DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical
22MET301	**CAD & CAM**	**3**	**3**	**0**	**0**

COURSE OUTCOMES:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes. The student will be able:

CO 1	To explain 2D and 3D geometric and modelling transformations
CO 2	To understand solid modelling of curves
CO 3	To understand different CAD standard systems
CO 4	To apply concepts of NC and CNC programming to develop part programmes
CO 5	To understand different types of techniques used in Cellular Manufacturing and FMS

COURSE CONTENT

INTRODUCTION : Brief introduction to CAD and CAM – Introduction to CAD/CAM concepts; Types of production; Manufacturing Planning, Manufacturing control; Product cycle – Design process - sequential and concurrent engineering; Computer aided design – CAD system architecture; Computer graphics – 2D and 3D Geometric and modelling transformations - Coordinate systems, homogeneous coordinates - Line drawing – Clipping - viewing transformation.

GEOMETRIC MODELING : Solid modelling and applications – Introduction to curves - Hermite curve - Bezier curve - B-spline curves-rational curves; Techniques for surface modelling – surface patch - Coons and bicubic patches- Bezier and B - spline surfaces.

CAD STANDARDS: Standards for computer graphics - Graphical Kernel System (GKS) - standards for exchange images - Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc.

FUNDAMENTAL OF CNC AND PART PROGRAMING : Introduction to NC systems and CNC; Machine axis and coordinate system; NC motion control systems; CNC machine tools - Principle of operation CNC; Drives and CNC controllers - 2D and 3D machining on CNC; CNC Part Programming, types - Detailed part programming using G codes and M codes; Machining of free form geometries.

FLEXIBLE MANUFACTURING SYSTEM (FMS) AND CAD/CAM APPLICATIONS : Group Technology; Part Families – Parts Classification and coding; Cellular Manufacturing; FMS – FMS Components - FMS Application & Benefits - FMS Planning and Control -Quantitative analysis in FMS; CAD/CAM applications – Computer Aided Assembly Planning - Computer Aided Inspection.

Reference Book(s)/ Text Book(s)

1. Zeid, I., “Mastering CAD/CAM”, Tata McGraw Hill, 2007.
2. Onwubiko, C., “Foundation of Computer Aided Design”, West Publishing Company, 1989.
3. Mortenson, M. E., “Geometric Modeling”, 3rd Ed., Industrial Press. 2006.
4. Groover, M. P., “Automation, Production systems and Computer Integrated Manufacturing”, 3rd Ed., Prentice-Hall, 2007.
5. Chang, T.-C., Wysk, R. A. and Wang, H.-P. “Computer Aided Manufacturing”, 3rd Ed., Prentice Hall, 2005.
6. Lynch, M., “Computer Numerical Control for Machining”, McGraw-Hill, 1992.

Rao, P. N., Tiwari, N. K. and Kundra, T. K., “Computer Aided Manufacturing”, Tata McGraw Hill, 199

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MET302	**Design of Machine Elements**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE : Engineering Mechanics, Mechanics of Solids, Kinematics and Dynamics of Machines

COURSE OUTCOMES

CO1	Understand and apply the fundamental design practices with regard to material selection, material properties, manufacturing considerations, and standards and codes.
CO2	Understand and apply stress analysis theory, appropriate static and fatigue failure theories/criteria to the design of various machine elements, the concept of Hydrodynamic lubrication
CO3	Analysis of basic machine elements, such as solid and hollow shafts, keys and couplings under various load conditions (i.e., static and dynamic); Temporary and Permanent Joints- riveted, bolted, welded Joints;
CO4	Design of basic machine elements, such as solid and hollow shafts, keys and couplings under various load conditions (i.e., static and dynamic); hydrodynamic bearings; Rolling contact bearings; Temporary and Permanent Joints, Compression Spring

COURSE CONTENTS

Overview of Design Process: Selection of Materials and Processes: Standard numbering system including BIS designations of materials, Load and Stress Determination, Stress concentration, Allowable stresses: factor safety.

Static and Fatigue Failure Theories in Design: Static failure theories, Variable load, load factor, Endurance strength; Endurance limit and modifying factors; Notch sensitivity and stress concentration. Goodman & Soderberg lines.

Design of machine members subjected to steady and/or alternating stresses: Shafts and Couplings; Temporary and Permanent Joints- riveted, bolted, welded Joints; Design of Compression Spring; Design of sliding & journal bearing; Selection of antifriction (rolling) bearings for different loads and load cycles.

Text Books/ Reference Books :

1. Machine Design: An Integrated Approach, Norton Robert L., Pearson Education Asia, 2020.
2. Mechanical Engineering Design, Shigley J. E. and Mischke C. R., Budynas R. G. and Nisbett K. J., Tata–McGraw Hill, 2020.
3. Design of Machine Elements, M. F. Spotts, Prentice Hall of India, 2019.

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MET303	**Fluid and Turbo Machines**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE: Engineering Thermodynamics**,** Fluid Mechanics

COURSE OUTCOMES:

CO1	Understand the concepts of energy flow, losses, and efficiencies in fluid machines
CO2	Apply the principles of model studies in the design of fluid machines
CO3	Understand the concept of velocity triangles as a tool for analysis of power consuming and power producing fluid machines
CO4	Analyze the performance of fluid machines with the effects of various parameters on performance

COURSE CONTENTS

Basics of Turbomachines, Classification of fluid machines, Turbomachines and Positive Displacement Machines, application of first and second laws of thermodynamics to turbo machines, Model Studies, Dimensional Analysis, Unit and Specific Quantities, Non-Dimensional Parameters and Their Significance, effect of Reynolds Number, Specific Speed

Thermodynamics of Fluid Flow: Static and Stagnation States, Thermodynamics of Turbomachine Processes, Isentropic and Isothermal Compression Process, Isentropic Expansion Process, Overall Isentropic Efficiency versus Stage Efficiency, Pre-heat Effect in Multi-stage Compressor, Re-heat Effect in Multi-stage Turbines, Infinitesimal-Stage or Small-Stage Efficiency or Polytropic Efficiency, Reheat Factor for Expansion Processes, Overall Isentropic Efficiency versus Finite-Stage Efficiency.

Energy Exchange in Turbomachines: Velocity Triangles, Basic Equations: Linear Momentum Equation, Impulse Momentum Equation, Moment of Momentum Equation, and Euler Turbine Equation, Alternate Form of the Euler Turbine Equation, *Components of Energy Transfer, Energy Equation of Relative Velocities,* Impulse and Reaction, Utilization Factor of Turbines, Speed Ratio.

General Analysis of Turbomachines: General Analysis of Radial Flow Machines, Radial Flow Machines (Pumps, Blowers, and Compressors): Velocity Triangles, Axial Flow Machines (Turbines and Compressors).

Steam Turbines: Classification of Steam Turbines, Compounding of Steam Turbines, Analysis: Rateau Stages, Parsons Stages, Curtis Stage. Governing of Steam Turbines.

Hydraulic Turbines: Classification of Hydraulic Turbines, Pelton Turbine, Francis turbine, Kaplan Turbine and Propeller Turbine. *Analysis, Efficiencies, Design Parameters;* Draft Tube, Cavitation, Governing of Hydraulic Turbines: Parts, working; Characteristics of the Hydraulic Turbine

Centrifugal Pumps: *Advantages of Centrifugal Pumps over Reciprocating Pumps,* Classification, different heads, efficiency, Analysis and Minimum Starting Speed of a Centrifugal Pump, Maximum Suction Lift and Net Positive Suction Head, Cavitation, Priming.

References-

Text Books/ Reference books- (Title, Authors, Publisher & Year)

1. S.L. Dixon and C.A. Hall. Fluid Mechanics and Thermodynamics of Turbomachinery, Sixth Edition. Butterworth-Heinemann, 2010
2. S. M. Yahya. Turbines Compressors and Fans. McGraw Hill, 2017
3. D. G. Shepherd. "Principles of Turbo Machinery. The Macmillan Company

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MET304	**Industrial Engineering**	**2**	**2**	**0**	**0**	**0**

PREREQUISITE: None

COURSE OUTCOMES: The course objectives define the student learning outcome for the course. After completing the above course, student is expected to:

CO1	Understand the evolution of different management theories.
CO2	Learn the basic concepts of productivity, work study along with the applications of ergonomics.
CO3	Determine the capacity and capability of workers engaged in a specific job.
CO4	Analyze and design wage and incentive plans for the workers.
CO5	Learn and apply the concepts of time value of money.
CO6	Apply the concept of depreciation and break-even analysis.

COURSE CONTENTS:

Industrial Engineering and Productivity: Evolution of Industrial Engineering, Contribution of Taylor, Gilbirth, Mayo etc.; Productivity, Factors influencing productivity, Productivity measurement techniques.

Work Study and Ergonomics: Work study, Method Study, Time Study, Recording techniques, Performance rating, Allowances, **Work Sampling, Predetermined Motion Time Systems (PMTS). Ergonomics:** Introduction and definitions of Ergonomics, Aspects of Ergonomics, Human-Machine System, Anthropometric measurement in product design.

Job Analysis and Job Evaluation: Job Description, Job Analysis and Job Evaluation, Job Evaluation techniques; Merit rating, Wage and Wage incentives, Bonus Schemes.

Engineering Economics and Cost Analysis: Concept and Scope of Engineering Economics, Element of costs, Break-even analysis; Value engineering and analysis; Time value of money; Replacement and Maintenance analysis – Types of maintenance, types of replacement problem; Depreciation.

References:

1. "Introduction to Work Study", International Labour Organisation.
2. "Motion and Time Study; Design and Measurement of Work", Ralph M. Barnes, John Wiley.
3. "Contemporary Engineering Economics", Chan S. Park, Prentice Hall of India, 2002.

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MET305	**Operations Research**	**3**	**2**	**1**	**0**	**0**

PREREQUISITE: None

COURSE OUTCOMES:

CO1	To develop mathematical operations research models from the verbal descriptions of real systems.
CO2	To understand the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type.
CO3	To understand and apply the mathematical tools that are needed to solve real life optimization problems related to assignments, transportation, replacement, waiting line, inventory etc.
CO4	To implement operational research knowledge in real world decision making

COURSE CONTENTS

- The Art and Science of Operation Research, Linear Programming: Formulation and Solution, Duality and Sensitivity Analysis.
- Transportation and Assignment Models, Integer Programming.
- Decision under Risk, Decision under Uncertainty, Game Theory.
- Basic elements of queuing model, Role of Poisons and Exponential distributions, Queuing with Combined arrival and departures, Simulation

References-

Text Books/ Reference books-

1. Operations Research, Taha, Hanmdy A., Prentice Hall, 2019
2. Principles of Operations Research, Wagner, Harvey M., McGraw hill,
3. Operations Research, Rao. K.C., Alpha Science Intl. Ltd., 2005.

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical
22MEP306	**CAD & CAM Lab**	**1**	**0**	**0**	**2**

COURSE OUTCOMES:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.
The student will be able:

CO 1	To understand the Science behind the CAD Software's
CO 2	To use the software packages for drafting and modelling
CO 3	To create 2D and 3D models of Engineering Components
CO 4	To create parts by using CNC programming

COURSE CONTENT

- Introduction and different features of the CAD/CAM Software
- To experiment for mathematical elements of Curves for geometric modeling, 2-D and 3D drafting and Assembly for a standard component using geometric modelling software.
- To move from CAD to CAM tabs in CAD/CAM software for CNC part programming
- To study the working principle and dimension systems in CNC machines.
- To study the common codes used in programming of CNC machines tools.
- To study various safety features of CNC Machine and Work offset Procedure on CNC milling machine.
- Manual and CAD based part programming using G and M codes for Linear and circular interpolation, Pocket milling, slotting, peck drilling and other fixed canned cycles on vertical milling machine tool.
- Manual and CAD based part programming using G and M codes for turning, step turning, taper turning on cylindrical components using CNC Lathe machine tool.
- Experimentation on design, slice and printing a standard component involving CAD/CAM tool for 3D printing purpose.

REFERENCE BOOK(S)/ TEXT BOOK(S)

1. Zeid, I., "Mastering CAD/CAM", Tata McGraw Hill, 2007.
2. Mortenson, M. E., "Geometric Modeling", 3rd Ed., Industrial Press. 2006.
3. Groover, M. P., "Automation, Production systems and Computer Integrated Manufacturing", 3rd Ed., Prentice-Hall, 2007.
4. Chang, T.-C., Wysk, R. A. and Wang, H.-P. "Computer Aided Manufacturing", 3rd Ed., Prentice Hall, 2005.
5. Lynch, M., "Computer Numerical Control for Machining", McGraw-Hill, Latest edition

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MEP307	**Industrial Engineering Lab**	**1**	**0**	**0**	**2**	**0**

PREREQUISITE: None

COURSE OUTCOMES: On successful completion of the course, the student will be able to:

CO1	Identify and apply various method improvement techniques.
CO2	Perform time study and estimate the standard time for doing a particular job.
CO3	Measure the anthropometric data and analyze it to interpret the relevant outcomes.
CO4	To be able to apply the concept of VE/VA.

COURSE CONTENTS

- Method to Improve the Assembly and Dis-assembly of Nut-Bolt and Washers
- Activity Charts
- Pegboard Study Experiment
- Determination of Standard Time by using Stop Watch Time Study Technique
- Rating Practice using Pack of Cards
- Measurement of Anthropometric- Data
- Ergo cycle Experiment
- Performing value analysis of given product.

References:

1. "Introduction to Work Study", International Labour Organisation.
2. "Motion and Time Study; Design and Measurement of Work", Ralph M. Barnes, John Wiley.
3. "Contemporary Engineering Economics", Chan S. Park, Prentice Hall of India, 2002.