SGGS INSTITUTE OF ENGINEERING AND TECHNOLOGY NANDED

Department of Mechanical Engineering

T.Y. B. Tech. (Mechanical) Curriculum Structure

Academic year 2020-21 onwards

Semester III (Second Year)

Programme Educational Objectives (PEOs)

PEO 1 Provide knowledge and skills of broad spectrum in domain of Mechanical Engineering.

PEO 2 Cater the needs of Indian as well as multinational industries and other organizations.

PEO 3 Be competent with a strong technological background, to formulate, analyse the societal, industrial and environmental challenges to obtain the economically viable solutions.

PEO 4 Foundation for higher studies, research, entrepreneurship and administrative services.

PEO 5 Inculcate the attitude of self and lifelong learning, out of box thinking, ethics and integrity, professional and managerial competencies to work on the multidisciplinary projects.

Programme Outcomes (POs):

Engineering Graduates will be able to:

a. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified

needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **Project management and finance:** 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.

l. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

B.Tech Mechanical Engineering

PSO 1 Apply Principal of engineering, basic sciences and mathematics to model, analyse, design mechanical systems and processes.

PSO 2 Plan, operate, control, maintain & improve mechanical systems, components & processes.

Correlation Matrix (Correlation between the PEOs and the POs)

PO/PSO ➡ PEO⬇	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO 2
PEO 1	√				√					√		√	√	√
PEO 2	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO 3	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO 4	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO 5	√						√	√		√	√	√	√	√

Note: The cells filled in with ✓ indicate the fulfillment/correlation of the concerned PEO with the PO.

SGGS INSTITUTE OF ENGINEERING & TECHNOLOGY, NANDED

(An Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

T.Y. B. Tech. (Mechanical) Curriculum Structure

Academic year 2020-21 onwards

Semester V (Third Year)

Course Code	Course Title	Hours/Week			Total contact Hours	Credits	
		(L)	(T)	(P)		Th.	Pr.
PCC-ME301	Heat Transfer	03	0	02	05	03	01
PCC-ME302	Dynamics of Machines	03	0	02	05	03	01
PCC-ME303	Design of Machine Elements	03	0	02	05	03	01
PCC-ME304	Manufacturing Processes-II	03	0	02	05	03	01
PEC-ME3**	Elective-I	03	0	00	03	03	00
	Total	**15**	**0**	**08**	**23**	**15**	**04**
		Total Credits				**19**	

Semester VI (Third Year)

Course Code	Course Title	Hours/Week			Total contact Hours	Credits	
		(L)	(T)	(P)		Th.	Pr.
PCC- ME308	Machine Design	03	0	02	05	03	01
PCC-ME309	Refrigeration & Air Conditioning	03	0	02	05	03	01
PEC-ME3**	Elective-II	03	0	02	05	03	01
PEC-ME3**	Elective-III	03	0	02	05	03	01
PCC-ME310	Automation in Manufacturing	03	0	02	05	03	01
	Total	**15**	**00**	**10**	**25**	**15**	**05**
		Total Credits				**20**	
L-No of Lecture Hours/week, T- No. of Tutorials Hours/ week, P- Practical Hours/week							

List of courses in Electives

Elective - I		**Elective - II**		**Elective - III**	
PEC-ME305	Power Plant Engineering	PEC-ME311	Internal Combustion Engines	PEC-ME314	Automobile Engineering
PEC-ME306	Product Design Engineering	PEC-ME312	Costing & Estimation	PEC-ME315	Pressure Vessel Design
PEC-ME307	Advanced Welding Techniques	PEC-ME313	Advance Manufacturing Technology	PEC-ME316	Productivity Improvement Techniques.

PCC-ME301 HEAT TRANSFER

(CREDITS THEORY: 03, PRACTICAL:01)

Course code: PCC-ME301 (L-03,T-0, P-02)

Course Objective:

1. To demonstrate the fundamentals of heat transfer along with material and medium properties.
2. To inculcate steady state behavior of heat transfer by different modes of heat transfer.
3. To develop an ability to understand mathematical representation of different modes of heat transfer methods.
4. To apply the knowledge of conduction, convection and radiation to analyze the heat transfer through extended surfaces, black bodies and heat exchangers.

Course Outcomes:

CO1 Student will be able to analyze heat conduction with and without internal heat generation, critical thickness of insulation and extended surfaces with the practical utilities.

CO2 Student demonstrates the concept and mechanism of convection, conduction and radiation.

CO3 Student exhibits application of mathematical approach to analyze and solve the numerical on complex heat transfer phenomena's.

CO4 Student can explain the design, performance analysis and practical applications of heat exchangers.

Articulation Matrix

PO/PSO➡ ⬇CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO1	2	3	2										2	
CO2	2	2	2	2			2						2	3
CO3	2	3	2	3			2						3	3
CO4	3	3	2	3									3	

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	**Practical**
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Introduction: Steady and unsteady heat transfer, Different modes & laws of heat transfer, Thermal conductance, Thermal resistance, Thermal conductivity, Electrical analogy, Thermal diffusivity

(06hrs)

Unit-II

Conduction: General three dimensional heat conduction equation in Cartesian coordinates, General three dimensional heat conduction equation in cylindrical & spherical coordinates (no derivation), Steady state one dimensional heat conduction without heat generation & temperature distribution in the: plane wall, composite wall, sphere and composite cylinder, Thermal contact resistance , Critical radius of insulation and its importance, Introduction to unsteady state heat conduction system with negligible internal resistance.**(08hrs)**

Extended surfaces: Types and Applications of fins, Heat transfer from a fin of uniform cross section area, Different end conditions to solve fin problems, Efficiency & Effectiveness of fins, errors in the measurement of temperature in a thermo-well.**(04hrs)**

Unit-III

Convection: Hydrodynamic & thermal boundary layer, Local & average heat transfer coefficient, Effect of various parameters on heat transfer coefficient, Free & force convection, physical significance of the dimensionless numbers related to free & forced convection, Empirical relations for free convection heat transfer over horizontal, vertical plate & cylinder.**(10 hrs)**

Unit-IV

Radiation: Fundamental concepts, Basic laws of radiation: Planks law, Kirchoffs law, Stefan Blotzman Law, Weins displacement law and Lambert's cosine law, Emissivity, Radiosity, Radiation heat exchange between two black bodies, Shape factor for simple geometries, Radiation heat exchange between two infinitely parallel plates & cylinders, Radiation shields, Heat transfer with radiation shields. **(10 hrs)**

Unit-V

Heat Exchangers: Heat exchangers classification, Overall Heat transfer coefficient, heat exchanger analysis- use of log mean temperature difference (LMTD) for parallel & counter flow heat exchangers, Special case of condensers & evaporators and heat exchangers where heat capacities of fluids are same, The effectiveness-NTU method for parallel and counter flow heat exchangers. Heat Exchangers design of heat transfer equipments, Heat Transfer analysis, Pressure drop analysis for heat exchangers. **(08 hrs)**

List of Experiments:

Any eight experiments and assignments on the above topics.

1. Determination of thermal conductivity of metal rod.
2. Determination of thermal conductivity of insulating powder.
3. Determination of thermal conductivity of composite wall.
4. Determination of heat transfer coefficient in natural convection.
5. Determination of heat transfer coefficient in forced convection.
6. Determination of emissivity of a test surface.

7. Study of performance of parallel & counter flow heat exchanger.
8. Determination of critical thickness of insulation.
9. Heat transfer from pin fin apparatus**.**

Practical Examination:

It shall consist of oral/practical examination based on above syllabus.

Text Books:

1. Yunus A. Cengel, "Heat & Mass Transfer: A practical Approach" TATA McGraw Hill Education 2007.

Reference Books:

1. J. P. Holman, "Heat transfer" McGraw Hill Book Company 1989, New York.
2. Dr. S. P. Sukhatme, "A Text book on Heat Transfer" Universities Press 2005.
3. Dr. D. S. Kumar, "Heat and Mass Transfer", S.K.Kataria & Sons publishers 2013
4. R.C. Sachdeva, "Fundamentals of Engineering Heat and Mass Transfer" New Age International 2012.
5. R. Yadav, "Heat and Mass Transfer" Central Publishing House 1992

PCC-ME302 DYNAMICS OF MACHINES

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PCC-ME302 (L-03,T-0, P-02)

Course Objective:

1. To demonstrate the principles of gear trains.
2. To expand student's background in kinematic synthesis and analysis.
3. To introduce the students to static & dynamic forces exerting on basic machine parts and their effects on it.
4. To demonstrate need of balancing and methods used to balance the working parts in kinetics.
5. To inculcate the principles of vibrations, its types and control measures.

Course Outcomes:

CO1 Ability to analyze the gear trains used in various machines.

CO2 Student demonstrates and analyzes different mechanisms used in various machines.

CO3 Student exhibit skills towards application of static force analysis and synthesis of mechanisms.

CO4 Student exhibits need, design and applications of balancing machine parts.

CO5 Student exhibits solutions to issues related to vibration, their effect and its control measures.

Articulation Matrix

PO/PSO ➡ / CO ⬇	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO1	3	2	3										2	2
CO2	2	3	3	2									2	3
CO3	2	3	3	1									3	
CO4	3	3	2	3									2	3
CO5	3	3	2										2	

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	**Practical**
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Gear Trains: Introduction, Types of gear trains, Analysis of epicyclic gear train.**(05 hrs)**

Unit-II

Static force analysis: Constraint and applied forces, Static equilibrium, Equilibrium of two and three force members, Equilibrium of four forces and torque, Force convention and free body

diagrams, Principle of virtual work, Static force analysis considering friction.**(10 hrs)**

Unit-III

Dynamic Force Analysis: D-Alembert's Principle, Dynamic analysis of Four link mechanism and slider-crank mechanism, Velocity & acceleration of piston and connecting rod, Engine force analysis, Inertia of connecting rod, Inertia force in reciprocating engines (Graphical method).
(10 hrs)

Unit-IV

Balancing: Static balancing, Dynamic balancing, balancing of several masses in different planes, Force balancing of linkages, balancing of reciprocating mass, balancing of locomotives, Effect of partial balancing in locomotives, balancing of inline engines, Balancing of V engines, Balancing of radial engines, Balancing machines, Field balancing.**(10 hrs)**

Unit-V

Vibration: Definitions, Types of vibration, Basic features of vibrating system, Degree of freedom, Free longitudinal vibration, Displacement, Velocity and Acceleration, Inertia effect of the mass of spring, Damped vibration, Logarithmic decrement, Forced vibration, Forced damped vibration, Dynamic magnifier, Transmissibility, Vibration isolation, Transverse vibration, Whirling of shaft & critical speeds, Free torsional vibration (Single and Two rotor system) **(10 hrs)**

Term Work:

1. Full imperial size sheets/Assignments on Static, Dynamic force analysis and balancing.
2. Assignment on each unit.

List of Experiments: (Any eight)

1. To determine the oscillations of simple pendulum.
2. To determine the radius of gyration of given compound pendulum.
3. To determine the radius of gyration of given bar by using Bi-Filar suspension.
4. To study the longitudinal vibrations of helical spring and to determine the frequency of vibration theoretically and experimentally.
5. To study the un-damped free vibration of equivalent spring mass system.
6. To study the forced vibrations of equivalent spring mass system.
7. To study the torsional vibration (un-damped) of single rotor shaft system.
8. To study the free vibration of two rotor system and to determine the natural frequency of

vibration theoretically and experimentally.

9. To study the damped torsional oscillations and to determine the damping coefficient Ct.
10. To verify the Dunkerley's Rule experimentally.
11. To study the forced lateral vibrations of the beam for different damping.

Practical Examination:

It shall consist of oral/practical examination based on above syllabus.

Text Book:

1. S. S. Rattan, "Theory of Machines," Tata McGraw Hill Publishing Co Ltd., New Delhi 2nd Edition, 2005.

Reference Books:

1. P.L. Ballaney, "Theory of Machines & Mechanism," Khanna Publishers, New Delhi, 21st Edition, 2005.
2. Thomas Bevan, "The Theory of Machines," CBS Publishers and Distributors, New Delhi, 1st Edition, Reprint 2005.
3. J. E. Shigley, J. J. Uicker, "Theory of Machines & Mechanism," McGraw HillPublication– New Delhi, 2nd Edition.

PCC-ME303 DESIGN OF MACHINE ELEMENTS

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PCC-ME303 (L-03,T-0, P-02)

Course Objective:

1. To develop an ability to understand the designing process for mechanical component.
2. To demonstrate different types of loadings to which mechanical component are subjected and apprehend the associated design principles.
3. To comprehend design principles for designing various types of joints involved in assembling machine components.
4. To demonstrate the application of design principles to certain torque transmitting and torque absorbing elements.

Course Outcomes:

CO1 Students understand the need, steps of machine design, and consideration for manufacturing.

CO2 Student will be able to evaluate life of machine components against static loads and fluctuating loads.

CO3 Student demonstrates skill of designing various temporary and permanent joints.

CO4 Students will design the transmission shafts, key and coupling.

Articulation Matrix

PO/PSO➡ ⬇CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO1	3	1	1	1			1							
CO2	2	2	2	3			2							2
CO3	2	2	3	2			1			2			3	
CO4	2	2	3	2			1						3	

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	**Practical**
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: 50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Introduction: Steps of design, Basic requirements of machine element, Design of machine elements, Design consideration for dynamic and static load, Selection of materials, Designation of material as per ISI, Various codes and standards. **(04hrs)**

Design against static load: Static Load, Modes of failure, Failure of ductile materials, Failure of brittle materials, Stress due to bending moment, Stress due to torsional moment, Eccentric axial loading, Design of machine parts subjected to combined direct and bending stress. **(06hrs)**

Unit-II

Design against fluctuating load: Definition, Stress concentration, Fluctuating stress, Fatigue failure, Endurance limit, S-N curve, Low cycle and High cycle fatigue.

Endurance Limit: Approximate estimation, Reversed stresses- Design for finite and infinite life, Cumulative damage in fatigue, Soderberg and Goodman lines, Modified Goodman diagrams, Gerber equation, Fatigue design under combined stresses.**(08hrs)**

Unit-III

Design of shafts, Keys & Couplings: Shaft design on strength basis, Shaft design on torsional rigidity basis.Keys: Definition, Types of keys and their design, Splines and their design. Couplings: Definition, Muff coupling, Rigid flange coupling, Bushed pin flexible coupling, Design for lateral rigidity, Castigliano's theorem, Area moment method, Critical speed of shaft. **(08hrs)**

Unit-IV

Threaded, Riveted and Welded Joints: Introduction, Basic types of screw fastening, Bolt of uniform strength, Eccentrically loaded bolted joints in shear, Bolted joint under fluctuating load, Bolted joints with combined stresses. Riveted Joint: Methods of riveting, Types of rivet heads, Types of riveted joints, Strength of joint, Eccentric loaded riveted joint. Welded Joint: Introduction, Types, Stresses in Butt and fillet joints, Strength of welded joints, Eccentrically loaded joints. **(08hrs)**

Unit-V

Clutches: Type of clutches, Friction materials, Torque transmitting capacity, Single-disc, Multi-disc, Cone and Centrifugal clutches, Energy equation, Thermal considerations.**(05hrs)**

Unit-VI

Brakes and Dynamometer: Introduction, Energy absorbed by brake, Heat to be dissipated during braking, Materials for brake lining, Types of brake, Shoe brake, Band brake, Band and block brake, Internal expanding brake. Dynamometer: Introduction, Types of dynamometers. **(05hrs)**

Term Work: It consist of theory assignments on above topics and following Practical work and Experiment.

Full imperial size sheets or 2D/3D CAD model and it's design for;

1. Keys, and Cotter joint or Knuckle joint.
2. Rigid and Flexible couplings.
3. Friction Clutches
4. Brakes.

Experiment: To determine the fatigue strength of specimen under reversed bending stresses and Draw

S-N Curve.

Practical Examination:

It shall consist of oral/practical examination based on above syllabus.

Text Book:

1. V.B.Bhandari, "Design of Machine Element," Tata McGraw Hill Publications, 4th Edition, 1997

Reference Books:

1. Joseph E. Shigley and Charles R. Mischke, "Mechanical Engineering Design," Tata McGraw Hill Publication, 6th Edition,2005
2. C.S Sharma & Kamlesh Purohit, "Design of Machine Elements," Prentice Hall of India publications, New-Delhi, Eastern Economy 3rd Edition, 2003.
3. Spott's M.F. and Shoup T.E. – "Design of Machine elements," Prentice Hall International.
4. Black P.H. and O. Eugene Adams, "Machine Design," McGraw Hill Book Co. Ltd.

Design Data Book:

1. Design Data Book for Mechanical Engineers, K. Mahadevanan & K. Balaveera Reddy, CBS Publishers & Distributor Delhi, 4th Edition 2008
2. Design Data Book – B. D. Shiwalkar, Central Techno Publication Nagpur, 2nd Edition 2007.

PCC-ME304 –MANUFACTURING PROCESSES-II

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PCC- ME304 (L-03, T-0, P-02)

Course Objective:

1. To impart the fundamentals of metal cutting process.
2. To inculcate the concepts of different machining processes.
3. To motivate the students to get known construction, working and applications of various machine tools.
4. To make familiar with concepts and working of non conventional machining process.

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

CO1. Demonstrate the metal cutting process and select the appropriate cutting tools for it.
CO2. Exhibit the characteristic, terminologies related to cutting tools.
CO3. Calculate the machining time, depth of cut, feed required.
CO4. Demonstrate knowledge related to various machining processes.
CO5. Exhibits the knowledge of various finishing processes.
CO6. Select proper machining processes for the product to be manufacture

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3												3	
CO2	3									2				
CO3	2													
CO4	2	1											2	
CO5	2												2	
CO6	2									2				

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	Practical
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit I

Introduction:

Definition, principles, types, components, machining parameters, drives and power requirements. [02]

Theory of Metal Cutting:

Metal cutting process, Orthogonal cutting and force diagram, Tool geometry of single point cutting tool, tool signature, Merchant's circle, Force measurement by dynamometers, effect of tool angles on machining, Tool materials - properties, selection and applications. Chip-formation, types of chips, built-up-edge, chip breakers. Cutting Tool Materials, Machinability, Factors affecting machinability index, Tool Life, Factors affecting tool life, Taylor's equation, types of tool failures,

tool wears, Tool condition monitoring. [10]

Unit II

Turning: Turning and Boring, Lathe: construction, accessories and operations, concept of speed, feed and depth of cut, Thread cutting: single and multi-start threading. Introduction to Boring Machines, Capstan and Turret lathe. [06]

Unit III

Drilling: Fundamentals of drilling processes, introduction to multi-point cutting tools, drill geometry, tool holder, types of drill, types of drilling machines, operations performed on drilling machines. Reaming processes and reamer types. [06]

Unit IV

Milling, Shaping and Planing: Fundamental aspects, cutter types and geometry, Operations performed on milling machine, dividing head method of indexing. Construction, working and operations performed on shaper, planer, and broaching machines, Introduction to Gear Manufacturing. [06]

Unit V

Finishing and Super Finishing: Grinding wheels, wheel marking, wheel selection, wheel mounting, types of grinding machines. Honing, lapping, super finishing, buffing and burnishing processes. [06]

Unit VI

Non-Conventional Machining: Introduction, Classification. Principle, Working and Applications of Chemical Machining, Electrochemical Machining, Electric Discharge Machining (EDM), Wirecut EDM, Abrasive Jet Machining and types, Laser Beam Machining, Plasma Arc Cutting.[06]

Term Work:

Each candidate shall be required to complete and submit the following term work.

Part A: One composite job consisting of Turning, Facing, Threading, Parting, Drilling and Boring operations.

Part B: One job should be made on any one non-conventional machining process.

Practical Examination: Practical examination consists of practical/ oral examination based on above syllabus.

Text Books:

1. P. N. Rao – "Manufacturing Technology (Metal Cutting and Machining Tools)" 2nd Edition (TMH)

Reference Books:

1. Serope Kalpakjian– "Manufacturing Engineering and Technology" – Prentice Hall, Sixth Edition.
2. HMT Hand book- Production Technology
3. Amitabha Ghosh and Asok Kumar Mallik, Manufacturing Science, 1985, Affiliated East West Press Pvt. Ltd., New Delhi.
4. R. K. Jain, 'Production Technology', Khanna Publications.
5. Chapman, "Workshop technology" Vol. I, II & III; Edward Arnold Publications Ltd. London.

6. Hajara Chaudhary S. K., “Workshop Technology” Vol. I & II, Media Prom & Publication, Mumbai.

PEC-ME305 –POWER PLANT ENGINEERING
(CREDITS THEORY: 03)

Course code: PEC- ME305 (L-03, T-00, P-00)

Course Objective:

1. To introduce the students to different types of power plants.
2. To demonstrate constructional features and working of different power plants.
3. To impart various factors affecting the site selection for a power plant.
4. To introduce students with economic analysis for a power plant and to demonstrate its process.
5. To comprehend pollution caused by power plants and different measures to control them.

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

CO1 Student demonstrates working and constriction of various power plants.
CO2 Student exhibits knowledge of systems of waste disposals from power plant.
CO3 Student exhibits techniques of power generation and storage systems.
CO4 Student will be able to calculate the economy of power plant.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3	1	3										2	2
CO2	3					1	3							2
CO3	3		2		2									2
CO4							2							2

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory
Mid Term : 30 Marks
End Term : 50 Marks
In Semester Evaluation: 20 Marks

Course Content:

Unit-I

Introduction: Energy sources and their availability, types of power plant, review of basic thermodynamic cycles used in power plants, Factor affecting Selection of Site. **(02Hrs)**

Hydroelectric power plant: General arrangement of hydroelectric project and its operation, site selection, Storage and pond age, classification of hydro stations, selection of prime movers, operation of different components of hydro station, reservoirs Dam, spill ways, canals, penstock, water hammering effects, surge tank, draft tube, advantages of hydro station, Hydrograph, flow

duration & mass curves, brief description of some important hydel installations in India. **(08Hrs)**

Unit-II

Thermal power plant: General layout of modern Thermal power plant, Working of Thermal power plant, Site Selection for Thermal power plant, thermodynamic cycles, Coal handling, storage, Preparation & Feeding, combustion and combustion equipment, Ash handling and dust collection, draught systems. **(06Hrs)**

Unit-III

Diesel engine power plant: Layout of Diesel Engine Power Plant, Type of Engines used for Diesel power plants, cooling & lubrication system for the diesel engines, filters, supercharging of Diesel engines, performance of diesel plant, advantages and limitations of diesel plant over thermal plant, Present Trends in Diesel research. **(04Hrs)**

Unit-IV

Gas Turbine Power Plant: Plant layout, method of improving the output and performance, fuel and fuel systems, method of testing open and closed cycle plants, operating characteristics, applications, advantage of combined working of different parts, effect of operating variable on thermal efficiency, regeneration, inter-cooling, reheating, performance of closed and semi closed cycle gas turbine plant. **(06Hrs)**

Unit-V

Nuclear Power Plant: Principle of release of nuclear energy fusion & fission reaction, nuclear fuels used in reactors, multiplication and thermal utilization factors, elements of nuclear reactor, moderators, control rods, fuel rods, coolants, brief description of reactor PWR, BWR, sodium graphite reactor, fast breeder reactor, Homogenous reactor and gas cooled reactors, radiation hazard, shielding, radioactive waste disposal, classification of nuclear power plants, waste disposal. **(06Hrs)**

Unit-VI

Choice of power site for power station: Load estimation, load duration curve, load factor, capacity factor, use factor, diversity factor, and demand factor, effect of variable load on power plant, selection of the number and size of units **(04Hrs)**

Economic analysis of power plant: Cost of energy production, selection of plant and generating equipment, performance and operating characteristics of power plants, Tariffs for electrical energy. **(02Hrs)**

Unit-VII

Air pollution Caused by Power Generation and Its Control: Effect of Air pollution, Green House Effect, Acid Precipitation, Human Health, Basic types of Systems for Air Quality Control, Fuel-Gas Desulfurization (FGD) system. The Wet –Gas Desulfurization system, the dry –Gas Desulfurization system, Single Alkali Scrubbing, NO removal, thermal pollution. Pollution from Nuclear power Plant, Radioactivity release, radioactive waste, high efficiency engines and turbines technology with near zero emission. **(06Hrs)**

Term Work:

It shall consist of at least 8 assignments based on above syllabus.

Text Books:

1. Domkundwar and Arora “Power Plant Engineering”, Dhanpat Rai and Sons, New Delhi.
2. E.I. Wakil, “Power Plant Engineering”, Publications, New Delhi.

Reference Books:

1. P. K. Nag, “Power Plant Engineering”, Tata McGraw Hill, New Delhi.
2. R. K. Rajput,“Power Plant Engineering”, Laxmi Publications, New Delhi.
3. R. Yadav - Steam and Gas turbines, central publishing house, Allahabad.

PEC-ME306 –PRODUCT DESIGN ENGINEERING

(CREDITS THEORY: 03)

Course code: PEC- ME306 (L-03, T-00, P-00)

Course Objective:

1. The course is aimed to appreciate the design and development as the central activity for the product utility view point. The general objectives for the course are.
2. To provide the realistic understanding of the design process.
3. To develop the attitude and approaches towards product development than merely presenting design techniques.
4. To understand modern tools and methods like collaborative practices, internet based design, PLM in context of product development.
5. To demonstrate case studies to learn from the implemented practices for product design and development

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

CO1 Employ engineering principles to execute a design from concept to finished product.
CO2 Select the optimum material and manufacturing process for a given component under a set of given working condition
CO3 Recommend a substitute material and/or a process for making a component in order to improve its performance, cost or other attributes under a given set of service conditions
CO4 Demonstrate design and development of the product, the associated manufacturing equipment and processes, and the repair tools and processes using concurrent engineering.
CO5 Realize concept of PDM and PLM

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3	1	1	1									2	
CO2				2			2							1
CO3		1		2										2
CO4			2	2	2									2
CO5										2	2			2

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory
Mid Term : 30 Marks
End Term : 50 Marks
In Semester Evaluation: 20 Marks

Course Content:

1. Introduction: Engineering design, Process and purpose of design, Types of design, importance of design, morphology of design, design considerations. **(05Hrs)**
2. Product Design Process: Steps in design: need identification & problem definition, Functional requirement analysis, defining a product development team, gathering information, concept generation & evaluation, organization for design, product specification and detailed design. **(05Hrs)**
3. Material And Manufacturing Process Selection In Design: Factors influencing material and process selection, approaches, tools and software used in selection. **(05Hrs)**
4. Development of Design: Concept to product, design for: function, manufacture/production, shipping, handling, installation, use, maintenance etc. **(05Hrs)**
5. Design Cost Evaluation: Need, methods, design to cost and life cycle, economics and financial feasibility, costing and use of software for estimation. **(05Hrs)**
6. Product Development Approaches: Concurrent engineering, partnership with supplier, collaborative and Internet based design. **(05Hrs)**
7. Design Project Management: PDM, PLM and related software tools. **(05Hrs)**
8. Case studies based on Concurrent and collaborative product development approaches. **(05Hrs)**

Text Books:

1. Engineering Design by Dieter George E. McGraw Hill Pub. Company, 2008.

Reference Books:

1. Product design and development by Ulrich Karl T and Eppinger Steven D., McGraw Hill Pub. Company 1995.
2. Product Design and Manufacture by Chitale AK and Gupta RC, Prentice-Hall of India, New Delhi
3. Fundamentals of Design and manufacturing, GK Lal, Vijay Gupta, N Venkata Reddy, Narosa Publications, 2006

PEC-ME307 –ADVANCED WELDING TECHNIQUES
(CREDITS THEORY: 03)

Course code: PEC- ME307 (L-03, T-00, P-00)

Course Objective:

1. To inculcate the need of advanced welding techniques.
2. To describe and demonstrate EBW,LBW,USW,AHW techniques
3. To demonstrate the working principles of underwater welding.
4. To make aware destructive and nondestructive testing methods for testing welded joints.
5. To apply different techniques of testing the welded joints to test simple welded joints.

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

CO1 Student knows the principles of various welding processes and their application and need of advanced welding processes.
CO2 Student demonstrates how different welding power sources work.
CO3 Relate Generation and control of laser beam for welding, its working and applications.
CO4 Understands Principle, working, energy flow, and applications of Ultrasonic welding, atomic hydrogen welding system, and under water welding.
CO5 Student show ability to analyze destructive and non-destructive testing methods for welds.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3													2
CO2					2								2	2
CO3	3													3
CO4	3												2	2
CO5	3	3											2	2

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory
Mid Term : 30 Marks
End Term : 50 Marks
In Semester Evaluation: 20 Marks

Course Content:

Unit-I

Introduction: Classification of welding processes, weld design, applications and need of advanced welding processes. **(08Hrs)**

Unit-II

Electron beam welding: Principle, working, key holing, power source requirements, variables that control EBW, applications. **(08Hrs)**

Unit-III

LASER welding: Principle, parallelism and intensity, focusing, quantum theory, population inversion, types of lasing materials, working and applications. **(08Hrs)**

Unit-IV

Ultrasonic welding: Principle, working, ultrasonic welding and energy flow, and applications. **(08Hrs)**

Unit-V

Atomic hydrogen welding: Atomic hydrogen welding system, Principle, working, atomic hydrogen flame, atomic hydrogen arc column, limitations and applications. **(08Hrs)**

Unit-VI

Under water welding: Principle, working, types, limitations and applications. **(02Hrs)**
Testing of welding: Destructive and non-destructive testing methods for welds **(02Hrs)**

Term Work:

It shall consist of at least 5 assignments based on above syllabus.

Text Books:

1. Welding Technology - O. P. Khanna

Reference Books:

1. Welding Technology - R. Little - TMH Pub.
2. Welding Manufacturing Process - Dr. Y.V. Deshmukh, P.K. Roy.
3. Manufacturing Technology-Foundry, Forming and welding by P. N. Rao, Tata McGraw Hill, 2006 .

PCC-ME308 –MACHINE DESIGN

(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PCC- ME308 (L-03, T-0, P-02)

Course Objective:

1. To demonstrate the terminology and design principles of different motion transmitting components.
2. To explain the principles of spring design under different loading conditions.
3. To develop the design approach for sliding and rolling contact bearings under static and dynamic loading.
4. To develop an ability to understand the gear terminology along with the force and strength analysis.
5. To comprehend safety and reliability concepts in the design of machine elements.

Course Outcomes:

CO1 Student shows ability to design and model components using knowledge they acquired.
CO2 Student exhibits ability to identify, formulates, and solves engineering problems.
CO3 Student demonstrates the skill of designing motion transmission parts.
CO4 Student contributes in design of new mechanical systems.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3		3	3									3	
CO2	1		3	3									3	
CO3	1		3	3									3	
CO4	1		3	3	3								3	

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	**Practical**
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Springs: Introduction, Types of springs, Terminology of helical spring, Stress and defection equations, Material for helical spring, Design of helical springs, Wahl's correction factor, Design against fluctuating load, Optimum design, Surging, Helical torsion spring, Leaf spring.**(07hrs)**

Unit-II

Belt, Ropes & Chain Drives: Introduction, Type of belts, Types of flat belt drives, Tension ratio in belts, Length of belt, Power transmitted by belt,Maximum power condition, Rope drive, Stresses in wire rope, Chain drives, Power transmitted by chain.**(07hrs)**

Unit-III

Sliding contact bearings: Introduction, Classification of bearing, Modes of Lubrication, Viscosity, Bearing materials, Petroff's eq^{n}, McKee's investigation, Hydrostatic step bearing, Sommerfeld number, Heat generated in journal bearing, Raimondi and boyd method, Bearing design, Thrust bearing.**(06hrs)**

Rolling contact bearings: Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's equation, Equivalent bearing load, Load-life relationship, Selection of bearing from manufacture's catalogue, Design for cyclic loads and speeds.**(06 hrs)**

Unit-IV

Spur Gears: Introduction, Gear terminology, Gear tooth failure, Selection of gear material,
Gear blank design, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear tooth, Estimation of Dynamic and Static tooth load, Wear strength (Buckingham's) equation, Design of spur gear.**(07 hrs)**

Unit-V

Helical, Worm and Bevel Gear: Helical Gears: Terminology, Tooth proportions, Force analysis, Strength analysis and Effective load on gear tooth. Bevel Gears: Terminology, Force analysis, Strength analysis and Effective load on gear tooth.Worm Gear: Terminology, Tooth proportions, Force analysis, Strength analysis. **(07hrs)**

Term Work:

Assignments consisting of theoretical questions and full imperial size sheets with the design problems.

List of Experiments:

1. Determine the stiffness of various springs by using spring testing machine.
2. To measure power transmitted with varied belt tensions.
3. To measure % slip at fixed belt tension by varying load on break drum and plot the graph of (T1-T2) vs %slip i.e. "Slip characteristics".
4. To study the creep of belt.
5. Determine the pressure distribution in the oil film of bearing for various speeds and plot polar curve for various speed.

Practical Examination: Practical examination consists of practical/ oral examination based on above syllabus.

Text Books:

1. V.B.Bhandari, "Design of Machine Element," Tata McGraw Hill Publications, 4th Edition, 1997.

Reference Books:

1. Joseph E.Shigley and Charles R.Mischke, "Mechanical Engineering Design," Tata McGraw Hill Publication, 6th Edition,2005
2. C.S Sharma & Kamlesh Purohit, "Design of Machine Elements," Prentice Hall of India

publications, New-Delhi, Eastern Economy 3rd Edition, 2003.
3. Spott's M.F. and Shoup T.E. – "Design of Machine elements," Prentice Hall International. Black P.H. and O. Eugene Adams, "Machine Design," McGraw Hill Book Co. Ltd.

Design Data Book:

1. Design Data Book for Mechanical Engineers, K.Mahadevanan & K.Balaveera Reddy, CBS Publishers & Distributor Delhi, 4th Edition 2008.
2. Design Data Book – B. D. Shiwalkar, Central Techno Publication Nagpur, 2nd Edition.

PCC-ME309 –REFRIGERATION & AIR CONDITIONING
(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PCC- ME309 (L-03, T-0, P-02)

Course Objective:

1. To comprehend the basic principles of refrigeration and air conditioning.
2. To impart the different properties of refrigerants used.
3. To make aware of operating thermodynamic cycles for refrigerating devices.
4. To inculcate psychometric principles to apply them in air conditioning.
5. To demonstrate the performance of different refrigerating & air conditioning machines.

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

CO1 Illustrate the fundamental principles and applications of refrigeration and air conditioning system

CO2 Obtain cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems

CO3 Present the properties, applications and environmental issues of different refrigerants

CO4 Calculate cooling load for air conditioning systems used for various applications

CO5 Operate and analyze the refrigeration and air conditioning systems.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3												2	
CO2			2	2									2	2
CO3	3					2	3							2
CO4	3						2						2	
CO5		3	2			2	2						2	3

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	**Practical**
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Introduction & Air refrigeration cycles: Refrigeration, Applications of refrigeration, elements of refrigeration system, unit of refrigeration, Co-efficient of performance (COP), Air refrigerator working on a reversed Carnot cycle, reversed Brayton cycle, Bootstrap, Regenerative, Reduced ambient air refrigeration cycles.**(06 hrs)**

Unit-II

Refrigerants: what is refrigerant, classification of refrigerants, Designation of refrigeration, desirable properties of ideal refrigerant, properties and applications of commonly used refrigerants, Leak detection. **(06 hrs)**

Unit-III

Vapour Compression Cycle: Introduction**,** simple vapour compression system, functions of parts of a simple vapour compression system, pressure enthalpy (p-h) chart, simple VCC on p-h chart, factors affecting the performance of a simple vapour compression system, actual vapour compression cycle, mathematical analysis of vapour compression refrigeration, methods of improving vapour compression cycle, refrigeration controls like hand expansion valve, automatic expansion valve, capillary tube etc, introduction to vapour compression refrigeration system with multiple evaporators and compressors.**(08 hrs)**

Unit-IV

Vapour Absorption Refrigeration: Simple vapour absorption system, actual vapour absorption system, properties of ideal absorbent, advantages of vapour absorption refrigeration system over vapour compression refrigeration system, comparison between VAS and VCS, Lithium Bromide absorption refrigeration system, Electrolux refrigeration system, enthalpy concentration charts.**(06hrs)**

Unit-V

Psychometric: Definitions, psychometric relations, different psychometrics, psychometric charts, and Psychometric process such as mixing of air streams, sensible heating, sensible cooling, cooling and dehumidification, heating and dehumidification, cooling and humidification, heating and humidification. Bypass factor sensible hear factor. **(06 hrs)**

Unit-VI

Air conditioning: Introduction, factors affecting human comfort, Air conditioning cycle, classification of Air-conditioning systems, ice system of air conditioning, selection of system, Room sensible heat factor, Grand sensible heat factor, Mobile air conditioning, applications of Air conditioning.**(08 hrs)**

Term Work:

Term work shall consist of any eight experiments from the following.

1. Experiment on of vapour compression refrigeration system
2. Experiment on split air conditioner.
3. Experiment on window air conditioner.
4. Demonstration of different compressors used in refrigeration.
5. Experiment on vapour absorption refrigeration.
6. Demonstration of household refrigeration.

7. Study of different controls used in refrigeration system such as thermostat, solenoid valve.
8. Study of Cascade refrigeration system.
9. Study of psychrometer used in determination of D.B.T. W.B.T study of humidistat.
10. A report on Visit to air-conditioned / air-cooled premises
11. Visit to ice factory.

Practical Examination: Practical examination consists of practical/ oral examination based on above syllabus.

Text Books:

1. C. P. Arora, "Refrigeration & Air-conditioning"-Tata McGraw Hill.

Reference Books:

2. R. K Rajput, "Refrigeration & Air-conditioning" S.K.Kataria & Sons publication.
3. S. Domkundwar, S. C. Arora , "A course in Refrigeration & Air-conditioning".
4. R. J. Dossat, "Principles of refrigeration," Willey Eastern Publication.
5. W. F. Stoker and J. W. Jones, "Refrigeration and air-conditioning," Tata McGraw Hill Publication.

PEC-ME311 –INTERNAL COMBUSTION ENGINES
(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC- ME311 (L-03, T-0, P-02)

Course Objective:

1. To develop an ability to understand the fundamentals of internal combustion engines.
2. To demonstrate the various operational processes from intake to exhaust.
3. To get analysed the performance of internal combustion engines.
4. To demonstrate cooling and lubrication systems in internal combustion engines.
5. To make aware of I. C. engine emissions and methods to control them.
6. To make aware of different possible alternative engines.

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

CO1 Student exhibits fundamentals of internal combustion engines.
CO2 Student demonstrates working and construction of internal combustion engines.
CO3 Student demonstrates knowledge about Carburetion and fuel injection systems.
CO4 Student shows competency about combustion in SI and CI Engines along with emission of pollutants and related control measures.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO1	3											1	2	
CO2	3		2										2	
CO3	3		2									1		2
CO4	3					2	3							2

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	Practical
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Introduction: Classification of I.C. engines, Analysis of Engine Cycles, Analysis of fuel-air cycle and actual cycles. **(04 hrs)**

Unit-II

Carburation and fuel injection:

Theory of curburation , Simple curburator, calculation of Air Fuel ratio for simple carburator with and without compressability of air, petrol injection system, aircraft carburator

requirements, heat release pattern, types of injection systems namely common rail, individual pump distributor and unit injection systems, types of nozzles. **(06 hrs)**

Unit-III

Combustion in S.I. and C. I. Engines: Fuel ignition systems, Types- battery and magneto ignition system. Combustion in S.I. engines: Ignition limits and stages of combustion, engine variables affecting stages of combustion, normal and abnormal combustion, pre-ignition, detonation, effect and control of detonation, combustion chamber design principles, various types of combustion chambers used and their comparison. Combustion in C. I. engines: Stages of combustion, variables affecting stages of combustion, delay period, knocking, its effect and control, types of combustion chambers used. **(10 hrs)**

Unit-IV

Testing performance of Engines& supercharging: Performance parameters, methods for measurement of B.P, I.P. and F.P., performance of S.I. and C.I. engines, heat balance sheet. Supercharging: Introduction, necessity of supercharging, advantages and limitations of supercharging, Methods of supercharging.**(08 hrs)**

Unit-V

Engine Friction, Lubrication and cooling: Total engine friction, effect of engine variables on friction, Lubrication requirements, theory of lubrication, types of lubrication, splash lubrication system, petrol lubrication system, forced feed lubrication system. Air cooling and water cooling – forced cooling systems, comparison of air and water cooling system. **(08 hrs)**

Unit-VI

I.C. Engine Emissions and control: Emissions from S.I. and C. I. engines, pollutants and their effects, methods for controlling emissions, current techniques of emission control. **(04 hrs)**

Alternative potential engine: Stratified charged engine, Wankel engine, Variable compression engine, Sterling Engine, Pulse jet engine, Ramjet engine.**(04 hrs)**

Term Work:

Term work shall consist of record of any eight experiments from the following.

1. Trial on diesel engine with variation of load.
2. Trial on diesel engine with variation in speed for torque speed characteristics.
3. Trial on petrol engine with variation of load.
4. Trial on petrol engine with variation in speed for torque speed characteristics.
5. Study of ignition system and variation of timing of spark and adjustment of contact breaker gap and spark plug gap.
6. Dismantling and assembling of fuel pumps and injectors for single and multi cylinder engines any one.
7. Dismantling and assembling of any one automotive carburettor.
8. Actual valve timing diagram for high and low speed engines.
9. Analysis of exhaust emission from S.I. engine.

Practical Examination: It shall consist of oral/practical examination based on above syllabus.

Text Books:

1. V. Ganesan, “Internal Combustion Engines”, Tata McGraw Hill Book Co, 2005

Reference Books:

1. J. B. Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co, 1988.
2. Mathur, Sharma, “Internal combustion engines”, Dhanpat Rai publications, 2005
3. Gill P W., J H. Smith, “Fundamentals of Internal Combustion Engines”, Oxford and IBH Publishing Company, 1972
4. Lester Clyde Lichty, “ Internal Combustion Engines”, McGraw-Hill book company, inc., 1939

PEC-ME312 –COSTING & ESTIMATION
(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC- ME312 (L-03, T-0, P-02)

Course Objective:

1. Ascertainment of cost and determination of selling price.
2. Cost control, cost reduction and ascertaining the profit of each activity
3. To provide basic knowledge of Economics and Financial Management
4. Assisting management in decision-making. Cost estimators play an important role in an organization, as they produce the majority of predictions of probable final product and process cost.

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

CO1 Compute different costs considering several overheads like factory, office, selling and distribution.

CO2 Analyse and evaluate the basic concept of cost, estimation and depreciation fund calculation.

CO3 Compute costs for various manufacturing processes like forging, welding, foundry etc.

CO4 Interpret the process of job costing, activity based costing, cost accounting and budgetary control.

CO5 Exercise during decision making, the concepts of CVP analysis, cost control techniques including time value of money.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	2										2			2
CO2	2	3		2							2		2	2
CO3	2	2	3	1							2		2	2
CO4	2	2									2		2	2
CO5	2					2					2			2

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	**Practical**
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

1. Compute different costs considering several overheads like factory, office, selling and distribution. **(4hrs)**
2. Analyse and evaluate the basic concept of cost, estimation and depreciation fund calculation. **(4hrs)**
3. Compute costs for various manufacturing processes like forging, welding, foundry etc. **(4hrs)**
4. Interpret the process of job costing, activity based costing, cost accounting and budgetary control. **(4hrs)**
5. Exercise during decision making, the concepts of CVP analysis, cost control techniques including time value of money. **(4hrs)**
6. Implement the basics of engineering economics and financial management for profit making by the organisation.**(4hrs)**
7. Standard costing and variance analysis **(4hrs)**
8. Elements of Economics **(4hrs)**
9. Financial Management **(4hrs)**
10. Tools for planning and control: Budgets **(4hrs)**

Term Work:

Assignments (including spreadsheet based exercises) based on the above syllabus.

Practical Examination: It shall consist of oral/practical examination based on above syllabus.

Text Books:

1. Cost Accounting – A managerial emphasis, Horngren, Datar and Foster; 11th ed., Pearson Education.
2. Cost and Optimization Engineering, F.C. Jelen and J.H. Black, McGraw Hill Int.
3. Mechanical Estimation and Costing, D.Kannapanet.al, TTTI, Madras.

Reference Books:

1. Mechanical Estimation and Costing, Banga Sharma
2. Mechanical Estimation and Costing, B.P. Sinha
3. J Pandey I M., Financial Management, Vikas Publication,10th Edition 2013
4. Henry M. Stenier, "Engineering economics Principles", McGraw Hill Publication

PEC-ME313 –ADVANCE MANUFACTURING TECHNOLOGY
(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC- ME313 (L-03, T-0, P-02)

Course Objective:

1. To gain knowledge about non-traditional machining processes.
2. To understand the theory behind material removal
3. To study and evaluate various process parameters involved in different non conventional machining processes.
4. To explore practical applications of different machining techniques.

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

CO1 Exhibit basic understanding of the machining capabilities, limitations, productivity and classification of advanced manufacturing processes.

CO2 Apply the working principles and processing characteristics of non-traditional machining to the production of precision components.

CO3 Explain the mechanism, equipments used, process parameters considered, applications and limitations of Mechanical machining processes

CO4 Analyses various parameters of different machining processes and contribute to research and development work.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3											1		2
CO2	2				2	2						1	2	
CO3	2					2	2					1		2
CO4	3	2										1	2	

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	Practical
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Introduction: Historical background of Non Traditional Machining Technologies., Classification, Basic fundamentals of various process, their process capabilities and related comparison. **(05 hrs)**

Unit-II

Mechanical Processes: Processes principles, equipment, processes parameters & Applications of Abrasive Jet Machining, Ultrasonic Machining, Water Jet Cutting, and Magnetic Abrasive

Machining. Evaluation of material removal rate (MRR) in AJM.**(06 hrs)**

Unit-III

Electrochemical Machining (ECM): Background, Electrochemistry, Classification, Equipment required, Process capabilities, Processes parameters & Trouble shootings. Electro chemical Grinding, Electrochemical deburring, electro chemical cutting. Application examples of ECM processes, Evaluation of MRR of pure metal in ECM. **(06 hrs)**

Unit-IV

Electrical Discharge Machining (EDM): Fundamental principle, Equipments required mechanism of machining, process parameters, process capabilities, application example & trouble shooting, Introduction to wire EDM and other recent developments in EDM technologies. **(06 hrs)**

Unit-V

Chemical Machining: Introduction, fundamental principles, process parameters, classification & selection of enchant, accuracy of the process, applications etc. Photo chemical machining and blanking. **(04 hrs)**

Unit-VI

Laser Beam Machining (LBM): Introduction, Background of laser action, production of photon cascade in solid optical laser. Machining applications of laser wire drilling, cutting, marking, welding, heat treating, cladding, and surfacing. **(05 hrs)**

Unit-VII

Allied Processes: Process principles, equipment, and mechanism of machining, applications examples of: Plasma Arc Cutting, Thermal Energy Method, Abrasive Water Jet Machining, and Electro Chemical Discharge Machining. **(05 hrs)**

Term Work:

It shall consist of at least six assignment based on above syllabus.

Practical Examination: It shall consist of oral/practical examination based on above syllabus.

Text Books:

1. V. K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd, (2005)

Reference Books:

1. P.C. Pandey & H. S. Shah, "Modern machining process" 1st Edition, TMH, 2010.
2. El-Hofy, Hassan Abdel-Gawad, "Advanced Machining Processes":Nontraditional And Hybrid Machining Processes", McGraw-Hill, 2005.
3. P.K. Mishra, "Non-conventional machining", Narosa Publications

PEC-ME314 –AUTOMOBILE ENGINEERING
(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC- ME314 (L-03, T-0, P-02)

Course Objective:

1. To familiarize with various types of automobile.
2. To motivate students to learn the fundamentals of power transmission in automobile.
3. To get familiar with steering, braking & suspension system which we commonly use.
4. To implement the knowledge obtained in theory towards design and analysis of various automobile systems.

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

CO1 Identify, uses and demonstrate working of various components of automobiles.

CO2 Understand various types of steering, braking & suspension systems.

CO3 Exhibits knowledge of design and analysis of various automobile systems.

CO4 Select appropriate wheels and materials for making of various parts of automotive.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3												2	
CO2	3													2
CO3	3	2											2	
CO4	3				2		1							2

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	Practical
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Introduction: Components of an automobile, vehicle specifications, classification of automobiles, layout with reference to power plant, chassis, construction and details (frames, sub-frames, frameless vehicles, vehicle dimensions), details of chassis & body materials. **(04Hrs)**

Unit-II

Clutches: Principle, types, their construction & working, fluid coupling. **(02Hrs)**

Transmission: Need transmission, types of transmission, different types of gear box, shift mechanisms, torque converter, and continuously variable transmission. **(04Hrs)**

Unit-III

Drive line: Propeller shaft, universal joint, slip joint, final drives, Hotchkiss and torque tube drives, rear axle types and construction, principle of differential, types of differential. **(04Hrs)**

Front Axle & Steering: Types of front axle, steering requirements, wheel alignment, steering geometry, steering mechanism, Turning radius, instantaneous centre, and wheel wobble, under-steer and over-steer, different types of steering gears, power steering. **(06Hrs)**

Unit-IV

Braking & Suspension: Principle, braking requirements, types of brakes, drum brakes, disc brakes, hydraulic brakes, electric brakes, vacuum assisted brakes, Engine exhaust brakes, air brakes, Antilock Breaking System (ABS). Function and types of suspension springs (leaf & coil springs), Torsion bars, shock absorber, conventional and independent suspension, stabilizers, Air suspension. **(12 Hrs)**

Unit-V

Electrical System: Battery, Charging circuit, Alternator ,generator, current – voltage regulator – starting systems, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator. **(08Hrs)**

Unit-VI

Wheels & Automotive materials: Types of wheels, tyre, desirable tyre properties, types of tyres, parameters affecting tyre life, various automotive materials, and natural materials smart materials, advances in automotive materials. **(08Hrs)**

Term Work:

Minimum ten experiments from the list given below should be conducted

1. Study of different automobile layouts.
2. Study and demonstration of working of single plate automobile clutch.
3. Study and demonstration of synchromesh gear box.
4. Study and demonstration of constant mesh gear box
5. Study and demonstration of car chassis with clutch , gear box and differential gear
6. Study and demonstration of working of hydraulic brake system.
7. Study and demonstration of working of air brake system.
8. Study and demonstration of working of vacuum assisted brake system.
9. Study and demonstration of hydraulic power steering.
10. Study and demonstration of electrical power steering.
11. Study of suspension system of a four wheeler.
12. Study and demonstration of Car wiring.

Practical Examination: It shall consist of oral/practical examination based on above syllabus.

Text Books:

1. Dr. Kirpal Singh, "Automobile Engineering" (Vol. I & II), Standard Publishers, 2011.
2. G.B.S. Narang, "Automobile Engineering", Khanna publications, New Delhi, new edition, 2006.

Reference Books:

1. Newton & Steed, “Motor Vehicles”, 13th ed., Butterworths London, 2001.
2. W. H. Crouse, “Automobile Mechanics”, McGraw Hill publishing Co., 2004.
3. H. M. Sethi, “Automotive Technology”, McGraw Hill. Education (India) Pvt. Limited, 2001.
4. Banga & Singh, “Automobile Engineering”, Khanna Publishers, Delhi, 1993.

PEC-ME315 –PRESSURE VESSEL DESIGN
(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC- ME315 (L-03, T-0, P-02)

Course Objective:

1. To acquire basic understanding of design parameters for pressure vessel design.
2. To make aware of different type of stresses to be considered in designing a pressure vessel.
3. To inculcate use ASME codes for designing pressure vessels.
4. To analyze different piping systems for stresses using flow diagrams, layouts.

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

CO1 Student demonstrates basics of pressure vessel design and important parameters to design.
CO2 Ability to design internal pressure vessels and external pressure vessels.
CO3 Ability to design special vessels (e.g. tall vessels) and various parts of vessels (e.g. heads).
CO4 Student shows ability to understand standard codes and use them to design process equipments.
CO5 Student shows ability to identify pitfalls in system and related control measures.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3												2	
CO2	1		3	2									3	
CO3	1		3										3	
CO4	2	1	1	1									3	
CO5	2					1	2						3	

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	Practical
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Stresses in vessels: General theory of membrane stresses in vessel under internal pressure and its application to shells (cylindrical, conical and spherical) and end closures. Bending of circular plates and determination of stresses in simply supported and clamped circular plate; Thermal stresses; Stress concentration in plate having circular hole due to bi-axial loading, excessive elastic deformation, plastic instability, brittle, rupture and creep. Theory of reinforced opening and reinforcement limits **(08Hrs)**

Unit-II

Design of Vessels using Codes: Introduction to ASME cods for pressure vessel design, Pressure vessel and related components' design using ASME codes; Supports for short vertical vessels, stress concentration at a variable thickness transition section in a cylindrical vessel; Design of nozzles. **(06Hrs)**

Supports for vertical & horizontal vessels: Design of base plate and support lugs. Types of anchor bolt, its material and allowable stresses. Design of saddle supports. **(06Hrs)**

Unit-III

Design Considerations: 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, Design of circumferential stiffeners, Buckling under combined External pressure and axial loading. Fatigue, shock, high pressure, high temperature, irradiation, corrosion, and other hostile environments, high strength, lightweight pressure vessels, vessels resistant to external high pressures found in undersea exploration, offshore drilling, and mineral mining. **(10Hrs)**

Unit-IV

Piping Analysis: Flow diagram, piping layout and piping stress analysis; Flexibility factor and stress intensification factor; Design of piping system as per B31.1 piping code. Piping components: bends, tees, bellows and valves. Types of piping supports and their behavior; Introduction to piping Codes and Standards. **(08Hrs)**

Unit-V

Storage Vessel: Storage of fluids, Storage of non-volatile fluid, Storage of volatile liquids, storage of gases, Design of rectangular tanks, design of tanks, nozzles and mountings, large capacity storage tanks. **(06Hrs)**

Unit-VI

Process Hazards and Safety Measures in Equipment Design: Introduction, Hazards in process industries, Analysis of Hazards, Safety Measures in equipment design, Pressure relief device. **(04Hrs)**

Term Work: It shall consist of at least six assignment based on above syllabus.

Practical Examination: It shall consist of oral/practical examination based on above syllabus.

Text Books:

1 V.V. Mahajani “Joshi's Process Equipment Design” Paperback – 2014.

2 M.V. Joshi, V.V. Mahajaini “Process Equipment Design”, Macmillan India Ltd.

Reference Books:

1. Henry H. Bedner, “Pressure Vessels”, Design Hand Book, CBS publishers, 2007.
2. John F. Harvey, “Pressure Vessel Design”, CBS publishers, 2007.
3. ASME Code for Pressure Vessel Design.

PEC-ME316 –PRODUCTIVITY IMPROVEMENT TECHNIQUES
(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PEC- ME316 (L-03, T-0, P-02)

Course Objective:

1. To introduce the concepts, principles and framework of contents of Productivity improvement techniques
2. To acquaint the students with various productivity enhancement techniques.
3. To acquaint the students with different aspects of Work measurement.
4. To make students apply knowledge of PIT in actual practice.
5. To develop ability to introduce techniques of time saving and improve productivity.

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

CO1 Student recognizes the impact of human factor at workplace for productivity improvement.

CO2 Student shows ability to calculate productivity of any industry.

CO3 Student demonstrates use of ergonomics in designing of different products for human comfort at work place.

CO4 Student shows skill of implementing method study technique in industries.

CO5 Student can evaluate the percentage utilization of man power and machines in industries.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	3												2	
CO2	2	2												2
CO3	2				2	2	2							2
CO4	2										2	2	2	
CO5	2							1			3	1	2	

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	**Practical**
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

Unit-I

Introduction to Work Study: Definition: Purpose of study, objectives, brief history and evolution, work study and productivity, human factor in application of work study, scope, applications, relationship, between Productivity & standard of living, basic work content, excess work content Management, techniques to reduce excess work content due to product process and ineffective time in control of workers and Management. **(4 hrs)**

Unit-II

Ergonomics: Introduction, Principles, Work system design, Man-machine system, Human behavior and equipment design, Tools, Techniques and applications, Effect of environment on performance of worker, working conditions, prevention accidents and hazards, lighting, ventilation etc. **(4 hrs)**

Unit-III

Method Study: Definition, Concept, Objectives and Procedure of method study, Flow and handling of materials; Process chart symbols, recording techniques like Flow process charts, Operation, Flow and Two handed Process charts, Flow diagram, String diagram, Multiple Activity chart, travel chart, Operation Analysis, Analysis of motion, analysis and critical examination of existing methods and development of improved methods, Motion economy, Design of work place layout, Therbligs, SIMO chart. **(15 hrs)**

Unit-IV

Work Measurement: Definition, significance of work measurement; origin, development and procedure of work measurement, introduction to various work measurement techniques. (02 hrs)

Time Study and Other Works Measurement Techniques: Time study: definition, equipment for basic time study, time study forms and other equipment. Steps in use of techniques of time study; selecting the job, breaking the job into elements, approach to the worker, the elements, timing each element, Maynard Operation Sequencing Technique (MOST),Average and qualified worker, rating procedures, criteria affecting the choice of rating procedures, continuous timing, fly back timing, accumulative timing; standard ratings, comparison of observed and standard ratings, factors affecting the rate of working, scales of rating, rating factors, recording the rating, summarizing the study, allowances, calculation and application of allowances. Work sampling and production studies; General study of standard data & PTS. Introduction to standard data and synthetic time standards, special timing devices and equipment, introduction of work study in an organization, introductory idea about incentives, problems in India in increasing productivity through work study and wage incentives. **(15 hrs)**

Unit-V

Use of the time Standards: Define work covered by allowance time, work specification, work unit, program planning & utilization of plant &labor, estimation, standard costing, budgetary control & incentive schemes. **(2 hrs)**

Term Work:

Minimum Eight assignments based on the above syllabus.

Practical Examination: It shall consist of oral/practical examination based on above syllabus and term work.

Text Books:

1. Introduction to work study – ILO

Reference Books:

1. Motion & Time study Design & Measurement of Work - Ralph Barnes (Wiley Eastern)
2. Work Study - R.M. Currie &J.Faraday. (ELBS Pitman)
3. Hand Book of Industrial Engineering - Irson& Grant
4. Productivity management - Concepts & Techniques- S. C. Sawhney

PCC-ME310 –AUTOMATION IN MANUFACTURING
(CREDITS THEORY: 03, PRACTICAL: 01)

Course code: PCC- ME310 (L-03, T-0, P-02)

Course Objective:

1. To understand use of computers in design process.
2. To understand the facilities in different CAD Software.
3. To understand theory of solid modeling techniques.
4. To understand NC/CNC and Part Programming basics.
5. To understand the basics of computer integrated manufacturing.

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

CO1 Students show ability to design and model components,assemblies using various automation tools.
CO2 Student contributes in various CAD/CAM/Automation software development activities.
CO3 Student demonstrates the skill of designing tool path.
CO4 Design of new mechanical systems.

Articulation Matrix

PO/PSO ➡ ⬇ CO	a	b	c	d	e	f	g	h	i	J	k	l	PSO1	PSO2
CO 1	2	3			2								3	
CO2	2		3	2									3	
CO3	2	3	3										3	
CO4	2	3											3	

Note: 1-Low, 2-Medium or 3- High.

Evaluation Scheme:

Theory	Practical
Mid Term : 30 Marks	Continuous Evaluation: 50%
End Term : 50 Marks	Continuous Evaluation: :50%
In Semester Evaluation: 20 Marks	

Course Content:

COMPUTER AIDED DESIGN:

Unit-I

Fundamentals of CAD: Introduction, The design Process, Application of computers for Design, benefits of Computer-Aided Design and hardware in CAD. **(05 hrs)**

Unit-II

Computer Graphics:

The Software Configuration of a Graphics System, Functions of a Graphics Package, Constructing

the Geometry, Graphics Primitives, Co-ordinate Systems used in Graphics and Windowing, View Ports, 2-D Transformations, Homogeneous Transformations, Combination Transformations, 3-Dimensional Transformations, Salient Features of Solid Modeling, Wireframe modeling. Solid modelling techniques- Half space, Octree, sweep, Constructive solid Geometry, B-rep, Feature Based Modelling, and Parametric modelling. Surface modelling. Introduction to Curves and Surfaces, Data exchange standards. **(15 hrs)**

COMPUTER AIDED MANUFACTURING:

Unit-III

Numerical Control: Fundamentals of NC Technology, Computer Numerical Control, Distributed Numerical control, Applications of NC, Engineering Analysis of NC Positioning Systems, NC Part Programming, APT programming. **(08 hrs)**

Unit-IV

Material Handling Systems: Introduction to Material Handling, Equipment, analysis of Material Transport systems, Storage system: Performance and Location strategies, Conventional Storage Methods and Equipment, Automatic Storage and Retrieval System **(05 hrs)**

Unit-V

Cellular Manufacturing: Part Families, Parts Classification and Coding, Production flow analysis, Cellular Manufacturing, Application of Group technology. **(05 hrs)**

Unit-VI

Flexible Manufacturing Systems: Introduction, FMS components, Applications and Benefits.

(02 hrs)

Term Work:

A. It will consist of assignment(s) based on Software Documentation, tutorials, manuals of any high CAD / CADD software.

B. It will consist of a simple job on CNC Lathe or Milling.

Practical Examination: Practical examination consists of practical/ oral examination based on above syllabus.

Text Books:

1. Ibrahim Zeid, "CAD/CAM theory and Practice," Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.

2. Groover M.P. “Automation Production Systems, and Computer Integrated Manufacturing,” PHI.

Reference Books:

1. Groover M.P. and Zimmers E. W., “CAD/CAM: Computer Aided Design and Manufacturing,” Prentice Hall International, New Delhi, 1992.
2. P. Radhakrishnan, S. Subramanayan and V.Raju, “CAD/CAM/CIM,” New Age International (P) Ltd., New Delhi.
3. Chris McMahon and Jimmie Browne, “CAD/CAM – Principle Practice and Manufacturing Management,” Addision Wesley England, Second Edition, 2000.
4. Rogers, D.F. and Adams, A., “Mathematical Elements for Computer Graphics,” McGraw Hill Inc, NY, 1989
5. S. Pabla, M. Adithan, “CNC Machines,” New Age International Ltd. New Delhi.
6. P.N. Rao, N.K. Tewari, T.K. Kundra, “Computer Aided Manufacturing,” Tata McGraw Hill Publishing Co. Ltd.