Department of Mechanical Engineering

BE-SEMESTER-V SYLLABUS

MEA-501	**MACHINE COMPONENT DESIGN**	**2L:1T:0P**	**03 credits**	**3Hrs/Week**

Course Preamble:

1. To familiarize the various steps involved in the Design process
2. To understand the principals involved in evaluating the shape and dimensions of a
3. Complete to satisfy function and strength requirements.
4. Students shall gain a thorough understanding of the different types of failure modes and
5. Criteria. They will be conversant with various failure theories and be able to judge which
6. Criterion is to be applied for a particular situation.
7. Student shall gain design knowledge of the different types of elements used in
8. the machine design process, for e.g. fasteners, shafts, couplings etc. and will be able to design these elements for each application.

Course Outcomes:

1. Ability to analyze the stress and strain of mechanical components and understand,
2. Identify and quantify failure modes for mechanical part.
3. Ability to decide optimum design parameters for mechanical systems.
4. Ability to design mechanical system for fluctuating loads.
5. . Acquire skill in preparing production drawing pertaining to various designs.

UNIT 1

Design Against Fluctuating Load : causes of stress concentration; stress concentration in tension, bending and torsion; Fluctuating Stresses, notch sensitivity, fatigue stress concentration factor, cyclic loading, endurance limit, S-N Curve, loading factor, size factor, surface factor. Design consideration for fatigue, Goodman and modified Goodman's diagram, Soderberg Equation, Gerber Parabola, Fatigue Design under Combined Stresses.

(9 hours)

UNIT 2

Design of components subject to static loads: riveted joints, welded joints threaded joints, pin, key knuckle, and cotter joints, Types of cotter Joint, Dimension of Various part of the knuckle Joint.

(9 hours)

UNIT 3

Springs: Design of helical compression and tension springs, consideration of dimensional and functional constraints, leaf springs and torsion springs; fatigue loading of springs, surge in spring;

special springs.

(9 hours)

UNIT 4

Brakes & Clutches: Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk , plate clutches, cone & centrifugal clutches. Design of brakes: Rope, band & block brake, Internal Expanding Brakes, Disk Brakes.

(9 hours)

UNIT 5

Spur and Helical Gears: Force analysis of Gear Tooth, modes of failure, Beam Strength, Lewis Equation, Form Factor, Formative Gear and Virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur and Helical Gears. Bevel Gears: Application of bevel, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear.

(9 hours)

References:

1. Shingley J.E; Machine Design; TMH
2. Sharma and Purohit; Design of Machine elements; PHI
3. Wentzell Timothy H; Machine Design; Cengage learning
4. Mubeen; Machine Design; Khanna Publisher
5. Ganesh Babu K and Srithar k; Design of Machine Elements; TMH
6. Sharma & Agrawal; Machine Design; Kataria & sons
   Maleev; Machnine Design.

MEA-501	**MACHINE COMPONENT DESIGN**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

Designing and sketching of components contained in the syllabus.

1. To study design procedure of Knuckle Joint with detailed drawing
2. To study design procedure of cotter joint with detailed drawing
3. To study design procedure of helical and torsion spring with detailed drawings
4. To study design procedure of brake with detailed drawings.
5. To study design procedure of clutch with detailed drawings.
6. To study design procedure of spur and helical gear with detailed drawings.

MEA–502	DYNAMICS OF MACHINES	2L:1T:0P	03 credits	3Hrs/Week

Course Preamble:

1. To understand the concept of balancing of rotating and reciprocating masses.
2. To understand the Force analysis of Reciprocating Engine.
3. To study different types of Gear Trains.
4. To understand the concept of Vibrations, Single Degree of Freedom systems and the Forced Vibrations.
5. To study different types of Governors and its functions.

Course Outcomes:

After completion of the course, the student will be able to:

1. Apply mathematical principles to perform dynamic force analysis on machine components.
2. Establish methods for balancing of machine components.
3. Analyze free vibration of various systems.
4. Analyze forced vibration of various systems.

UNIT 1

Dynamics of Engine Mechanisms: Displacement, velocity and acceleration of piston, turning moment on crankshaft, turning moment diagram.

(9 hours)

UNIT 2

Governor Mechanisms: Types of Governors, Characteristics of Centrifugal Governors, Gravity and Spring Controlled Centrifugal Governors, Hunting of Centrifugal Governors, Inertia Governor.

(10 hours)

UNIT 3

Balancing of Inertia Forces and Moments in Machines: Balancing of Rotating Masses, Two plane balancing, determination of balancing masses (graphical and analytical methods), balancing of rotors, balancing of I.C. engine.

(9 hours)

UNIT 4

Friction: Frictional Torque in Pivots and Collars by Uniform Wear and Uniform Pressure, Boundary and Fluid Film Lubrication, Friction in journal and thrust bearings, rolling friction, Clutches.

(8 hours)

UNIT 5

Belt : Belt drives; Velocity ratio, limiting ratio of tension; power transmitted; centrifugal effect on belts, maximum power transmitted by belt, initial tension, chain and rope drives; Brakes: Band brake, Block brakes, Internal and External Shoe brakes, braking of vehicles. Dynamometer types and uses. Analysis of Cams, Response of Un-damped Cam Mechanism.

(9 hours)

References:

1. Rattan SS; Theory of machines; TMH
2. Dr.R.K.Bansal& Dr.Brar; Theory of Machines LP
3. Ghosh and Mallik; Theory of Mechanisms and Machines; Affiliated East-West Press, Delhi
4. Norton RL; kinematics and dynamics of machinery; TMH
5. Grover; Mechanical Vibrations
6. Thomson; Theory of Vibrations

MEA–502	DYNAMICS OF MACHINES	0L:0T:2P	1 credits	2Hrs/Week

List of Experiment

1. To Study of various models of governors.
2. To Study of gyroscopic motion and calculation of value of gyroscopic couple.
3. To Study of various types of Cams and followers.
4. To Study of various first order vibration systems.
5. To study working of friction clutches using models
6. To study working of internal expanding brake

MEA-503	Metal Cutting & CNC Machines	2L:1T:0P	03 credits	3Hrs/Week

Course Preamble:

The main learning objective of this course is to prepare the students for:

1. Applying fundamental knowledge, principles in material removal processes and importance of metal cutting parameters.
2. Applying the fundamentals of turning and automatic machine tools.
3. Applying the principles of reciprocating, milling and gear cutting machines.
4. Applying the principles of abrasive processes and broaching processes.
5. Applying the CNC machine tools and programming manufacturing processes.

Course Outcomes:

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

1. Apply fundamental knowledge, principles in material removal processes and importance of metal cutting parameters.
2. Apply the fundamentals of turning and automatic machine tools
3. Apply the principles of reciprocating, milling and gear cutting machines.
4. Apply the principles of abrasive processes and broaching processes
5. Apply the CNC machine tools and programming manufacturing processes

UNIT I

Lathe: Classification of machine tools and their basic components; lathe- specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature.

(8 hours)

UNIT II

Grinding: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

(8 hours)

UNIT III

Milling: Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters.
Drilling & Broaching: Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

(9 hours)

UNIT IV

Shapers: Classification and specifications, principle parts, quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities. **Gear Cutting**: Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding gear testing.

(10 hours)

UNIT V

Mechatronics: Introduction to control systems, analog control, transfer function, procedure for writing transfer function, signal flow diagram, introduction to electronic components like switches, magnetic type, electromagnetic type, transducers and other sensors, servo motors, basics of CD-ROM players, PLC, applications, CNC machines.

(9 hours)

References:

1. Rao PN; Manufacturing Technology vol I and II; TMH
2. Hazra Chadhary; Workshop Tech.II; Media Promoter and Pub
3. Lindberg RA; Processes and Materials of Manufacturing; PHI.
4. Raghuvanshi;BS; Work shop technology Vol-I, II; Dhanpat Rai Delhi
5. Alciatori DG, Histand MB; Introduction to Mechatronics and Measurement system;
6. HMT; Production Processes; TMH

MEA-503	**Metal Cutting & CNC Machines**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiment:

1. To make a job on lathe machine with all operations.
2. To Study of center less grinding machine/ tool and cutter type grinding machine.
3. To Study of horizontal/ universal milling machine, diving head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. To Study of radial drilling machine and preparing a job on it.
6. To study a sapping machine to learn about working of quick return mechanism.

MEA-504 (A)	**Turbo Machinery**	**3L:1T:0P**	**04 credits**	**4Hrs/Week**

Course Preamble:

The purpose of the course is to introduce the means by which the energy transfer is achieved in the main types of turbo machines and the different behaviors of individual types in operation. The course aims at introducing preliminary design fundamentals of turbo machines including axial and radial flow turbines and axial and centrifugal flow compressors.

Course Outcomes:

Demonstrate a basic understanding of laws of fluid flow and thermodynamics in association with the turbo machinery Course Learning Outcomes:
II- Tackle turbo machinery problems associated with industry
III- Design some parts in gas turbine systems.
IV- Develop computational skills to analyze and design of components such compressor intake, diffusers, and gas turbine exits

UNIT 1

Energy transfer in turbo machines: Application of first and second laws of thermodynamics to turbo machines, Moment of momentum equation and Euler turbine equation, Principles of impulse and reaction machines, Degree of reaction, Energy equation for relative velocities.

(8 hours)

UNIT 2

Steam turbines: Impulse staging: Velocity and pressure compounding, Include qualitative analysis, Effect of blade and nozzle losses on vane efficiency, Stage efficiency, Analysis for optimum efficiency, Mass flow and blade height. **Reactions staging:** Parson‟s stages, Degree of reaction, Nozzle efficiency, Velocity coefficient, Stator efficiency, Carry over efficiency, Stage efficiency, Vane efficiency, Conditions for optimum efficiency, Axial thrust, Reheat factor in turbines, Free and forced vortex types of flow, Governing and performance characteristics of steam turbines.

(10 hours)

UNIT 3

Water turbines: Classification, Pelton, Francis and Kaplan turbines, vector diagrams and work done, draft tubes, governing of water turbines.

(8 hours)

UNIT 4

Centrifugal Pumps: Classification, Advantage over reciprocating type, Definition of mano- metric head, Gross head, Static head, Vector diagram and work done. Performance and characteristics: Application of dimensional analysis and similarity to water turbines and centrifugal pumps, Selection of machines, Hydraulic, volumetric, Mechanical and overall efficiencies.

(10 hours)

UNIT 5

Compressors: Centrifugal Compressor – Vector diagrams, Work done, Temp and pressure ratio, Slip factor, Work input factor, Pressure coefficient, Dimensions of inlet eye, Impeller and diffuser. Axial flow Compressors Vector diagrams, Work done factor, Temp and pressure ratio, Degree of reaction.

(9 hours)

References:

1. Venkanna BK; turbomachinery; PHI Csanady; Turbo machines
2. Kadambi V Manohar Prasad; An introduction to EC Vol. III Turbo machinery
3. Bansal R. K; Fluid Mechanics & Fluid Machines;
4. Rogers Cohen &SarvanMulto Gas Turbine Theory
5. Kearton W. J; Steam Turbine: Theory & Practic

MEA-504 (B)	**Production & Operation Management**	**3L:1T:0P**	**04 credits**	**4Hrs/Week**

Course Preamble:

1. To introduce the students to the types of productions in the industries as well as
   - they should be familiar with the functions of PPC used in the shop floor of the
   - industry.
2. To introduce the students to the design and development of the product as well as
   - importance of product characteristic for the design and development of product.
3. To familiarize the students with the batch production of the shop floor for
   - optimization for the cost or profit .
4. To introduce the students by using the multi activity chart for calculation of
5. machine cycle efficiency also familiarize with line balancing problems of shop
   - floor.
6. To introduce with calculation of cost of the product as well as replacing the
   - machine after its life time.
7. To introduce the students the necessity of maintaining the inventory.

Course Outcomes:

Upon successful completion of this course, the student will be able to.....

1. Illustrate the types of production and use of functions of PPC on the shop floor.
2. Illustrate the design and development of the product on the shop floor.
3. Illustrate the optimization technique used in batch production.
4. To calculate the idle time and machine cycle efficiency to improve the
5. To develop the balanced line of production with minimum idle time.
6. To understand how to maintain the inventory for shop floor.

UNIT 1

Introduction : System concept of production; Product life cycle; Types and characteristics of production system; Productivity; Process and product focused organization structures; Management decisions – strategic, tactical and operational.

(8 hours)

UNIT 2

Forecasting : Patterns of a time series – trend , cyclical, seasonal and irregular; Forecasting techniques : moving average, simple exponential smoothing, linear regression; Forecasting a time series with trend and seasonal component.

(8 hours)

UNIT 3

Materials Management and Inventory Control : Components of materials management; Inventory control : EOQ model, Economic lot size model, Inventory model with planned shortages, Quantity discounts for EOQ model; ABC analysis; Just-in-time inventory management. **Materials Requirement Planning** : MRP concept – bill of materials (BOM), master production schedule; MRP calculations.

(10 hours)

UNIT 4

Machine Scheduling : Concept of Single machine scheduling – shortest processing time (SPT) rule to minimize mean flow time, Earliest due date (EDD) rule to minimize maximum lateness, Total tardiness minimizing model; Minimizing makespan with identical parallel machines; Johnson‟s rule for 2 and 3 machines scheduling.

(9 hours)

UNIT 5

Project Scheduling : Activity analysis; Network construction; critical path method (CPM); Crashing of project network. **Quality Assurance** : Meaning of Quality; Quality assurance system; choice of process and quality; Inspection and control of quality; Maintenance function & quality; Process control charts : x-chart and Rchart, p-chart and c-chart; Acceptance sampling : Operating characteristic (O.C) curve, Single sampling plan, Double sampling plan, Acceptance sampling by variables; concept of Six Sigma.

(9 hours)

References :

1. Buffa and Sarin, Modern Production/Operations Management, John Wiley & Sons.
2. R. Panneerselvam, Production and Operations Management, PHI.
3. Russell & Taylor, Operations Management, PHI.
4. Adam and Ebert, Production and Operations Management, PHI.
5. Production & Operations Management by Starr, Cenage Learning India.

MEA-505 (A)	**Work Study and Ergonomics**	**3L:1T:0P**	**04 credits**	**4Hrs/Week**

Course Preamble:

This course introduces the role of Work Study in the industry and how productivity issues in the industry can be addressed by the application of Work Study, while stimulating critical thinking on the techniques of Method Study and Work Measurement. The course also introduces the concept of conducting time studies and production studies to assess time standards and production standards for fulfilling production goals in an organization. The course further introduces the scope of ergonomics and the application of ergonomic principles to workplace design and work organization and culminates with the concept of evaluating the impact of various human factors to design of safe workplace environment.

Course Outcomes:

The students will be able to:

1. develop a case for productivity improvement in any manufacturing or service industry scenario
2. independently conduct a method study in any organization with the objective of improving a process, material movement system or design of a work place
3. develop time standards for operations, identify production bottlenecks and improvise operations
4. apply principles of good ergonomic design of work areas and equipment
5. identify, explain and evaluate the impact of various personal attributes (anatomical, physiological and anthropometric) on proper safe working practice

UNIT 1

Method study: purpose of work study, its objectives, procedure and applications; method study definition and basic procedure, selection of job, various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, simo, cyclographs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method; principles of motion economy and their application in work design; micro motion study, memo motion study and their use in methods study.

(10 hours)

UNIT 2

Work measurement: Introduction & definition, objectives and basic procedure of work measurement; application of work measurement in industries; time study: basic procedure, equipments needed, methods of measuring time, selection of jobs, breaking a job into elements; numbers of cycles to be

Timed ; rating and methods of rating, allowances, calculation of standard time.
Work sampling: Basic procedure, design of work sampling study conducting work sampling study and establishment of standard-time.

(9 hours)

UNIT 3

Job evaluation and incentive schemes: Starlight line, Tailor, Merrick and Gantt incentive plans **Standard data system;** elemental and non-elemental predetermined motion systems, work factors system; Methods Time Measurement (MTM), MOST.

(8 hours)

UNIT 4

Human factor engineering: Definition and history of development of human factors engineering, types & characteristics of man-machine-system, relative capabilities of human being and machines; development and use of human factor data; information input and processing: Introduction to information theory; factors effecting information reception and processing; coding and selecting of sensory inputs.

(8 hours)

UNIT 5

Display systems and anthropometric data: Display- types of visual display, visual indicators and warning signals; factorial and graphic display; general principles of auditory and tactral display, characteristics and selection.

(8 hours)

References:

1. ILO; work-study; International Labour Organization
2. Khan MI; Industrial Ergonomics; PHI Learning
3. Barrnes RM; Motion and Time Study; Wiley pub
4. Megaw ED; Contenmprory ergonomics; Taylor & fracis
5. Sandera M and Mc Cormick E; Human Factors in Engg and design; MGHill
6. Currie RM; Work study; BIM publications
7. Mynard; Hand book of Industrial Engg;

MEA-505 (B)	**Industrial Safety Engineering**	**3L:1T:0P**	**04 credits**	**4Hrs/Week**

Course Preamble:

1. Possess a mastery of Health safety and environment knowledge and safety management skills, to reach higher levels in their profession.
2. Knowledgeable safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
3. Well communicate the information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities

Course Outcomes:

1. Apply knowledge of Mathematics, Science, Engineering fundamentals and an engineering Specialization for hazard identification, risk assessment, analysis the source of incidents and control of occupational Dieses & hazards.
2. Design, Establish, Implement maintain and continually improve an occupation health and safety management system to improve safety.
3. Conduct investigations on unwanted incidents using e.g. (Root cause analysis, what if analysis) and generate corrective and preventive action to prevent repetition and happening of such incidents.

UNIT 1

Safety management-Need for safety, safety and productivity, planning for safety, formulation of safety policy, safety management techniques-job safety analysis, safety sampling technique, incident recall technique, plant safety inspection, safety organizations and its functions.

(8 hours)

UNIT 2

Accident prevention-Nature and causes of accidents, accident proneness, cost of accidents, accident prevention methods, accident reporting and investigation, personal protective equipment's, safety education and training, damage control and disaster control.

(8 hours)

UNIT 3

Operational Safety

General safety considerations in material handling – manual and mechanical, safety in machine shop, safety in use of hand and portable (power) tools, safety in use of electricity, safety in welding and cutting, principles of guarding, safety in grinding, safety in heat treatment shop, safety in gas furnace operation.

(9 hours)

UNIT 4

Occupational Health and Hygiene-Concept and spectrum of health, levels of prevention, functional units of occupational health service, activities of occupational health unit, occupational and work related diseases such as silicosis, asbestosis, lead, nickel, chromium and manganese toxicity, prevention and control, gas poisoning, effects and prevention, hearing conservation programme - physical and chemical hazards - control measures.

(10 hours)

UNIT 5

Fire engineering and explosion control-Fire triangle, classification of fires, fire properties of solid, liquid and gas, building evaluation for fire safety, fire load, fire resistance materials and fire testing, structural fire protection, exits and egress - industrial fire protection systems, sprinkler – hydrants, portable extinguishers - fire suppression systems, detection systems, principles of explosion - detonation and blast waves, explosion venting, explosion parameters, explosion suppression systems based on CO2 and halogen.

(10 hours)

References:

1. Heinrich H. W, “Industrial accident prevention”, McGraw Hill Company, New York, 1980
2. Frank P. Lees, “Loss prevention in process industries”, Vol. I, II & III, Butterworth, London, 1980
3. Brown D. B, “System analysis and design for safety” Prentice Hall, New Jercy, 1976
4. Derek James, “Fire prevention hand book”, Butter Worths and Company, London, 1986
5. “Accident prevention manual for industrial operations”, National Safety Council, Chicago, 1989
6. Clayton and Clayton, “Patty‟s industrial hygiene and toxicology”, Vol. I, II & III, Wiley.

MEA-506	Industrial Training	0L:0T:4P	2 credits	4 Hrs/Week

Objective of Industrial Training

The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem .

Scheme of Studies:
Duration: Minimum 2 weeks in summer break after IV semester, assessment to be done in V Semester

Scheme of Examination:
For the assessment of industrial training undertaken by the students, following components are considered with their weightage.

(a) Term Work in Industry Marks Allotted

Attendance and General Discipline 20
Daily diary Maintenance 20
Initiative and participative attitude during training 30
Assessment of training by Industrial Supervisor 30

Total 100*

(b) Practical/Oral Examination (Viva-Voce) in Institution Marks Allotted
1. Training Report 50
2. Seminar and cross questioning (defense) 100

Total 150

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* - Marks of various components in industry should be awarded by the I/c of training in Industry but in special circumstances if not awarded by the industry then faculty in charge /T.P.O. will give the marks.
During training students will prepare a first draft of training report in consultation with section In charge. After training they will prepare final draft with the help of T.P.O. /Faculty of the Institute. Then they will present a seminar on their training and they will face viva-voce on training in the Institute.