buckle. Design of bolted joints subjected to following conditions- 1) Joints in shear 2) joints subjected to load perpendicular to the axis of bolt. Design of welded joints- 1) Strength of transverse and parallel fillet welds 2) Eccentric load in the plane of weld 3) Welded joint subjected to bending moment. Review of shaft design, ASME code for shaft design, Types and Design of Keys.

Unit 3 Design of Spring and Power Screw **7 Hrs.**

Types of springs, its materials and applications, Styles of end, Design of Helical Compression Spring subjected to static loading.

Design of Power Screw

Forms of threads, Terminology of threads, Torque requirement (lifting and lowering load) Self-locking and overhauling properties, Efficiency of square threaded, Self-locking screw, collar friction torque.

Unit 4	**Aesthetic and Ergonomic consideration in Design**: Basic types of product forms, designing for appearance, shape, Design features, Materials, Finishes, proportions, Symmetry, Contrast etc. Morgon's colour code. Ergonomic considerations-relation between man, machine and environmental factors. Design of displays and controls. Practical examples of products or equipment's using aesthetic and ergonomics design principles.	**6 Hrs.**
Unit 5	**Rolling Contact Bearing:** Introduction to tribological consideration in design, Types, Static and dynamic load capacities, Stribeck's equation, Equivalent bearing load, Load-life relationship, bearing life, Load factor, Selection of bearing from manufactures catalogue, Ball and Roller bearing, Design for variable load and speed, Bearings with probability of survival other than 90 %. Lubrication and mountings, Dismounting and preloading of bearings, Oil seal and packing.	**6 Hrs.**
Unit 6	**Sliding Contact Bearing:** Bearing material and their properties: Sintered bearing materials, bearing types and their construction details. Hydro-Dynamic Lubrication: Basic theory, thick and thin film lubrication, Reynolds's equation, Sommerfield Number, Design consideration in hydrodynamic bearings, Raimondi and Boyd method relating bearing variables, Heat balance in journal bearings, Temperature rise.	**5Hrs.**

Text Books:

1. "Design of Machine Elements", V.B. Bhandari., Tata McGraw Hill Pub., 3rdEdition.
2. "Machine Design", R.K.Jain, Khanna Publication.

Reference Books:

1. "Machine Design", Hall, Holowenko Laughlin, Tata McGraw Hill Pub Schaums Outline Series.
2. "Design of Machine Element", J.F. Shigley, TATA McGraw Hill Publication.
3. "Design of Machine Element" M.F. Spotts, Pearson Education Publication, 6th Ed.
4. PSG Design data Book.
5. "Mechanical Analysis and Design", H. Burr and Cheatam, Prentice Hall Publication.
6. "Design of Transmission Systems", P. Kannaiah, Scitech Publication.
7. "Machine Design", P. Kannaiah, Scitech Publication, 2nd Edition.
8. "Machine Component Design", Robert C. Juvniall, Willey Ltd, 5th Edition.
9. "Machine Design an Integrated Approach", R.L. L Norton, Pearson Edu Pub, 2nd Edi.

Third Year B. Tech. Semester V
MEL354: CONTROL ENGINEERING

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites – Engineering Mathematics, Basic Mechanical Engineering, Machine Design, Theory of Machine.

Course Objective:

1 To understand control system, its type and applications
2 To model physical system
3 To determine system stability and system response
4 To analyze various control systems

Course Outcomes:

At the end of the course students will be able to

1 Describe control systems and generate grounded chair representation of the systems
2 Create mathematical models of simple system using basic principles of state space methods, block diagram algebra
3 Plot the root locus of control systems.
4 Linearize the nonlinear applications

Course Content

Unit 1	**Introduction to Automatic Control:** Feedback control system, System representation, Modern control systems, Operational notations, Generalized Control System Types, Open Loop and Closed Loop, Applications of Automatic Control Systems. **Representation of control components:** Mechanical components, Electrical Components, Degrees of freedom, Force balance.	**6 Hrs.**
Unit 2	**Grounded Chair Representation:** Series and parallel laws, Analogous Systems, Force – Voltage Analog, Force – Current Analog.	**7 Hrs.**
Unit 3	**Representation of control system:** Linearization of Nonlinear functions, Linearization of operating curves.	**6 Hrs.**
Unit 4	**Block Diagram Algebra:** Rules for Reduction of Block Diagram, Transfer function of control system, examples. **Stability:** Routh's Stability Criteria.	**7 Hrs.**
Unit 5	**Root Locus Technique**: Significance of Root Locus, Construction of Root Loci, General Procedure, Effect of Poles and Zeros on the System	**7 Hrs.**
Unit 6	**State Space Analysis:** System Representation, Direct, Parallel, Series and General Programming.	**6 Hrs.**

Text Books:

1. Automatic Control Engineering: F.H. Raven (5th ed.), Tata McGraw Hill Publication.
2. Modern Control Systems: K Ogata, 3rd Ed, Prentice Hall Publications
3. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering: W. Bolton, Pearson.

Reference Books:

1. Control System Engineering: R Anand Natarajan, P. Ramesh Babu, SciTech Publication
2. Control Systems: A. Anand Kumar, Prentice Hall Publication
3. Automatic Control Systems: B.C. Kuo, 7thEd, Willey India Ltd. / Prentice Hall Publication
4. Automatic Control Engineering: D. Roy and Choudhari, Orient Longman Publication. Calcutta

Third Year B. Tech. Semester V
MEL355: TOOL ENGINEERING

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites- Machine: Tool & Processes, Workshop Practice I & II, Machine Shop Practice I.

Course Objective:

1 To study of metal cutting technology including the process, measurements, design and selection of various cutting tools and their industrial specifications.
2 To study the design practices of jigs and fixtures.
3 To prepare process sheets, tool layout, cam profile design for single spindle automat.
4 To study of die design for presswork.

Course Outcomes:

At the end of the course students will be able to
1 Describe various terms related to metal cutting, tool geometry, single spindle automat, jigs and fixtures, press tools.
2 Determine parameters of metal cutting, tool geometry and press tools.
3 Design system and processes for single spindle automat, jig and fixture.
4 Analyze between terms related to metal cutting, tools, jigs and fixtures, types of dies, press tool operation.

Course Content

Unit 1 Theory of metal cutting: **7 Hrs.**
Metal Cutting Operations and Machine Tools, cutting tool materials and their properties Concept of speed, feed and depth of cut, orthogonal and oblique cutting, Wedge action, mechanics of metal cutting-chip formation, types of chips, cheap breaker, effect of various factors on metal cutting, heat generation in machining, its effect on cutting force, Friction in metal cutting, machinability of metals- factors affecting and machinability index

Unit 2 Tool Geometry and Tool Life: **6 Hrs.**
Tool geometry- parts, angles and geometry of single point cutting tools, Tool signature, and tool geometry of multipoint cutting tools-drills, milling cutters, reamers.
Tool life - Cutting ratios, shear plane shear angle, velocity relationship, force analysis, Merchant circle, Force measurement with dynamometer. Tool life, Taylors equation.

Unit 3 Form tools and automat: **6 Hrs.**
Introduction, form tools, types (flat, circular, dovetail), tool layout of single spindle automat, process sheet, cam profile, calculation of production rate.

Unit 4 Design of Jigs for Drilling: **7 Hrs.**
Applications, basic elements, principles and types of locating, clamping and indexing elements, auxiliary elements like tenon, setting block etc., type of drilling jigs.

Unit 5	**Design of fixtures for milling and fabrication:** Milling fixtures- Introduction, Design consideration of drilling jigs and milling fixtures with respect to different operations, introduction to modular fixtures, significance of fixtures in fabrication, types and classification, design considerations, various approaches used in design of fixtures for fabrication.	**7 Hrs.**
Unit 6	**Press Tools:** Press operations, press working equipment, press working terminology, types of dies, punches, types of presses, principle of metal cutting, clearances, cutting force, methods of reducing cutting forces, design consideration for die elements, strip layout, center of pressure, calculation of press capacity, design procedure for progressive die.	**6 Hrs.**

Text Books

1. "Text Book of Production Engineering", P.C. Sharma, S. Chand Publication.
2. "Elements of Workshop Technology Vol. II", S. K Hajra Choudhury, Media Promoters and Publishers, Mumbai.
3. "Principles of Modern Manufacturing", Groover, Wiley Publication, 5th Edition.
4. "Production Technology", R.K. Jain.

Reference Books:

1 HMT, Tata McGraw-Hill Publishing Ltd. ISBN, 0070964432, 9780070964433, (2001).
2 "Fundamentals of Tool Design" ASTME, Prentice-Hall of India, New Delhi Publi (1976).
3 "Tool Design", Donaldson, THM Publication, 3rd Edition.
4 "Jigs and Fixtures", Kempster, ELBS.
5 "Metal Cutting and Machine Tools", Thirupati Reddy, Scitech Publication, 1st Edition.
6 "Production Technology", Thirupati Reddy, Scitech Publication, 1stEdition
7 "Principals of Metal Cutting", C. Kuppuswamy Sangam Books.
8 "Fundamentals of Manufacturing Engineering", D. K. Singh, Anes Book Ltd., 2nd Rev.Edi.
9 Jigs and fixtures by Grant Hiram E., TataMcgraw Hill Education Pvt. Ltd

Third Year B. Tech. Semester V
MEP356: THEORY OF MACHINE – II LAB

Teaching Scheme	
Practicals	2 Hrs./Week
Total Credits	2

Evaluation Scheme	
CIE	50
SEE	50
Total	**100**

List of Experiments:

1 Experiment on Gyroscope.
2 Generation of involute profile using rack cutter method.
3 Experiment on Epicyclic gear train.
4 Problems on Epicyclic gear train using tabular method.
5 Balancing of rotary masses (Static and Dynamic)
6 Demonstration of dynamic balancing machine
7 a) Experiment on Longitudinal vibrations of helical springs.
b) Determination of logarithmic decrement (Free Damped Vibrations).
8 Experiment on Forced vibration characteristics
9 Experiment on Whirling of shaft.
10 Study of various vibration measuring instruments.
11 Demonstration of noise and vibration measurement using FFT Analyzer..
Note: Minimum 8 experiments conducted from above list

Submission: Completed Journal.

Third Year B. Tech. Semester V
MEP357: HEAT & MASS TRANSFER LAB

Teaching Scheme	
Practicals	2 Hrs./Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

List of Experiments:

1 Determination of thermal conductivity of Insulating powder.
2 Determination of thermal resistance and temperature distribution in a Composite wall.
3 Determination of local and average heat transfer coefficient in Natural convection heat transfer from a vertical cylinder.
4 Determination of emissivity of a Nonblack surface.
5 Determination of Stefan Boltzmann Constant.
6 Determination of Critical Heat Flux.
7 Determination of overall heat transfer coefficient and effectiveness in a Parallel flow and Counter flow Heat Exchanger.
8 Study and Demonstration of Heat Pipe.
9 Computer programs on any two experiments.

Submission: A completed journal of above experiments.

Third Year B. Tech. Semester V
MEP358: TOOL ENGINEERING LAB

Teaching Scheme	
Practicals	2 Hrs./Week
Total Credits	2

Evaluation Scheme	
CIE	50
SEE	50
Total	**100**

Prerequisites:
Machine Tool and Processes, Workshop Practice, Workshop Practice II.

Course Objectives

1. To study of metal cutting technology including the process, measurements, design and selection of various cutting tools and their industrial specifications.
2. To study the design practices of jigs and fixtures.
3. To prepare process sheets, tool layout, cam profile design for single spindle automat.
4. To study of die design for presswork.

List of Experiments:

1 Study of theory of metal cutting.
2 Numerical on metal cutting.
3 Study of tool life and tool geometry.
4 Numerical on tool life.
5 Study of form tools and automats.
6 Tool layout, process sheet and cam design for single spindle automat.
7 Study of drilling jigs and milling fixtures.
8 Design and drawing of any one drilling jig.
9 Design and drawing of any one milling fixture.
10 Study of fixtures for fabrication.
11 Study of press tools.
12 Industrial visit to study jigs and fixtures/ press tools.

Note: Any 10 Experiments conducted from above list

Submission:

A completed journal of above experiments.

Third Year B. Tech. Semester V
MEP359: CONTROL ENGINEERING LAB

Teaching Scheme	
Practicals	2 Hrs./Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Course Objective:

1. Student should be able to describe control system, its type and applications.
2. Student should be able to model physical system.
3. Student should be able to determine system stability
4. Student should be able to analyze various control actions.

List of Experiments:

1 Study of On-Off Controller for Flow/ Temperature.
2 Study of Control Modes like P, PD, PI, PID for Pressure / Temperature / Flow.
3 Study of representation of control components
4 Study of Linearization
5 Study of Block Diagram Algebra
6 Study of Stability
7 Study of Root Locus
8 Study of State Space Method

Submission:

A completed journal of above experiments.

Third Year B. Tech. Semester V
MEP360: MACHINE SHOP PRACTICE – II LAB

Teaching Scheme	
Practicals	2 Hrs./Week
Total Credits	2

Evaluation Scheme	
CIE	50
SEE	50
Total	**100**

Course Objective:

1 To provide an insight to different machine tools, accessories and attachments
2 To train students in machining operations to enrich their practical skills
3 To inculcate team qualities and expose students to shop floor activities
4 To educate students about ethical, environmental and safety standards

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

1. Perform turning, facing, knurling, thread cutting, tapering, eccentric turning, keyways/slots/grooving, gear tooth cutting and allied operations
2. Understand precautions and safety norms followed in Machine Shop
3. Exhibit interpersonal skills towards working in a team
4. Apply controlled key dimensions on a component using principles of metrology
5. Prepare a process sheet to manufacture a component and implement the same

List of Experiments

Sr. No.	Experiment Title
1	Prepare Drawing part details (for all parts)
2.	Metal cutting as per dimensions
3	Performing different operations like Facing, centre drilling, turning, Parting off
4	Performing Milling/shaping/ surface grinding and finishing operation
5	Performing Internal /External threading/ tapping/ drilling and finishing operation
6	Apply controlled key dimensions on a component using principles of metrology.
7	Assembling of the machined parts.
8	Preparation of process sheet and submission of job.

Submission

1. Completed assembly of manufactured components using machine tools in the mechanical workshop.
2. Detailed drawing and process sheet.
3. Depending on the component to be manufactured and different operations to be performed, the number of students in the group should be decided, a **maximum six no. of students allowed in a group.**

Third Year B. Tech. Semester V
MEP361: MACHINE DESIGN–I LAB

Teaching Scheme	
Practicals	2 Hrs./Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

List of Experiments:

1 Selection of materials for various engineering applications showing their IS codes, composition and properties.
2 Design and Drawing of Knuckle joint.
3 Design and Drawing of Turn-Buckle.
4 Study of helical compression spring subjected to static load and numerical problems.
5 Study of Power Screw and numerical problems.
6 Study of Ball bearing mountings and its selection preloading of bearings.
7 Aesthetic and Ergonomic design consideration – A case study

Note:
1) A detail report of design procedure calculation and sketches should be submitted alongwith A4 size drawing sheet containing details and assembly drawn either on CAD software or manually for Experimental No. 2 and 3.
2) All the assignments should be solved by using standard design procedure using design data.

Submission: Completed Journal.

Reference Books:

1. "Machine Design", Hall, Holowenko Laughlin, Tata McGraw Hill Pub Schaums Outline Series.
2. "Design of Machine Element", J.F. Shigley, TATA McGraw Hill Publication.
3. "Design of Machine Element" M.F. Spotts, Pearson Education Publication, 6th Ed.
4. PSG Design data Book.
5. "Mechanical Analysis and Design", H. Burr and Cheatam, Prentice Hall Publication.
6. "Design of Transmission Systems", P. Kannaiah, Scitech Publication.
7. "Machine Design", P. Kannaiah, Scitech Publication, 2nd Edition.
8. "Machine Component Design", Robert C. Juvniall, Willey Ltd, 5th Edition.
9. "Machine Design an Integrated Approach", R.L. L Norton, Pearson Edu Pub, 2nd Edi.

Third Year B. Tech. Semester V
MED362: CDIO PROJECT – I (REGULAR)

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Prerequisites - Theory of Machines, Analysis of Mechanical Elements, Metrology& Quality Control.

Course Objective:

1 Educate students to master a deeper working knowledge of the technical fundamentals.
2 Educate engineers to lead in the creation and operation of new products and systems.
3 Educate future researchers to understand the importance and strategic value of their work

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

1 Demonstrate working knowledge of the technical fundamentals related to design of mechanism
2 Show the creation and operation of new product and system.
3 Demonstrate the working of designed kinematic structure and show the working ability of the product.

Course Content

Unit 1 **Forming Groups and Selection of Project:** **4 Hrs.**
There will be a short start-up meeting where: Groups are formed by students of 4 to 5 people. The groups are formed based on the students' own preferences, although we encourage them to form groups based on which skills are needed in this specific project work. Project ideas are presented. We will have a project catalogue with ideas to inspire the groups to find a motivating project and students can contact companies on their own. Learning objectives, level of implementation, guidance form and evaluation form will be monitored.

Unit 2 **Problem Formulation:** **4 Hrs.**
Students work seriously with the problem formulation and specification. The problems shall be related to basic kinematic mechanisms applied to a need. (4-bar, slider crank chain, indexing, Actuators, Cams, Gears, Levers, Ratchets, Springs) Refer Sample List.

Unit 3 **Design the mechanism/ Gadget** **6 Hrs.**
Students will refer various books, use the knowledge they have acquired, use own creativity and design the mechanism. They can use GD&T procedures.

Unit 4 **Fabricate the mechanism/ Gadget:** **8 Hrs.**
Students will have hands on experience to fabricate, monitor, and assemble the mechanism.

Unit 5 **Prepare Report:** **6 Hrs.**
Students will prepare a report on the work they have done

Submission : Complete Report.

Text Books:

1. Text books in Theory of Machines, Strength of Materials.
2. Reference books on design and manufacturing, Design Data Books.
3. Text books on Metrology and Quality Control
4. Report Writing Books referred at First Year B.Tech. level.

Reference Books:

1. Reference books on design and manufacturing engineering
2. CDIO website http://cdio.org
3. Preamble dkte_mech_note
4. Sample List
    1. Quick Return Mechanism For Shaping Machine
    2. Indexing Mechanism
    3. Cam Operated Hammer, Bending Machine
    4. Flying On Flapping Wings By Using Quick Return Mechanism
    5. Design And Fabrication Of Agricultural Cutter Using 4 Bar Mechanism
    6. Box Transfer Mechanism , Through Kinematic Link
    7. Design And Fabrication Of Film Frame By Geneva Mechanism
    8. Automatic paper cutting machine using Geneva mechanism
    9. Design and Fabrication of Hand Water Pump Operated By a Pendulum
    10. Design And Fabrication Of Water Pump Using Scotch Yoke Mechanism
    11. Design And Fabrication Of Gear Type Self-Centering Arm Gripper
    12. Design and Fabrication Of Idler Gears- Mechanical Project
    13. Hand Operated Or Manually Operated Punching Machine
    14. Road Power Generation (RPG) By Sliding Mechanism

Third Year B. Tech. Semester V
MED363: CDIO PROJECT – I (RE)

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Prerequisites - Analysis of Mechanical Elements, FEA, Automobile Engineering, EVs

Course Objective:

1 Educate students to master a deeper working knowledge of the technical fundamentals.
2 Educate engineers to lead in the creation and operation of new products and systems.
3 Educate future researchers to understand the importance & strategic value of their work.

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

1 Demonstrate working knowledge of the technical fundamentals related to design of mechanism
2 Show the creation and operation of new product and system.
3 Demonstrate the working of designed kinematic structure and show the working ability of the product.

Course Content

Unit 1	**CATIA V5 Domain:** Sketcher, Part Modelling, Surfacing, Assembly, Drafting	**4 Hrs.**
Unit 2	**Product Design and Development:** Introduction to Design, Typical Product Life Cycle, Automotive Design Process for Production Release, CAS Surfaces from Digital Clay Models	**4 Hrs.**
Unit 3	**CAE Considerations:** What is Computer Aided Engineering (CAE), Finite Element Analysis (FEA), NVH, Dura, Crash, Occupant Safety, CFD, Difference between implicit and explicit solvers, Pre-post and Solvers and types of solvers	**6 Hrs.**
Unit 4	**Formability:** Simultaneous Engg. Feasibility study, Sheet metal processes, Types of draw dies, Forming simulations, Various Material properties, Forming Limit Curve (FLD)	**6 Hrs.**
Unit 5	**Die Design & Fixture Design:** Sheet Metal parts and their operation, Presses, Various elements used in die design, Process of die design, Functions of the elements required for each die, Correlation of types of joints for Fixture Design, Joining processes and their Applications Overview, Need of Fixtures & Type of Fixtures, Use of product GD&T in the Fixture design	**8 Hrs.**

Submission : Complete Report.

Text Books:

1. Sydney F. Page, "Body Engineering", 3rd ed. Chapman & Hill Ltd., London.
2. J Fairbrother, "Fundamentals of Vehicle Body work", Hutchinson, London.
3. P.M. Heldt, "Automotive Chassis", Chilton Co. NK

Reference Books:

1. Reference books on
    1) John Fenton, "Vehicle Body Layout & Analysis", Hutchinson, London.
    2) J Powloski, "Vehicle Body Engineering", Business Books Ltd., London.
    3) J.G. Giles, "Body Construction and Design", Vol. 6.,llefe Books/
    4) Butterworth & Co. London
    5) Crouse W. H. & Anglin D. L., "Automotive Chassis", McGraw-Hill Int.
    6) Book Co.
    7) P. L. Kohli, "Automotive Chassis & Body", Papyrus Publishing House,
    8) New Delhi.
2. CDIO website http://cdio.org
3. Preamble dkte_mech_note
4. Sample List
    1. Development of sheet metal components/ die Component/ fixture component for simple car parts
    2. Modelling and analysis of simple sheet metal components/ die Component/ fixture component for automotive
    3. 3D Modelling of different automotive components
    4. Modelling and development of prototype of simple exterior automotive components by using 3D printing machine
    5. Different Conceptual 2D sketching of automotive
    6. Design And Fabrication Of Fixture
    7. Design And Fabrication Of Jig
    8. Development of any component by using 3D scanner.

Third Year B. Tech. Semester VI
MEL364: MACHINE DESIGN–II

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites - Strength of Mechanical Elements, Theory of Machine I, Machine Drawing and Machine Design I.

Course Objective:

1 Design machine elements subjected to fluctuating loading.
2 Design various types of gears using strength and wear considerations.
3 To study the concepts of optimization of mechanical systems/ elements.
4 To study design of mechanical system such as pressure vessels

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

1 Memorize basic principles and theories.
2 Design a machine component using different criteria.
3 Use design data books, Manufacturer's catalogue and standard practices.
4 Apply to learn optimize design of various components/systems in mechanical engineering.

Course Content

Unit 1 Design of Spur Gear: **6Hrs.**
Introduction to Gears, Gear terminology, Material selection, Types of gear failure, Applications of gears. Gear tooth loads, No. of teeth, Face width, Strength of gear teeth, Static beam Strength (Lewis equation) Barth equation, Dynamic tooth load (spott's equation and Buckingham equation), Wear strength (Buckingham's equation), Estimation of module based on beam strength and wear strength. Gear design for maximum power transmission capacity.

Unit 2 Design of Helical and Bevel Gear: **9 Hrs.**
Formative number of teeth in helical gears, Force analysis, Beam & wear strength of helical gears, effective load & design of helical gear Straight tooth bevel gear terminology and geometrical relations, Guidelines for selection of dimensions and minimum number of teeth, Force analysis, mounting of bevel gear and bearing reactions, Beam and wear strength, Dynamic tooth load, Design of straight tooth bevel gears based on beam and wear strength.

Unit 3 Design of Worm Gears: **4 Hrs.**
Terminology and geometrical relations. Standard dimensions and recommendation of worm gearing, Force analysis, Friction, Efficiency of worm gear drive, Design of worm drive as per IS 7443-1974 based on beam strength and wear strength rating, Thermal consideration in worm gear drive.

Unit 4 Design for Fluctuating Loads: **6 Hrs.**
Stress concentration - causes and remedies, fluctuating stresses, S-N diagram under fatigue load, Endurance limit, Notch sensitivity, Endurance strength-

	modifying factors, Design for finite and infinite life under reversed stresses, Cumulative damage in fatigue failure, Soderberg and Goodman diagrams, Modified Goodman diagram, Fatigue design for components under combined stresses such as shafts, springs, High cycle and low cycle fatigue.	
Unit 5	**Design of Pressure Vessel:** Thin and thick cylinders, failure criteria of vessels, Lame's equation, Clavarino's and Birnie's equation. Autofrettage and compound cylinders. Types of pressure vessels-Horizontal and Vertical, Classification of pressure vessel as per IS2825:1969. Introduction to design of pressure vessels as per IS Codes. Shell and end closures. Effect of opening & nozzles in shell & covers. Types of pressure vessel support	**7 Hrs.**
Unit 6	**Optimum Design:** Objectives of optimum design-Johnsons Method of Optimum Design (MOD),Adequate and optimum design. Primary, Subsidiary and Limit equations-Optimum design with normal specifications of simple machine elements like tension bar, transmission shaft, helical spring. Introduction to optimum design with Lang range Multiplier.	**7 Hrs.**

Text Books:

1. "Design of Machine Elements", V.B. Bhandari., Tata McGraw Hill Publi., 3rdEdition.
2. "Machine Design", R.K. Jain, Khanna Publication.
3. "Machine Design", Pandya Shah, Charotar Publication

Reference Books:

1. "Machine Design", Hall, Holowenko Laughlin, Tata McGraw Hill Pub Schaums Outline Series.
2. "Design of Machine Element", J.F. Shigley, TATA McGraw Hill Publication.
3. "Design of Machine Element" M.F. Spotts, Pearson Education Publication, 6th Ed.
4. PSG Design data Book.
5. "Mechanical Analysis and Design", H. Burr and Cheatam, Prentice Hall Publication.
6. "Design of Transmission Systems", P. Kannaiah, Scitech Publication.
7. "Machine Design", P. Kannaiah, Scitech Publication, 2nd Edition.
8. "Machine Component Design", Robert C. Juvniall, Willey Ltd, 5th Edition.
9. I.S.:2825 Code for unfired Pressure Vessels.
10. Engineering Optimization Theories and Practice by S.S.Rao, New Age Publication
11. "Machine Design an Integrated Approach", R.L. L Norton, Pearson Edu Pub, 2nd Edi.

Third Year B. Tech. Semester VI
MEL365: PROGRAMMING AND COMPUTATIONAL METHODS

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites– Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics-III and Computer programming.

Course Objective:

1. To introduce numerical methods for solving linear and non-linear equations.
2. To apply the knowledge of these methods to solve practical problems with suitable software.
3. To introduce numerical methods for evaluating definite integrals.
4. To describe best fit curve for equations.
5. The students gain the Knowledge about ordinary differential.

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

1 Define the basic mathematical techniques, errors and approximations.
2 Study the mathematical problem and select appropriate numerical method to solve the problem.
3 Use modern tool such as Scilab, C, C++ and Excel to solve numerical problems.
4 Understand the importance of Numerical methods for lifelong use.

Course Content

Unit 1 **Errors:** Introduction, Types of errors, Rules for estimate errors, Error propagation, Error in the approximation of function **7 Hrs.**
Roots of Equation:
Bracketing Method: Bisection Method, False position method.
Open method: Newton Raphson's, Multiple Roots, Iteration system of non-linear Equations.
C. Roots of polynomial: Muller's Method. Problems based on engineering application.

Unit 2 **Linear Algebraic Equation:** **5 Hrs.**
Gauss Elimination Method- Naïve Gauss Elimination, Pitfalls of Elimination, Techniques of improving solutions, Gauss-Jordan method.
Matrix Invention- LU decomposition, Gauss Seidal, Jacobi Iteration method. Problems based on engineering application.

Unit 3 **Curve fitting:** **8 Hrs.**
Least Square Regression– Linear regression, Polynomial Regression.
Interpolation – Newton's divided difference, Interpolating polynomial, Languages interpolating polynomial, with considering mechanical engineering application.
Statistics: Mean and standard deviation, Addition and multiplication laws probabilities, Binomial, Poisson and normal distribution.

Unit 4	**Numerical Differentiation and Integration:** Newton's cote's Integration of equation: Trapezoidal rule, Simpson's rules, Integration unequal segments. Integration of Equation: Romberg's Integration and Gauss Quadrature. Numerical differentiation, Differentiation formulae, Richardson extrapolation, Derivation of unequally spaced data, Forward difference, Central difference, backward difference, Problems based on engineering application.	**7 Hrs.**
Unit 5	**Ordinary Differential Equation:** Taylor's series method, Picard's Method, Runge-Kutta method, Euler's Method, Improved polygon method, System of equation. Boundary value and Eigen value problem, Shooting Method, Finite Difference Method, Eigen value problem based on polynomial method, Power method. Problems based on engineering application.	**6 Hrs.**
Unit 6	**Partial Differential Equation:** Finite Difference– Elliptical equation, Laplace's equation, Liebmen's Method, Secondary variables, Boundary condition. Finite Difference- Parabolic Equation, Explicit Method- Bender- Schmidt method, implicit method- Crank Nicolson Method. Problems based on engineering application.	**6 Hrs.**

Text Books:

1. Numerical Methods by Dr.B.S. Grewal.
2. Numerical Methods by Dr. Kandasamy.
3. Numerical Methods for Engineers by S.C. Chapra

Reference Books:

1. Higher Engineering Mathematics by Dr.B.S. Grewal, Khanna Publication.
2. Numerical Methods by E Balguruswamy Tata Mcgraw Hill Publication
3. Introductory Method of Numerical Analysis by S.S. Sastry.
4. Numerical Methods by Dr. V.N. Vedamurthy. Vikas Publication.
5. Numerical Mathematics and Computing. Wardcheney, CENGAGE 7th Edition.
6. Principles Analysis and Algorithms by Shrimanta Pal, OXFORD University Press.
7. Spreadsheet Tools for Engineers using Excel, Bryan S. Gottfield, McGraw Hill Pub.

Third Year B. Tech. Semester VI
MEL366: ENGINES AND AIR CONDITIONING

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites–Applied Thermodynamics, Basic Mechanical Engineering, Heat & Mass Transfer.

Course Objective:

1. To Study constructional details and various types of internal combustion engines.
2. To Impart knowledge about various engine performance characteristics and its testing
3. To Understand the latest developments in I.C. Engine.
4. Study basic refrigeration cycles and Psychrometry.
5. Performance Evaluation of Refrigeration and Air Conditioning Systems

Course Outcomes:

1 Understand the engine construction, function of various parts of the engine.
2 Know the need and use the methods of engine testing.
3 Know the impact of vehicular pollution and ways to reduce or control the pollution.
4 Demonstrate an understanding of Psychrometry and its application in HVAC engineering and design and will practice or observe psychrometric measurements.
5 Heating and cooling load estimation.

Course Content

Unit 1 **Introduction to I.C. Engines and fuel systems:** **6 Hrs.**

Introduction, Classification of I. C. Engines, applications, Selection of IC Engine for different applications, Engine specifications Engine Cycles: Engine cycles, Deviation of actual cycles from air standard cycles, Valve timing diagram for high and low speed engine, Port timing diagram.

Complete carburettor, Electronic Petrol injection system (MPFI) – components such as sensors, ECU etc., merits and demerits Fuel Systems for C.I. Engines: Requirements of injection system, Types of injection systems – Individual pump, Common rail and Distributor systems, Unit injector, Types of fuel nozzles- single hole, multi hole, pintle, and pintaux, Formation of Spray, Atomization and penetration. Governing of C.I. engines

Unit 2 **Combustion in S. I. and C. I. Engines:** **6 Hrs.**

Stages of combustion, Ignition lag, Flame propagation, Factors affecting flame speed, Abnormal combustion, Influence of engine design and operating variables on detonation, Fuel rating, Octane number, Fuel additives, HUCR, Requirements of combustion chambers of S.I. Engines and its types.

Stages of combustion, Delay period, Factors affecting delay period, Abnormal combustion- Diesel knock, Influence of engine design and operating variables on diesel knock, Comparison of abnormal combustion in S.I. and C.I. Engines, Cetane number, Additives. Requirements of combustion chambers for C.I. Engines and its types.

Unit 3 **Performance Testing of Engines and Engine emissions:** **8 Hrs.**

Performance parameters, I. S. Standard Code10000 (I to XI) to 10004 for testing of engines), Measurement of performance parameters like torque, power, Volumetric Efficiency, Mechanical Efficiency, BSFC, Brake and Indicated Thermal efficiencies. Numerical on Heat Balance Sheet and engine performance, Performance curves

S.I. engine emission (HC, CO, NOx) Control methods- Evaporative (ELCD),Thermal, Catalytic converters, C.I. Engines Emission (CO, NOx, Smog, Particulate), Control methods- Chemical, EGR, Standard pollution Norms like EURO, Bharat, Alternative fuels for S. I. Engines & C.I. engines, S.I. engine operation using LPG, alcohol and hydrogen fuels. C.I. engine operation using CNG, bio-gas, bio diesels, Introduction to Super charging and Turbo-charging, Latest advancement in I.C. Engines: Lean burn engines, Multi-valving, camless valve gearing, variable valve timing and variable compression engine.

Unit 4 **Vapour Compression Refrigeration system:** **6 Hrs.**

A Refrigerating Machine, Energy Ratios (EER), BEE star rating COP, Power Consumption of a Refrigerating Machine, Refrigeration Cycle, vapour as a Refrigerant in Reversed Carnot Cycle Limitations of Carnot Cycle with Gas as a Refrigerant, Reversed Brayton or Joule or Bell Coleman Cycle, Introduction to aero-plane air conditioning cycles (Only Theory).

Actual Vapour Compression Cycle, Multistage, Multi evaporator and cascade system, System Practices for Multistage Systems (Simple analytical treatment), Introduction to cryogenic Engineering and applications, Claude Cycle, Linde Cycle.

Refrigerant Classification, Desirable Properties like thermodynamic, physical, and chemical, Comparison among commonly used refrigerants, Selection of Refrigerants, Alternative Refrigerants. ASHRAE nomenclature. Insulation, types and different applications, properties of ideal insulations. Compressor, Condenser, Evaporator, Expansion devices, Types, selection Applications of Refrigeration, Ice plant, Cold storage, Dairy plant.

Unit 5 **Psychrometry, Human comfort and air conditioning:** **6 Hrs.**

Moist air as a working substance, Psychrometric properties of air, Use of Psychrometric tables and charts, Processes, Combinations and Calculations, ADP, Coil Condition lime, Sensible heat factor, Bypass factor, Air washer andit's applications. Thermal exchange between human body and environment, factors affecting comfort, effective temperature comfort chart, ventilation requirements.

Unit 6 **Heating and cooling loading calculations and distribution of air:** **6 Hrs.**

Design of air conditioning systems, different Heat sources, sensible heat factor, RSHF, GSHF, ERSHF, Room apparatus dew point and coil apparatus dew point, Cooling Load estimation, Room/Split and Packaged Air Conditioners, Central air-conditioning systems.

Re-circulated air, Ventilation air, Duct work, duct system, principle of duct sizing and air distribution, diffusers, dampers, layout, duct systems for theatres, auditorium, hospitals, assembly shop etc., Energy Conservation and Green Buildings, Pharmaceutical and hospital air conditioning, textile, car air conditioning.

Text Books:

1. "Internal Combustion Engines", Mathur and Sharma, Dhanpat Rai Publication, Delhi.

2. "Internal Combustion Engines", V. Ganesan, Tata McGraw Hill Publication.
3. "Refrigeration and Air Conditioning", Arora Domkundwar, Pearson Education, 3rd Edition.
4. "Refrigeration and Air Conditioning", R.S. Khurmi / J.K. Gupta, S. Chand Publishers

Reference Books:

1. "Internal Combustion Engines", Maleev, CBS Publication and Distributors.
2. "Internal Combustion Engines", J. B. Heywood, Tata McGraw Hill Publication.
3. "Principles of Refrigeration" Roy J. Dossat Pearson Education, 4th Edition
4. "Refrigeration and Air Conditioning", C. P. Arora, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1981, 2nd Edition.
5. "Basic Refrigeration and Air Conditioning" P. N. Ananthanarayan, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, (1981)

Third Year B. Tech. Semester VI
MELOE: OPEN ELECTIVE

Teaching Scheme	
Lectures	3 Hrs. /Week
Total Credits	3

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

NOTE:

1. This course is an interdisciplinary and choice based course which will be decided from other departments who are offering that course.
2. Students have to choose 'Open Elective' course which will be offered from other department.
3. Title of the course will be conveyed to the students before start of semester.

Third Year B. Tech. Semester VI

MEL367: PSYCHOLOGY OF STRESS, HEALTH AND WELL-BEING

Teaching Scheme	
Lectures	2 Hrs. /Week
Total Credits	2

Evaluation Scheme	
SE-I	25
SE-II	25
SEE	50
Total	**100**

Prerequisites– Communication Skill.

Course Objective:

1. To understand and enhance positive mental health and wellbeing particularly in the field of psychology.
2. To address the issues of health, adjustment and well-being
3. To understand the both negative and positive side of human behavior.
4. To provide insights from the field of psychology to make life more satisfying and meaningful.

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

1 Understand and enhance positive mental health and wellbeing particularly in the field of psychology.
2 Address the issues of health, adjustment and well-being.
3 Understand the both negative and positive side of human behavior.
4 Provide insights from the field of psychology to make life more satisfying and meaningful.

Course Content

Unit 1	**Stress, health and well-being:** Overview; Nature and physiology of stress, trauma and health: Mind-body connections; Stress and non-infectious diseases; Stress and infectious diseases; Stress and psychological disorder Week 3: Positive aspects of stress and trauma: Stress, trauma and posttraumatic growth; Factors influencing stress tolerance	**4 Hrs.**
Unit 2	**Coping processes and strategies:** Types of coping strategies; Coping strategies of limited value; Unconscious mind and defensive coping; Characteristics of constructive coping; physical ways of coping Mind-body strategies; Mental ways of coping; Coping with social support and meaning in life; Mindfulness and acceptance	**5 Hrs.**
Unit 3	**Beyond stress and recovery:** Positive mental health and well-being; Psychology of happiness: What is happiness? What makes us happy? Socio-economic factors and happiness; Positive emotions	**4 Hrs.**
Unit 4	**Can we become happier? :** Genetic set-point and hedonic adaptation; Sustainable happiness model and intentional activities	**5 Hrs.**
Unit 5	**Happiness Activities:** Expressing gratitude and positive thinking; Love and kindness; Avoiding over thinking and social comparison Identifying signature strengths; Achieving happiness with "Flow".	**5 Hrs.**
Unit 6	**Is happiness sufficient?**: The concept of eudaimonic well-being; Self-determination and motivation Meaning and purpose in life: The concept of meaning in life and logo-therapy; Life goals.	**4 Hrs.**

Text Books:

1. Psychology Of Stress, Health And Well-Being- Prof. Dilwar hussain ,Department of Humanities and Social Sciences IIT Guwahati

Third Year B. Tech. Semester VI
MEP368: MACHINE DESIGN-II LAB

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	2

Evaluation Scheme	
CIE	50
SEE	50
Total	**100**

List of Experiments:

1 Spur gear/ Helical gear/ Bevel gear/ Worm and Worm Wheel design.
2 Pressure Vessel Design
3 Problems based on Design for Fluctuating Loads.
4 Problems based on Optimum design.

Note:
1. A detail report of design procedure calculation and sketches should be submitted along with drawing sheet containing details and assembly.
2. At least one project (detail and assembly) will be complete by using any relevant 3Dsoftware and one by manually out of Experiment No. 1 and 2.
3. All the assignments should be solved by using standard design procedure using design data.

Submission: A completed journal of above experiments.

Reference Books:
1. "Machine Design", Hall, Holowenko Laughlin, Tata McGraw Hill Pub Schaums Outline Series.
2. "Design of Machine Element", J.F. Shigley, TATA McGraw Hill Publication.
3. "Design of Machine Element" M.F. Spotts, Pearson Education Publication, 6th Ed.
4. PSG Design data Book.
5. "Mechanical Analysis and Design", H. Burr and Cheatam, Prentice Hall Publication.
6. "Design of Transmission Systems", P. Kannaiah, Scitech Publication.
7. "Machine Design", P. Kannaiah, Scitech Publication, 2nd Edition.
8. "Machine Component Design", Robert C. Juvniall, Willey Ltd, 5th Edition.
9. I.S.:2825 Code for unfired Pressure Vessels.
10. Engineering Optimization Theories and Practice by S.S. Rao, New Age Publication
11. "Machine Design an Integrated Approach", R.L. L Norton, Pearson Edu. Pub, 2nd Edi.

Third Year B. Tech. Semester VI
MEP369: PROGRAMMING AND COMPUTATIONAL METHODS LAB

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

List of Experiments:

1 Program on Bisection method

2 Program on Muller's method

3 Program on Newton-Raphson method

4 Program on Gauss Elimination method

5 Program on Seidel method

6 Program on Linear Regression method

7 Program on Simpsons method

8 Program on RK method

9 Program On Picard's method

10 Program on Laplace method

Minimum eight experiments (but not limited to above list) to be conducted from above list.

Submission:

Completed journal with programs (C, C++, Scilab and Excel).

Third Year B. Tech. Semester VI
MEP370: ENGINES AND AIR CONDITIONING LAB

Teaching Scheme			**Evaluation Scheme**	
Practical	2 Hrs. /Week		CIE	50
Total Credits	2		SEE	50
			Total	**100**

List of Experiments:

1 Constructional details of I.C. engines, dismantling and assembly.
2 Study of Engine specifications
3 Test on four stroke Diesel Engine.
4 Test on computer controlled I.C. Engine
5 Visit to an engine manufacturing company / repairing unit
6 Study and demonstration of refrigeration systems (water cooler, refrigerators, Chiller, iceplant and cold storage)
7 Trial on Refrigeration Test Rig
8 Trial on air conditioning Test Rig
9 Visit to central air conditioning or cold storage or dairy plant to ice plant related with refrigeration and air conditioning system
10 Market survey of various refrigeration and air conditioning systems which include the equipments with related specifications, manufacturers, cost and comparison

Submission:

A completed journal of above experiments.

Third Year B. Tech. Semester VI
MEP371: INDUSTRIAL FLUID POWER LAB

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Course Objectives:

1 Introduction to basic concept of fluid power
2 Understanding the behavior of fluid power systems.
3 Make students aware about construction, working principle of hydraulic and pneumatic components

Course Outcomes:

1 Identify and sketch ISO symbols of fluid power elements and fluid power circuits.
2 Design the fluid power circuits for industrial applications.
3 Know different fluid power elements and fluidic systems.

List of Experiments :

1 Study of ISO/JIC symbols for hydraulics and pneumatics systems.
2 Applications of fluid power in different sectors.
3 Study of different types of valves used in hydraulics and pneumatics system.
4 Study of hydraulic and pneumatic actuators.
5 At least five circuit preparations on hydraulic trainer kit.
6 At least five circuit preparations on pneumatic trainer kit.
7 At least two Circuit preparations using Fluid simulation software.
8 Study of any one stationary hydraulic/pneumatics system, like in any machine tool and its detailed report.
9 Industrial visits based on hydraulics and pneumatics system and their report.

Submission:

A completed journal.

Third Year B. Tech. Semester VI
MEP372: CNC LAB

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Course Objectives:

1 Application of computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines
2 Use of G and M codes in manual as well as computer part programming.
3 Apply Simulation techniques for part programming
4 Emphasize on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively.

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

1 Recognize the modern techniques for integrating CAD/CAM.
2 Recognize the importance of CAM in today's scenario &its impact on global competition.
3 Understand basics of CNC Programming.
4 Students are able to develop CNC programming and work on CNC machine.

Course Contents:

1 Introduction to CNC: Numerical control, components of CNC machine, coordinate systems, types of motions, classification of CNC machines.
2 Elements of CNC: Basic functions of CNC machining, drives, power drives, spindle drives, Electrical drives.
3 Part programming: Introduction to CNC Machining, basics of CNC programming, Introduction to G codes and M codes, CNC part programming using CAM packages, Simulation of turning, drilling and milling operations. Typical simulations to be carried using simulation packages like MasterCAM or any equivalent software.
4 Steps in part programming for Milling and Turning: Type of Dimensioning System, Machining sequence classification of process, tool start up point, cutting depth etc.
5 CNC machining – turning centers: Types of CNC turning and milling centers, Discussions on CNC maintenance.

List of Experiments :

1 Components of CNC. Study of "G" Codes and "M" Codes
2 Manual Part Programming of CNC Turning operations
3 Manual Part Programming of CNC Milling operations
4 Manual Part Programming of CNC Drilling operations
5 Part programming and simulation of CNC Turning operations.
6 Part programming and simulation of CNC Milling operations.
7 Part programming and simulation of CNC Drilling operations.
8 CNC-Simple Turning (Practical on CNC)
9 Assignment on CNC machining – turning centers
10 Industrial Visit

Reference Books:

1 "Numerical Control of Machine Tools" by S.J. Martin
2 "Computer Numerical Control" by Joseph Pusztai and Michael Sava
3 "Programming for Numerical Control" by Roberts Prentice
4 "Computer control of Manufacturing Systems" by Yoram Koren
5 CAD/CAM/CIM: Radhakrishnan
6 Computer Integrated Manufacturing: James Rehg
7 CAD/CAM/CAE Chougule N.K.

Third Year B. Tech. Semester VI
MEP373: SOFTWARE TRAINING
"Phython Programming"

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Prerequisites: Basic understanding of 'C' programming.

Course Objectives:

1. To learn and understand Python programming basics and relevant concepts.
2. To acquire programming skills in Python language.
3. To practice various computing strategies for Python-based solutions to real world problems.

Course Outcomes:

At the end of the course student will be able to –
1. Understand the basic concepts related to python programming language.
2. Design and implement python programs using various programming commands.
3. Familiarize with types and applications python libraries.

Course Contents:

1. Introduction to Python: What is Python, Why Python, Uses of Python Programming Language / Python Applications, Features of Python Programming Language, Installing Python, Modes of programming in python.
2. Python data types: Variables in python, numbers, strings, lists, tuples, dictionary, and data type conversion.
3. Conditional structures: Introduction, If – else statements, while loop, for loop, break and continue, simple python functions.
4. File handling: Introduction to working files, Opening, creating and writing files, renaming and deleting files.
5. Python libraries: Introduction to python libraries like Open CV, Tensor Flow, Matplotlib, Numpy, Pandas, Scikit-learn, Keras, etc. and their applications.

List of Experiments :

1 Introduction to python programming
2 Python programming using variables, numbers and strings
3 Python programming using lists and tuples
4 Python programming using conditionals structures
5 Python programming using functions
6 Simple python programming using any one of the python library
7 Applications of python programming in engineering domains

Text Book :

1. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor &Francis, 2018. ISBN-13: 978-0815394372.
2. R. Nageswara Rao, —Core Python Programming, Dreamtech
3. Python Programming - Using Problem Solving Approach, Reema Thareja, Oxford University Press (ISBN-0-19-948017-6)

Reference Books / Web links:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, O'Reilly Media, Inc., 2016.
2. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
3. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
4. Introduction to Python, Kenneth A. Lambert, Cengage
5. Learning Python, Mark Lutz, Orielly
6. https://www.w3schools.com/python/
7. https://www.tutorialspoint.com/python/index.htm
8. Dictionaries: https://www.youtube.com/watch?v=daefaLgNkw0
9. Tuples and Sets: https://www.youtube.com/watch?v=W8KRzm-HUcc

Third Year B. Tech. Semester VI
MED374: PROJECT (WINTER INDUSTRIAL TRAINING)

Teaching Scheme	
Practical	1 Hr. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Course Objectives

1. To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.
2. To have hands-on experience in the students' related field so that they can relate and reinforce what has been taught at the university.
3. To promote cooperation and to develop synergetic collaboration between industry and the university in promoting a knowledgeable society.
4. Introduce their professional and ethical responsibilities

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

1. Comprehend the knowledge gained in the course work
2. An ability to work in actual working environment.
3. Expose the students to future employers
4. Write technical documents and give oral presentations related to the work completed.

Course Contents

1 Industrial Training

The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with Mechanical engineering during the semester break after Fifth semester and complete within 15 calendar days before the start of sixth semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.

It is expected that students should undertake small assignment or work related to any of the course related aspect. Report is based on compilation of work carried out related to facility and layout planning, Industrial engineering- time study and motion study, Line efficiency evaluation and improvement, process capability evaluation, Industrial automation, process or machinery modification as identified

2 Industrial Training Report Format:

Maximum fifteen students in one batch, involving three groups of maximum five students, shall work under one teacher. The same group shall work for project under the same guide. However, each student should have different industrial training and its presentation.

The report should be of 20 to 30 pages. For standardization of the report the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches

5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Pt. font
7. Line Spacing: 1.5 lines
8. Page Numbers: Right aligned at footer. Font 12 Pt. Times New Roman
9. Headings: New Times Roman, 14 Pt., Bold face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not individual student. Certificate should have signatures of Guide, Head of Department and Principal.

The entire report should be documented as one chapter with details like
1. "Name of Industry with address along with completed training certificate"
2. Area in which Industrial training is completed

3 Term Work Evaluation

Department will constitute an Evaluation Committee to review the industrial training work. The evaluation committee consists of faculty members of departments. The completion of industrial training, the submission of the report and assessment should be done at the end of Part-II (Sixth semester).

Third Year B. Tech. Semester VI
MEP375: PSYCHOLOGY OF STRESS, HEALTH AND WELL-BEING

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Prerequisites: Communication Skill.

Course Objective:
1. To understand and enhance positive mental health and wellbeing particularly in the field of psychology.
2. To address the issues of health, adjustment and well-being
3. To understand the both negative and positive side of human behavior.
4. To provide insights from the field of psychology to make life more satisfying and meaningful.

Course Outcomes: At the end of the course students will be able to –
1 Understand and enhance positive mental health and wellbeing particularly in the field of psychology.
2 Address the issues of health, adjustment and well-being
3 Understand the both negative and positive side of human behavior.
4 Provide insights from the field of psychology to make life more satisfying and meaningful.

List of Experiments:

1. Case study on "Stress, health and well-being"
2. Case study on "Coping processes and strategies"
3. Case study on "Beyond stress and recovery"
4. Case study on "Can we become happier"
5. Case study on "Happiness Activities"
6. Case study on "Is happiness sufficient"

Submission :

A completed Journal of above experiments.

Third Year B. Tech. Semester V
MED376: CDIO PROJECT – II (REGULAR)

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Prerequisites - Theory Thermodynamics, Fluid Mechanics/Machines, simulation of dynamic systems, electronics and hydraulic systems.

Course Objective:

1 Educate students to master a deeper working knowledge of the technical fundamentals.
2 Educate engineers to lead in the creation and operation of new products and systems.
3 Educate future researchers to understand the importance & strategic value of their work.

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

1 Demonstrate working knowledge of the technical fundamentals related to design of mechanism
2 Show the creation and operation of new product and system.
3 Demonstrate the working of designed thermal/pneumatic/hydraulic system and show the working ability of the product.

Course Content

Unit 1 **Forming Groups and Selection of Project:** **4 Hrs.**
There will be a short start-up meeting where: Groups are formed by students of 4 to 5 people. The groups are formed based on the students' own preferences, although we encourage them to form groups based on which skills are needed in this specific project work. Project ideas are presented. We will have a project catalogue with ideas to inspire the groups to find a motivating project and students can contact companies on their own. Learning objectives, level of implementation, guidance form and evaluation form will be monitored

Unit 2 **Problem Formulation:** **4 Hrs.**
Students work seriously with the problem formulation and specification. Refer Sample List.

Unit 3 **Design the system/ Gadget:** **6 Hrs.**
Students will refer various books, use the knowledge they have acquired related to (not limited to) thermal/pneumatic/hydraulic system.

Unit 4 **Fabricate the system / Gadget:** **8 Hrs.**
Students will have hands on experience to fabricate, monitor, and assemble a simple thermal/pneumatic/hydraulic system, demonstrate working principles on the models, fabricate a model of a large system based on schematic system. Refer sample list.

Unit 5 **Prepare Report:** **6 Hrs.**
Students will prepare a report on the work they have done.

Submission: Complete Report.

Text Books:

1. Text books in Theory of Machines, Strength of Materials.
2. Reference books on design and manufacturing, Design Data Books.
3. Text books on Metrology and Quality Control
4. Report Writing Books referred at First Year B.Tech. level.

Reference Books:

1. Reference books on design and manufacturing engineering, control engineering, hydraulics/pneumatics/
2. CDIO website http://cdio.org
3. http://dx.doi.org/10.1088/1742-6596/891/1/012367 refer similar papers
4. Preamble dkte_mech_note
5. https://www.mechanical-farm.com/101-thermal-project-ideas/ refer similar project ideas.
6. Sample List –
    1. A Project On Refrigeration Using Waste Heats In Car
    2. Elimination Of Carbon Particles From Exhaust Gas
    3. A Project On Fabrication Of Solar Sterling Engine
    4. A Project On Fabrication Of Miniature Boiler
    5. Multi-Purpose Ground Dryer (Or) Multi-Purpose Dryer And Room Heater
    6. A Project On Fabrication Of Hot And Cold-Water Dispenser
    7. A Project On Fabrication Of Double Reflection Solar Cooker
    8. Fabrication Of Solar Water Dissolution By Using Photovoltaic Method
    9. A Project On Fabrication Of Thermo-Electric Refrigerator Pneumatic Clamping
    10. Fabrication of Pneumatic automatic Vegetable Cutting Machine
    11. Fabrication of Hydraulic Pressure Testing Pump
    12. D & F of Pneumatic Bearing Puller
    13. D & F of Pneumatic Bearing Press System
    14. Electro-Hydraulic System for Automation
    15. D & F of Pneumatic reciprocating Hack saw Machine
    16. Fabrication of Automatic Electro hydraulic Jack
    17. Compressed Air And Air Drill Operated Bicycle

Third Year B. Tech. Semester VI
MED377: CDIO PROJECT – II (RE)

Teaching Scheme	
Practical	2 Hrs. /Week
Total Credits	1

Evaluation Scheme	
CIE	50
Total	**50**

Prerequisites - FEA, Automobile Engineering, EVs, AutoCAD

Course Objective:

1 Educate students to master a deeper working knowledge of the technical fundamentals.
2 Educate engineers to lead in the creation and operation of new products and systems.
3 Educate future researchers to understand the importance & strategic value of their work.

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

1 Demonstrate working knowledge of the technical fundamentals related to design of mechanism
2 Show the creation and operation of new product and system.
3 Demonstrate the working of designed kinematic structure and show the working ability of the product.

Course Content

Unit 1 **Introduction of Body-In-White& Part Design:** **4 Hrs.**
Requirement Specification in the Pre-Program Stage, Product life cycle and important gateways for BIW, Identification of commodities for BIW, Design concepts and considerations in BIW, BIW Materials and Grades (Steel, Aluminum, Composites), GD&T Functions, Symbols. 3-2-1 Principle, Sheet Metal Joining - Welds, Adhesives, TWBs.

Unit 2 **DFMEA Analysis for BIW&CAE Analysis for BIW:** **4 Hrs.**
Design Failure Modes and Effect Analysis, DFMEA Objectives, DFMEA Process, DFMEA Benefits, Finite Element Analysis, NVH Analysis, Crash Worthiness and, Durability Analysis, Four post method.

Unit 3 **Design Verification & Testing & Manufacturing and Future Trends of BIW:** **6 Hrs.**
CAE Methods and Gateway Supports for BIW: - Understanding design verification, Test Methods & applications, CAE role in different phases of product development, Structural analysis & Fatigue life, Crash Analysis, Heat & CFD analysis , Test Validation & Assessment, Manufacturing - Sequence, Welding & Assembly, Future Trends in BIW, Examples and Case Studies.

Unit 4 **Introduction to Plastics & Trims, Design Requirements & Trim Materials:** **6 Hrs.**
Requirement Specification in the Pre-Program Stage, PLC and important gateways for Trims, Identification of commodities for Trims, Vehicle Regulations, Automotive Safety, Design for Environment, Material Classifications, Selection criteria, Plastic Additives.

Unit 5 **Design of Plastics, CAE Analysis, Manufacturing & Testing:** **8 Hrs.**
Plastics Part Overview, Plastics Part Design, Principles behind Engg. Plastics, DFMEA Objectives, Process & Benefits, Mold-flow of plastic parts, Crash & Durability, Manufacturing Process, Test Validation & Assessment, Assembly Sequence, Future Trends & Case Studies: - Future Materials, Recycling, Light Weight Materials, Case Studies

Submission: Complete Report.

Text Books:

1. John Fenton, "Handbook of Automotive Body Construction and Design Analysis", Professional Engineering Publishing.

Reference Books:

1. Reference books
    1. "Automotive Chassis & Body", by P.L. Kohli, Papyrus Publishing House, New Delhi.
    2. "Automotive Chassis", by Crouse W.H.& Anglin D.L, McGraw-Hill Int. Book Co.
    3. "Body Engineering", by Sydney F. Page, Chapman & Hill Ltd., London.
    4. "Fundamentals of Vehicle Body work", by J. Fairbrother, Hutchinson, London.
    5. "Automotive Chassis", by P.M. Heldt, Chilton Co. NK
    6. "Vehicle Body Layout & Analysis", by John Fenton, Hutchinson, London.
    7. "Vehicle Body Engineering", by J. Powloski, Business Books Ltd., London.
2. CDIO website http://cdio.org
3. Preamble dkte_mech_note
4. Sample List
    1. Clay modeling for sample car design.
    2. Modeling and analysis of simple automotive components.
    3. Modeling and development of prototype of simple interior automotive components by using 3D printing machine.
    4. Different Conceptual 2D sketching of automotive.
    5. Identify and collection of different Plastic parts.
    6. Identify and Collection of different fasteners.
    7. Write a report on DFMEA.
    8. Development of any component by using 3D scanner.
    9. Different joining processes like TIG_MIG welding, arc welding, riveting types and fastening.
    10. Joining of sheet metals by using different rivets.