DESIGN OF TRANSMISSION ELEMENTS

11-ME401

L-T-P
3-1-0

Introduction: Types of drives and their classification, merits and de merits and applications of drives

Belt Drives :Materials and construction of flat and V-belts, Geometric relationships for length of belt, Power rating of belts, Maximum power condition, Selection of flat and V-belts from manufacturer's catalogue, Belt tensioning methods, Relative advantages and limitations of flat and V-belts, Construction and applications of timing belts.

Chain Drives: Construction and materials of roller chain, Length of chain and number of links, Polygonal effect, Power rating of roller chains, Construction of sprocket wheels, Silent chains, Relative advantages and limitations-of chain drives.

Bearings: Classification, modes of Lubrication, Sliding contact bearing design, bearing materials, selection of lubricant. Rolling contact bearings- types, selection of ball, roller bearings-under static load, dynamic load.

Brakes and Clutches: Introduction to Brakes, Types, Analysis and Design of Block brakes, internal shoe Brakes, End shoe Brakes, Pivoted shoe Brakes, Band Brakes, Temperature rise, Friction materials. Introduction to Clutches, Analysis and Design of simple and multiple disc Clutches, Cone Clutches and Centrifugal Clutch, friction materials, comparison of Brakes and Clutches.

Spur Gears :Introduction, force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Estimation of module based on beam and wear strength, Methods of lubrication.
Helical Gears: Transverse and normal module, Virtual number of teeth, Force analysis, Beam and wear strengths, Effective load on gear tooth, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears.

Bevel Gears: Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis, Design criteria of bevel gears, Beam and wear strengths, Dynamic tooth load by velocity factor and Buckingham's equation, Effective load, Design of straight tooth bevel gears, Selection of materials for bevel gears, comparison of spiral bevel gears and hypoid gears and straight tooth bevel gears.

Design and analysis of worm gear drive

Text Books:
1. Bhandari V.B., "Design of machine elements", Tata McGraw Hill Public Co. Ltd.
2. Shigley J.E, "Mechanical Engineering Design", McGraw-Hill, 1996.

Reference books:
1. Black P.H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. Ltd.
   "Usage of: "Design Data", P.S.G. College of Technology, Coimbatore. is recommended

ENGINEERING MANAGEMENT

11-ME402

L-T-P
3-0-0

(Pre-requisite = NIL) 3 Credits

General Management: Definition, Functions of management, Principles of management, Types of organization structure- line, functional, line & staff.
Forms of business organization: Salient features of sole proprietorship, partnership, joint stock company – private limited and public limited company.

Human resource management: definition, functions of HRM, staff role in HRD, Job design, Job evaluation. Motivational theories: Maslow's Hierarchy of needs, Hedsberg two factor theory.
Marketing management: Functions of marketing, channels of distribution, advertising and sales promotion, product life cycle, pricing, market research.

Financial management : Concept of interest : simple interest, compound interest, equivalent cash flow diagrams, present and future worth of a single amount, concept of Annuity – uniform series to present and future worths, differed annuities. Economic evaluation of alternatives: Present worth method, future worth method, annual equivalent method, internal rate of return method.
Depreciation : Definition, types, Common methods – straight line, declining balance, sum of years digits method.

Materials management : Introduction, Purchasing – definition , objectives, source selection, vendor rating, procurement methods, break-even-analysis.
Quality control: Inspection and types, Quality – SQC, control charts for variables, attributes, application and construction of charts, problems, Acceptance sampling, O.C.curve.

Inventory management : definition, types, various costs associated, selective control techniques – A B C analysis. Concept of EOQ model with constant demand & shortages, EPQ model, make or buy decision analysis, quantity discounts.

TEXT BOOKS
1. A.R.Aryasri, Management Science, 2nd Edition, 2005, Tata Mc-Graw Hill.
2. R.K.Gupta & Sashi K.Gupta, Industrial Organization & Management, Kalyani Publishers.

REFERENCES
1. William G. Sullivan, James A. Bontadelli, Elin M. Wicks, Engineering Economy, 11th Edition, 2001, Pearson Education Asia.
2. Banga T, Sharma Sc, Industrial Organization & Engineering Economics, 2007, Khanna Publications.
3. Philip Kottler, Marketing Management, 13th Edition, 2008, PHI.

CONDITION MONITORING AND FAULT DIAGNOSIS

11-ME430

L-T-P
3-0-0

Productivity, Quality circle in Maintenance, Reliability, Reliability assurance, Maintainability vs. Reliability.Failure analysis, Equipment downtime analysis, breakdown analysis.

Maintenance type, Breakdown maintenance, Corrective maintenance, Opportunity maintenance, Routine maintenance, Preventive and predictive maintenance, Condition based maintenance systems, Design-out maintenance.

Equipment health monitoring, Signals, Online & off-line monitoring, Visual & temp. Monitoring, Leakage monitoring, Lubricant monitoring and sensors.

Ferrography, Spectroscopy, Crack monitoring, Corrosion monitoring, thickness monitoring. Noise/sound monitoring, Smell/Odour monitoring, Thermography and sensors.

Virbration-characteristics, Causes of vibrations, identification, measurement of machine vibration. C.M.of lubes and hydraulic systems, C.M. of pipe lines, Selection of C.M.techniques Advantages vibration signature, fault diagnosis.

Text Books:
1. Collacott, R.A., Mechanical Fault Diagnosis and Condition Monitoring, Chapman & Hall, London, 1982.
2. John S. Mitchell, Introduction to Machinery Analysis and Monitoring, Penn Well Books, Penn Well Publishing Company, Tulsa, Oklahoma, 1993.

Reference books:

1. Nakra, B.C. Yadava, G.S. and Thuested, L., Vibration Measurement and Analysis, National Productivity Council, New Delhi, 1989.
2. Pox and Zenkins, Time Series Analysis.
3. A.H. Search, Vibration and Time Series Analysis.*".*

SUPPLY CHAIN MANAGEMENT

11- ME431 / 11-OE402

L-T-P
3-0-0

Pre-requisite   NIL 3 Credits

Introduction – Definition, supply chain, supply chain management-Decision phases in supply chain management-process view of supply chain-Managing uncertainty-Global optimization-importance of supply chain management-Key issues in supply chain management.

Supply chain management –Competitive and supply chain strategies- Achieving strategic fit-Expanding strategic scope-Drivers of supply chain-Frame work for structuring Drive-inventory, Transportation, Facilities, Information, Obstacles to Achieving fit

Network of supply chain - role of net work design,- Factors influencing net work design decisions-Frame work for net work design decision,
Integration of supply chain – Push, Pull & Push –pull system: Push based supply chain, pull based supply chain, Push-Pull supply chain-Demand driven strategies – impact of the internet on supply chain strategies- distribution strategies-Centralized Vs decentralized control.

Value of information in supply chain- Bullwhip effect, Quantifying the bull whip effect, impact of centralized information on the bull whip effect, methods for coping with bull whip effect - lead time reduction.
Organization and information system : The management task, logistics organization, the logistics information systems- topology of sc application – MRP, ERP, Warehouse management system, product data management – cases.

Information technology in supply chain- Goal of supply chain information technology – supply chain IT frame work- customer relation ship management - internal supply chain management-supplier relation ship management- integrating supply chain information technology- future of IT in supply chain
Role of E-business: Impact of e-business, value of e-business, setting of e-business in case studies.

TEXT BOOKS
1. Sunil Chopra, Peter Meindl, Supply Chain Management, 2006, PHI.
2. Ronald H. Ballou, Business Logistics/ Supply Chain Management, 2008, Pearson Education.

REFERENCES
1. G.Raghuram, Logistics & Supply Chain Management, 2004, Macmillan India Ltd.
2. Altekar, Supply Chain Management, 2007, PHI.

MODERN MANUFACTURING PROCESSES

11-ME432   *L-T-P*

                                                                          3-0-0

INTRODUCTION: Need for Non Traditional machining methods, Classification of modern machining processes – considerations in process selection. Materials, Applications.

MECHANICAL ENERGY BASED PROCESSES: Study of Process Parameters and its variables of Abrasive jet machining, Water jet machining and Ultrasonic Machining: Basic principles, equipments, mechanics of metal removal, MRR, application and limitations.

CHEMICAL ENERGY BASED PROCESSES: Study of Process Parameters and its variables of Chemical machining. **ELECTRO – CHEMICAL ENERGY BASED PROCESSES**: Study of Process Parameters and its variables of electro chemical machining, electro-chemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Surface finish and accuracy economic aspects of ECM – Simple problems for estimation of metal removal rate.

THERMO ELECTRIC ENERGY BASED PROCESSES: Study of Process Parameters and its variables of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes, Electron Beam Machining, Laser Beam Machining, Ion Beam Machining, Plasma arc Machining – thermal features, cutting speed and accuracy of cut. Metal removal mechanism, accuracy and surface finish. **ADVANCED WELDING TECHNIQUES**: Study of Process Parameters, principles of operation and applications of Electron Beam welding, Plasma Arc Welding, Laser beam Welding, Explosive welding, Diffusion welding, Friction welding, Ultrasonic welding, stud welding, under water welding and cold welding. **HIGH VELOCITY FORMING PROCESS**: Introduction, selection, comparison of conventional, explosion forming process, Electro hydraulic forming, magnetic pulse forming, petro forge hammer.

TEXT BOOKS:

1. Advanced machining processes / Jain V K / Allied Publishers, 2005
2. Welding and Welding Technology, Richard L. Little, McGraw Hill.Inc., U S,Ist Edition.

REFERENCE BOOKS:

1. Modern Machining Processes / Pandey P.C. and Shah H.S./ TMH, 1995
2. New Technology / Bhattacharya A/ The Institution of Engineers, India 1984
3. Production Technology -- H.M.T.
4. High velocity forming of metals -ASTME Prentice Hall

TURBOMACHINES

11-ME433

L – T – P
3 – 0 – 0

Introduction: Classification of fluid machines. **Rotodynamic machines:** Basic equation of energy transfer, definition of impulse and reaction machines, principle of similarity and dimensional analysis in rotodynamic machines, concept of specific speed. Pelton wheel, analysis of force and power generation in a Pelton wheel, governing of Pelton wheel. Francis turbine, velocity triangles and analysis of force, power and efficiency, net head across Francis turbine, draft tubes. Kaplan turbines. Characteristics of reaction turbines. Comparison of specific speeds of hydraulic turbines. **Pumps:** Classification of pumps. Centrifugal pump, pumping system and net head developed by a pump, manometric efficiency, losses in centrifugal pumps, head discharge and power-discharge characteristics of a centrifugal pump. Axial flow pump. Matching of pump and system characteristics, pumps in series and parallel. Cavitation, NPSH. **Reciprocating Machines:** Reciprocating pump, head-discharge characteristics, rate of delivery. Multi-cylinder pumps. Air vessels. Gear pump. **Air compressors:** Centrifugal compressor, principle of operation, velocity triangles, stagnation pressure and temperature rise. Axial flow compressor, cascade flow and nomenclature, velocity triangles, degree of reaction, stalling and surging of compressor. **Fans and Blowers; Testing and characteristics of Fluid Machinery.**

TEXT BOOKS:

1. Turbine, Compressors and Fans by S.M.Yahya, TMH
2. Hydraulic and Compressible Flow Turbomachines by A.T.Sayers, Mc-Graw Hill

REFERENCE BOOKS:

1. Fundamentals of Turbomachinery by William W. Peng, John Wiley & Sons
2. Principles of Turbomachinery by Seppo A. Korpella, John Wiley & Sons

POWER PLANT ENGINEERING

11-ME435

L – T – P
3 – 0 – 0

Introduction, Energy sources, types of power plants. **Hydro Electric Power Plant:** Hydrology, Rainfall, Run off and their measurement, hydrograph, Flow duration curve, Mass curve and calculation of storage capacity, site selection of hydro plant, different types of hydro plants. **Diesel Power Plants:** Classification, main components of plant, plant layout, application and comparison with other plants. **Thermal Power Plant:** General layout, Fuels, Coal analysis, Coal handling, Burning of coal - stoker and pulverized Systems, Ash handling systems, ESP, cooling ponds and towers (wet and dry types), Deaerators. **Nuclear Power Plants:** Nuclear Fission, Nuclear Fuels, Components of Reactor, types of Nuclear Reactors, Breeding, Fast Breeder Reactor, Radiation shields, Nuclear waste disposal. **Power Plant Economics:** Various performance, Factors (load factor, diversity factor, use factor etc.). Fixed costs, operating costs, cost per kWh, comparison of fixed and operating costs of hydro, thermal, nuclear plants, power tariffs. **Non Conventional Energy Sources:** Solar Energy **-** Solar collectors, solar energy storage, solar ponds, solar energy utilization and applications. **Wind Power:** Basic principle, different types of wind mills, wind energy conversion systems, other applications. **Geothermal Power:** sources, energy conversion system. **OTEC:** ocean thermal energy conversion systems, introduction to tidal power. **Direct Energy Conversion Systems:** Fuel cells, MHD, Solar cell. **Pollution And Control:** Introduction, particulate and gaseous pollutants, thermal pollution and solid waste pollution, methods to control pollution - brief description. **Energy Management & Auditing:** Role of Energy Manager, Energy Audit-types, Sankeyiagram for Energy Audit, Principle of Energy Conservation, Energy Conservation Technologies.

TEXT BOOKS

1. Power Plant Technology, M.M. El-Wakil McGraw Hill
2. Power station Engineering and Economy by Bernhardt G.A.Skrotzki and William A. Vopat- Tata McGraw Hill

REFERENCES:

1. An introduction to power plant technology by G.D. Rai-Khanna Publishers, Delhi
2. Power Plant Engineering by P.K. Nag, Tata McGraw Hill
3. Power plant engineering by Nagpal, Khanna Publications,New Delhi.

WORK STUDY & ERGONOMICS

11-ME436 / 11-OE404

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L-T-P
3-0-0

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(Pre-requisite = NIL) 3 Credits

Productivity: Meaning and importance of productivity, factors affecting productivity. Productivity and living standards, productivity measurements, work design and productivity. Operations analysis: total time for a job or operation, total work content and in-effective time , methods and motions , graphic tools.

Work study : Techniques of work study, basic procedure of work study.

Method study: Tools for recording techniques – Flow process chart, flow diagram, string diagram, multiple activity chart, Man-machine chart.
Micro motion study: Therbligs, motion economy principles, SIMO chart.

Work measurement : Stopwatch time study procedure - breaking the job into elements, timing methods, number of cycles to be timed, rating, rating methods, allowances, setting standard time, PMTS, MTM.
Work sampling: Confidence levels, number of observations, use of random number table.

Measuring work by physiological methods: heart rate measurement, oxygen consumption, metabolic measurement.
Fatigue, factors affecting degree of fatigue-hours of work, rest periods, lighting, heating, ventilation, noise, vibration, mental attitude.
Ergonomics: Introduction, human factors, applications in work place layout.

Wage payment plans: introduction, classification of wage incentive plans, types-straight piece rate, straight piece rate with a guaranteed minimum wage, differential piece rate system, Halsey plan, Rowan plan, Gantt plan, Bedaux plan, Emerson's efficiency plan, group plan.

TEXT BOOKS
1. Introduction to work study- ILO, 4th Revised Edition, 1992.
2. Motion and Time study- Ralph M Barnes, John Wiley, 8th Edition, 1985.

REFERENCES
1. Human Factors in Engineering Design-6th Edition, M S Sanders and E J McCormic, McGraw Hill.
2. Banga T, Sharma Sc, Industrial Organization & Engineering Economics, 2007, Khanna Publications.

CONCURRENT ENGINEERING

11-ME437

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L-T-P

3-0-0

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Introduction: Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs. **Support for CE:** Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process. **Design Product for Customer:** Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). **Modeling of Concurrent Engineering Design:** Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns. **Design for Manufacture (DFM):** Introduction, role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assemblability. **Quality by Design:** Quality engineering & methodology for robust product design, parameter & Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach. **Design for X-ability:** Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

Text Books:

1. Geoffrey Boothroyd, Peter Dewhurst, Winston Anthony Knight-" Product design for manufacture and assembly", Taylar & Francis

2. Andrew Kusaik, "Concurrent Engineering : Automation tools and Technology" Wiley, John and Sons Inc., 1992

Reference Books:

1. "Concurrent Engineering fundamentals: Integrated product Development" Prasad, Prentice Hall, 1996.

2. Sammy G Sinha, "Successful Implementation of Concurrent Product and Process", Wiley, John and Sons Inc., 1998.

ADVANCED STRENGTH OF MATERIALS

11-ME330

L-T-P
3-0-0

INTRODUCTION: Classification of Beams, Types of Stresses, Overview of shear force and bending moment diagrams of statically determinate beams.

STATICALLY INDETERMINATE BEAMS: Statically indeterminate Beams, Analysis by the differential equations of the Deflection curve, Moment Area Method.

CONTINUOUS BEAMS: Clapeyron's theorem of three moments, Beams with constant and varying moments of inertia.

CURVED BEAMS: Stresses in Beams of small and large initial curvature, The Winkler-Bach theory, Stresses in Crane Hook and C-Clamp with Rectangular, Circular and Trapezoidal cross-sections.

Unsymmetrical Bending: Shear Center, Examples of unsymmetrical bending, Simple problems on shear center.
CENTRIFUGAL STRESSES: Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.

Photo elastic and Moire Experiment Methods: Experimental methods and verification, Photo elastic stress measurement, Circular polariscope, Determination of principal stresses, 3-D photo elasticity, Moire method.

ENERGY METHODS: Introduction, Principles of virtual work, unit load, Method for calculating displacements, Strain energy & complementary energy, Strain Energy Methods

Text books:
1. Gere and Timoshenko "Mechanics of Materials" CBS publishers, 2nd edition.
2. Daley and Relay "Experimental stress analysis"

Reference Books:
1. Strength of Materials by Sadhu Singh

ROBOTICS

INTRODUCTION: Introduction to Robotics, Major components of a Robot, Classification of Robots- Classification by configuration, by power drive and by control method, Specifications of Robots, Fixed versus flexible automation, Economic analysis.

ROBOT END EFFECTORS: Introduction, types of end effectors- grippers and tools, gripper mechanisms, Considerations in the selection and design of remote centered devices.

ROBOTIC SENSORY DEVICES: Objective, Non-Optical position sensors-Potentiometers, Synchros, Inductosyn, optical position sensors-opto interrupters, Optical encoders (absolute & incremental).

PROXIMITY SENSORS: Contact type, non-contact type-reflected light and scanning laser sensors.

TOUCH & SLIP SENSORS: Touch sensors- proximity Rod & Photo detector sensors, Slip sensors – Forced oscillation slip sensor, interrupted type slip sensors, force and torque sensors.

CONTROL SYSTEMS: Basic control systems, concepts and models- mathematical models, Transfer function, Block diagrams- configuration of a control system for a robot joint.

CONTROLLERS: On-off control, Proportional control, Integral control, Proportional plus Integral control, Derivative control, Proportional plus derivative control, PID control, Control system analysis.

PLC's, Microprocessors and computer control methods and their programming.

ROBOT APPLICATIONS: Industrial Applications – Material Transfer, material handling, Loading and unloading, processing, spot and continuous arc welding, spray painting, grinding, Assembly and Inspection and Non-Industrial Applications.

SELECTION OF ROBOT DESIGN: Robotic systems, design based case studies of problems derived from domestic, industry, defense for example- An aerial Surveillance robot, Automated guided vehicles, Multi Arm Industrial Robot, Underwater Vehicles, Medical and Surgical Robots etc.

<u>**Recommended Text Books**</u>**:**
1. Robotic engineering by Richard D. Klafter (PHI)
2. Industrial robotics by Mikell P.Groover, (MGH)
3. Robotics and Control by R K Mittal (MGH)

<u>Recommended References</u>:

1. Introduction to Robotics - John J. Craig (Pearson Education India)
2. Robotics Fundamental concepts and analysis: Ashitava Ghoshal (Oxford Higher Education).
3. Robotics – K.S. Fu, Gonzalez & Lee (MGH)
4. Robotics For Engineers by Yoram K koren (MGH)

MECHATRONICS

INTRODUCTION TO MECHATRONICS: Introduction, Elements of Mechatronic system, Applications.

SENSORS AND TRASDUCERS: Introduction, Performance terminology, Displacement-Position-Proximity sensors, Velocity and motion, Force, Fluid Pressure, Liquid flow, Liquid level, Temperature, Light sensors, Selection of sensors.
SIGNAL CONDITIONING: Introduction, data acquisition –Quantizing theory, Analog to Digital conversion, Digital to Analog conversion.

DATA PRESENTATION SYSTEMS: Data presentation elements, Data acquisition systems, systems measurement, Testing and calibration.
ACTUATION SYSTEMS: Pneumatic and hydraulic actuation systems, Stepper Motors

SYSTEM MODELS: Modeling of one and two degrees of freedom Mechanical, Electrical, fluid and thermal systems. Block diagram representations for these systems.

SYSTEM RESPONSE: Introduction, Transfer function of Mechanical and Electrical systems, Time response analysis of mechanical systems.

CLOSED LOOP CONTROLERS: Continuous and discrete processes, control modes, Two-step, proportional, Derivative, integral, PID controllers.

DIGITAL LOGIC: Logic gates, Boolean algebra, Karnaugh maps.

PLC: Introduction, basic structure, I/P and O/P processing, programming, ladder diagrams, Timers, Internal relays and counters ,data handling, selection of a PLC.

DESIGN: Mechatronic systems Design based case studies of problems derived from Domestic, Industry, Defense for example An Aerial Surveillance camera, Automated Guided Vehicles, Fully Automatic Car Parking System, Self Controlled Washing Machines, Intelligent Televisions etc.

Recommended Text Books:

1. W.Bolton,"Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" , 3rd Edition, Pearson education,2007.

2. David G. Alciatore, Michael B. Histand ," Introduction to mechatronics and measurement systems", 2nd Edition, McGraw-Hill Professional, 2002.

Recommended References:

1. Godfrey Onwubolu, " Mechatronics: Principles and Applications" 1st Edition, Elsevier, 2005.
2. Robert H. Bishop " Mechatronics: An introduction" CRC Press, 2006.
3. NitaigourPremchandMahalik, "Mechatronics", Tata McGraw-Hill, 2003.

HMT Limited, "Mechatronics", McGraw-Hill Education (India) Pvt Ltd, 2000