MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering
For batches admitted in Academic Session 2018-19 Batch

120601: Advanced Production Technology

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Department Core-DC	Advanced Production Technology	120601	2	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the student understand:

1. the application of computers in various aspects manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity and reduces the unnecessary costs.

2. the fundamental of automation and brief history of robot configurations, sensors, end effectors, vision systems and to impart knowledge of various additive manufacturing Technologies for application to various industrial needs.

Pre-requisite: Manufacturing Processes, Metal cutting

Syllabus

UNIT-I FUNDAMENTALS OF NC, CNC & DNC MACHINES: Principles of numerical control, types of CNC machines, features of CNC systems, integration of CNC machines in CIM environment, Direct numerical control (DNC), Open loop system, Closed loop system.

UNIT-II CONSTRUCTIONAL FEATURES OF CNC MACHINES and PART PROGRAMMING: Features of CNC Machines such as Structure, Drive Mechanism, Main drive, feed drive, Spindle Motors, Axes motors, Tool magazines, ATC, Control systems, Feedback devices, Input media and coding formats. Manual part programming for Lathe, Drilling and Milling machines, Cutter diameters and Length compensation. Computer assisted part programming Languages APT, EXPAT, ADAPT, COMPACT .Computer numerical control, direct and distributed numerical control, adaptive control.

UNIT-III GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS: - GT Part Families, Classification & coding, M/C Cell Design, Benefits of GT, FMS Workstations, Material Handling & Storage Systems, Computer Control System, Planning of FMS Analysis Methods. Basic Elements of an Automated system, Levels of Automation.

UNIT-IV INDUSTRIAL ROBOTICS: Industrial Robots and their applications for transformational and handling activities. Configuration and motions, robot classification and their performance capabilities, hardware of robots, Actuators, sensors and end effectors, selecting assembly machines Feeding and transfer of arts, applications of robots in manufacture and assembly.

UNIT-V ADDITIVE MANUFACTURING: Introduction and Basic Principles of Additive Manufacturing, Development of Additive Manufacturing Technology, Generalized Additive Manufacturing Processess, Photopolymerization Processes / Powder based system Processes / Extrusion-Based Systems, Material Jetting / Binder Jetting / Sheet Lamination/sintering Processes,

Prototyping, Rapid Tooling, Applications of Additive Manufacturing, Comparison of Additive Manufacturing Methods.

Course Outcomes: After successful completion of this course students will be able to:

CO1 **Illustrate** the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion.

CO2 **Demonstrate** the machining operations, programming languages and its control system used for solving practical problems of automation based

CO3 **Compare** the components of computer integrated manufacturing and integrate them in a coordinated manner.

CO4 **Decide** between the various trade-offs when selecting AM processes, devices and materials to suit particular engineering requirements.

CO5 **Designing** Flexible manufacturing cell after carrying out Group technology study, Automated Material Handling Systems, Automated Inspection Systems and finally creating FMS.

CO6 **Knowledge** in the broad spectrum of Production Engineering.

Text & References Books:

1. Automation, Production system and computer integrated manufacturing by M.P. Groover, PHI publication.
2. CAD/CAM by P. N. Rao, P. N. Rao, Tata McGraw Hill publication
3. Computer control of machine tools by Koren Yoram, Tata McGraw Hill publication
4. Manufacturing Engineering And Technology by Serope Kalpakjian, PHI publication.
5. CAD/CAM/CIM by Bhupendra Gupta, Dhanpat Rai publication
6. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009.
7. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005.

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120611: Vibration and Noise Engineering

Category	Title	Code	Credit - 4			Theory Paper
Departmental Elective-DE1	Vibration and Noise Engineering	120611	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Prerequisite:
Engineering Mathematics, Basics of Electrical and Electronics, Theory of Machines, Mechanics of Materials

Course Objectives:
1. To understand the fundamentals of Vibration Theory.
2. To be able to mathematically model real-world mechanical vibration problems.
3. To be able to resolve industrial problems related to vibration and noise.

Syllabus

Unit-I: Basics of Vibration: Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition, beats phenomena, undamped and damped vibrations, free and forced vibration**,** Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations using Newton's second law, D' Alembert's principle and Principle of conservation of energy.

Unit-II: Multi Degree Freedom System: Free Vibration equation of motion. Langranges Equations Matrix Method, Eigenvalues and Eigenvector problems.Modal Analysis.Forced Vibrations of undamped system and modal analysis.
Numerical Methods: Rayleigh`s Method, Rayleigh-Ritz Method, Holzer`s Method, Methods of Matrix iterations, Transfer Matrix Method, Impulse response and frequency response functions.

UNIT III Continuous System:
Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous systems.
Transient vibrations: Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response functions.
Vibration Control:
Balancing of rotating machine, In-situ balancing of rotors, control of natural frequency, introduction of damping, transmissibility, vibration isolation & vibration absorbers.
UNIT IV Vibration Measurement:
Transducers, FFT analyzer, vibration exciters, signal analysis. Time domain & Frequency domain analysis of signals.Experimental modal analysis, Machine Conditioning and Monitoring, fault diagnosis.

UNIT V Noise and Its Measurement:

Sound waves, governing equation its propagation**,** Fundamentals of Noise, Decibel, Sound Pressure level, Sound Intensity, Sound fields, reflection, absorption and transmission. Noise measurement, Sound meter, Allowed exposure levels and time limit by B.I.S., Octave Band analysis of sound, Fundamentals of Noise control, source control, path control, enclosures, noise absorbers, noise control at receiver.

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Course Outcomes: After completing this course students are able to:
CO1: **understand** basics of vibration and noise.
CO2: **define** the physical systems in to spring-mass-damper systems.
CO3: **use** different methods and principles applicable to dynamic systems.
CO4: **determine** responses of vibrating systems.
CO5: **analyse** the behaviours of physical systems.
CO6: **design** the mechanical systems by considering vibration and noise.

Text Books:

1. Mechanical Vibrations: G K Groover.

References Books:

1. Theory of Vibrations with Applications: W T Thomson CBS Publishers Delhi
2. Mechanical Vibrations: S SRao Addison-Wesley Publishing Co.
3. Fundamentals of Vibration: Leonard Meirovitch , McGraw Hill International Edison.
4. Principles of Vibration Control: Asok Kumar Mallik, Affiliated East-West Press.
5. Mechanical Vibrations A H Church ,John Wiley & Sons Inc
6. Mechanical Vibrations J P Den Hartog ,McGraw Hill.
7. Mechanical Vibration Analysis: Srinivasan ,McGraw Hill.
8. Vibration and Noise for Engineers: KewalPujara ,DhanpatRai& CO.

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120612: Statistical Quality Control

Category	Title	Code	Credit-4			Theory Paper
Departmental Elective-DE1	Statistical Quality Control	120612	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course Objective: To make the students to understand:
1. The concepts of inspection techniques.
2. About reliability, life testing and costing of product.

Syllabus

Unit-I: Statistical Concepts:
Inspection types, Organization, Advantages & Limitations. Comparison with quality control. Development. Statistical Concept-Frequency, Tally Sheet, Histogram, Bar Chart, Mean, Median, Mode, Standard Deviation. Variance. Concept of Probability, Hyper, Geometrical, Binomial, Poison & Normal Distribution, Area Under Normal Curve, Estimation of Parameters.

Unit-II: Control Chart Techniques:
Control Charts for Average, range & Standard Deviation, Fraction Defective & Percent Defectives, Control Chart for No. of Defects Per Unit.

Unit-III: Acceptance Sampling:
Fundamentals, OC Curves, Single Sampling Plan, Double Sampling plan, Sequential Sampling Plan. AQL & AOQL. Dodge – Roming Plan for Lot by Lot Acceptance Sampling for Attributes.

Unit-IV: Reliability, Cost & Design Aspects of S.Q.C.:
Life Testing & Reliability, Cost due to Poor Quality, Quality Cost With- 100% inspection, Sampling Inspection & NO. Inspection. Statistical Aspect of Tolerance Setting Design.

Unit-V: Quality Assurance:
Quality planning, Customer Satisfaction, History of Quality of Design, Quality of Conformance, Contribution of Juran, Demming Crosby, Ishikawa, Taguchi, Feighbaum, Quality Environment. 5-S, Vendor Rating, Quality in Purchasing, Quality After Sales Services, Quality of Performance, Human Resources. ISO Quality Standards-History, Need & Evaluation of Common Quality Standards. Product V/S System Quality. ISO 9000 Series of Standards & its Revisions. Management Participation, Quality Policy, Quality manual, Training Manual for Certification Bodies NACCB (UK), RVC (Netherlands), RAB(ASQC) USA, BIS. Certification Procedure, Quality Audit, Lead Assessors. ISO-14000 Standards. Limitations & Advantage for ISO Standards.

Course Outcomes: After successful completion of this course students will be able to:
CO1: Draw the histogram, bar charts.
CO2:**State** various techniques including various variable and attribute control charts
CO3: Relate mathematical standard plots for defect analysis.
CO4: Justify the life cycle of component on the basis of Reliability and Quality.
CO5: Compare various statistical quality control tools.
CO6: Solve quality-related problems using these SQC tools and methods.

Text books:

1. Grant, Statistical Quality Control, McGraw Hill, New York.
2. Mahajan and Mahajan , Statistical Quality Control Laxmi publication

Reference books:

1. M. Jeya Chandra ,Statistical Quality Control by, CRC Press

2. Douglas C. Montgomery ,Statistical Quality Control, John Wiley & Sons
3. Amitava Mitra, Fundamentals of Quality Control and Improvement , John Wiley & Sons

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120613 : Work Study and Ergonomics

Category	Title	Code	Credit-4			Theory Paper
Departmental Elective-DE1	Work Study and Ergonomics	120613/190612	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course Objective: To make the students to understand:
1. Concept and significance of work study and ergonomics.
2. Various techniques of work-study for improving the productivity of an organization.

Syllabus

Unit -I Human being in Man Made World, Gross Human Anatomy, Anthropometrics, Static and Dynamic, Muscles and Work Physiology, Static and Dynamic Work including Maximum Capacity.
Unit-II Biomechanics, Environmental Condition including Thermal, Illumination Noise and Vibration, Biological Transducer and Nervous system including their Limitations. Control and Displays Psycho Physiological aspects of Design. Research Techniques in Ergonomics .Generation. Interpretation and application as statistical Methods. Case Analysis
Unit-III Method Study: - Selection of Problem, Application of critical examination techniques. Preparation of work Study Reports, Development of improved methods, preparation for and presentation of improved methods, implementation of improved methods, follow-up techniques and report.
Unit-IV Work Measurement: - Work Sampling. Fundamental statistical concepts sample size, procedure for making a work sampling study, determining time standards by work sampling, practical applications, advantages and disadvantages.
Unit-V Micro Motion Study:- PMTS. MTM Systems work factor system and Production Incentives

Course Outcome: After successful completion of this course students will be able to:
CO1. Identify potential and current OH&S hazards in the workplace relating to ergonomics issue.
CO2. Describe relation between human motion and industry.
CO3. Calculate the production capacity of man power of an organization.
CO4. Analyze the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.
CO5. Devise appropriate wage and incentive plan for the employees of an organization.
CO6. Design physical and psychosocial work system and work places.

Text & References Books:

1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
2. Lakhwinder Pal Singh, “Work Study and Ergonomics” CAMBRIDGE , 2010.
3. S.K. Sharma Savita Sharma , “Work Study and Ergonomics” S K Kataria and Sons 2006.
4. P.C.Tiwari, “Work Study and Ergonomics” CRC Press , 2004.
5. Suresh Dalela and Saurabh Dalela, “Work Study and Ergonomics” CRC Press , 2001.
6. Marvin E, Mundel & David L, "Motion & Time Study: Improving Productivity", Pearson Education,2000.
7. Benjamin E Niebel and Freivalds Andris, "Methods Standards & Work Design", Mc Graw Hill, 1997.

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120614: Turbo Machinery

Category	**Title**	**Code**	**Credit - 4**			**Theory Paper**
Departmental Elective –DE1	Turbo Machinery	120614	L	T	P	Max.Marks-70
			4	-	-	Min.Marks-22
						Duration-3hrs

Course Objectives: To make the students to understand:
1. To enable the students know the operation of turbo machines for compressible and incompressible fluids.
2. To provide students thorough understanding of velocity triangles, thermodynamic plots and losses in turbo machinery.

Syllabus:

UNIT-I Fundamentals Of Turbo Machinery:
Energy Transfer in Turbo Machines Application of first and second Laws 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, one dimensional analysis only.

UNIT-II Steam Turbine:
Impulse staging, velocity and pressure compounding utilization factor, analysis for optimum U.F. curtis stage, and Rateau stage, including qualitative analysis. Effect of blade and nozzle losses on Vane efficiency, Stage efficiency. Analysis for optimum efficiency vortex types of flow, flow with constant reaction. Governing and Performance characteristics of steam turbines.

UNIT-III Water Turbines:
Classification, Pelton, Francis and Kaplan turbines, vector diagrams and workdone, Draft Tubes, governing or water turbines, cavitation problem, methods to avoid cavitation, performance characteristics of water turbine.

UNIT-IV Centrifugal Pumps:
Classification, advantage over reciprocation type, definition of manometric head gross head, static head, vector diagram and work done. Performance and Characteristics: Application of dimensional analysis and similarity to water turbine and centrifugal pumps, unit and specific quantities, selection of machines, Hydraulic, volumetric mechanical and overall efficiencies, Main and operating characteristics of the machine cavitation.

UNIT-V Rotary Fans, Blowers and Compressors:

Classification based on pressure rise, Centrifugal and axial flow machines.
Centrifugal Blowers: Vane shapes, Velocity triangle degree of reactions, slip cost event speed of machine. Vane shape and stresses, efficiency characteristics. Fan laws and characteristics.
Centrifugal compressor : Vector diagrams, work done, temp, and pressure ratio, slip factor , was input factor, pressure coefficient, Dimensions of inlet eye, impeller and diffuser.
Axial flow compressors: Vector diagrams, work done factor, temp. and pressure ratio, degree reaction. Dimensional Analysis, Characteristics, surging, Polytropic and isentropic efficiencies.

Course Outcomes: After successful completion of this course students will be able to:
CO1:Understand the working principles of rotating machines.

CO2:Describe the velocity triangles, thermodynamic plots and losses in turbo-machinery.

CO3:demonstrate the knowledge of working, stages, performance characteristics, governing and selection of turbo machinery.

CO4:analyze energy transfer through graphical and analytical methods in turbo machines.

CO5:design different type of rotating machines

CO6:evaluate the performance characteristics of different kinds of turbo machines

Text Books:

1. Fluid mechanics and fluid power engineering – by Dr. D. S. Kumar, Kat Son, Latest edition
2. Thermal Engineering – by P L Ballaney, Khanna Publisher Latest edition.

Reference Books:

1. Thermal Engineering-by R.K. Rajput, Latest edition
2. Turbines, Fans & Compressors – by S.M. Yahya, TMH Latest edition
3. Fluid Mechanics, Thermodynamics of Turbomachinery, S. L. Dixon, Butterworth-Heinemann, Latest edition
4. Power plant engineering, P K Nag TMH, Reprint Latest edition

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120651/190651: Viscous Fluid Flow

Category	Title	Code	Credit - 4			Theory Paper
Departmental Elective-DE 2	Viscous Fluid Flow	120651/190651	L	T	P	As per SWAYAM/NPTEL norms
			4	-	-	

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_me45/preview
The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	09-04-2021	25-04-2021	12 Weeks

COURSE LAYOUT

Week 1: Introduction
Week 2: Steady One-dimensional Rectilinear Flows
Week 3: Steady Axisymmetric Flows
Week 4: Transient One-dimensional Unidirectional Flows
Week 5: Steady, Two-dimensional Rectilinear Flows
Week 6: Lubrication Theory
Week 7: Laminar Boundary Layers - I
Week 8: Laminar Boundary Layers - II
Week 9: Laminar Free Shear Flows
Week 10: Stability Theory
Week 11: Turbulent Flows - I
Week 12: Turbulent Flows - II

BOOKS AND REFERENCES

1. White, F. M., Viscous Fluid Flow, McGraw-Hill, 2011.
2. Papanastasiou, T. C., Georgiou, G. C., and Alexandrou, A. N., Viscous Fluid Flow, CRC Press, 2000.
3. Sherman F. S., Viscous Flow, McGraw-Hill College, 1990.
4. Ockendon H., and Ockendon J.R., Viscous Flow, Cambridge University Press, 1995.
5. Schlichting, H., and Gersten, K., Boundary Layer Theory, Springer- Verlag, 2000.

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120652 Fundamental of welding science and Technology

Category	**Title**	**Code**	**Credit - 4**			**Theory Paper**
Departmental Elective-DE 2	Fundamental of welding science and Technology	120652	L	T	P	As per SWAYAM/NPTEL norms
			4	-	-	

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_me23/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
18/01/2021	12/03/2021	21/03/2021	8 Weeks

COURSE LAYOUT (**Syllabus):**

Week 1 : Introduction and classification of welding

Week 2 : Nomenclature and symbol of welding joints

Week 3 : Power source of welding

Week 4 : Physics and principle of arc welding

Week 5 : Different type of welding methods and their details

Week 6 : Different type of welding methods their details

Week 7 : Different type of welding methods their details

Week 8 : Welding defects and inspection

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120655 Properties of Materials (Nature and Properties of Material: III)

Category	**Title**	**Code**	**Credit - 4**			**Theory Paper**
Departmental Elective-DE 2	Properties of Materials (Nature and Properties of Material: III)	120655	L	T	P	As per SWAYAM/NPTEL norms
			4	-	-	

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_me18/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
15/02/2021	09/04/2021	24/04/2021	8 Weeks

COURSE PLAN :

Week 1: Introduction to Engineering materials & Mechanical properties

Week 2: Atomic bonding and crystal structure

Week 3: Metals and Ceramics

Week 4: Polymers

Week 5: Composite Materials

Week 6: Smart Materials

Week 7: Materials selection in Engineering design

Week 8: Non-mechanical properties and Laboratory demonstration

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900101 (OC-1): Robotics

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Open Course-OC	Robotics	900101	2	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. Study and understand the concepts of robotics and mechatronics.
2. Impart basic knowledge about the different sensors and their applications in robotics.
3. Learn the basic fundamentals of actuation Systems.
4. To impart knowledge on the basic concepts of measurement, static and dynamic characteristics of measurement systems.
5. To work professionally in the area of robot programming.

Syllabus

UNIT - I Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system, Chain type: Serial manipulator and Parallel Manipulator. Components of Industrial robotics-recession of movement-resolution, accuracy and repeatability

Kinematic and Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors, Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, Force or Torque sensors.

UNIT - II Grippers - Mechanical Gripper-Grasping force, Magnetic gripper, vaccume cup gripper-considerations in gripper selection and design, **Industrial robots** specifications. Selection based on the Application.

UNIT – III Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix. Direct and Inverse Kinematics for industrial robots. Differential Kinematics for planar serial robots. **Dynamics**: Equations of motion, State-Space equation,

UNIT - IV Trajectory planning: Joint space scheme- Cubic polynomial fit, Obstacle avoidance in operation space-cubic polynomial fit with via point, Introduction Cartesian space scheme. Control-Interaction control, Rigid Body mechanics, **Control architecture**- position, path velocity, and force control systems, computed torque control, adaptive control, and Servo system for robot control.

UNIT – V Basics of data acquisition systems, Programming of Robots - programming methods (Arduino MATLAB, Bond Graph, etc.), Vision System, Bioinspired robots and applications, Teach pendent- overview of various textual programming languages, Application of knowledge.

Course Outcomes: After successful completion of this course students will be able to:

CO1. Understand importance of robotics and its impact on human safety, quality of life,economy, environment, etc.; basics of open-ended type of Robotic manipulators.

CO2. Discuss Kinematics and dynamics of open ended robotic mechanisms; Fixing frames

CO3. Ability to formulate, derive, analyse, design and synthesize kinematics and dynamics of open ended robotic mechanisms.

CO4. Apply detailed concepts relating to various actuators, sensors, and theirintegration with drives and signal conditioning for robotics

CO5. Impart knowledge on the basic concepts of measurement, static and dynamic characteristics of measurement systems. control theory and applying them to design and development of robots

Text & References Books:

1. Introduction to Robotics: Mechanics and Control, **by** John J. Craig, Addison-Wesley.
2. Introduction to Robotics **by** S. K. Saha, Tata McGraw-Hill Publishing Company Ltd.
3. Introduction to Robotics Analysis Systems, Applications **by** S. B. Niku of Pearson Education.
4. Industrial Robotics-Technology Programming and Applications **by** M. P. Groover, M. Weiss, R. N. Nagel and N. G. Odrey of McGraw-Hill Book and Company
5. Robotics: Fundamental Concepts and Analysis **by** A. Ghosal of Oxford University Press.
6. Robot Dynamics and Control, **by**Spong M. W., and Vidyasagar M., John Wiley & Sons.
7. Mechatronic Systems: Fundamentals **by** R. Iserman ofSpringer.
8. Fundamentals of Mechatronics **by** Musa Jouaneh of Cengage Learning.
9. Mechatronics **by**W.Bolton, Pearson education.
10. Micromechatronics, Modeling, Analysis, and Design with MATLAB **by** V. Giurgiutiu and S. E. Lyshevski, CRC Press.
11. Bond Graph in Modeling, Amalendu**by** Mukherjee, RanjitKarmakar and Arun Kumar Samantaray, Simulation and Fault Identification, I. K. International Publishing House Pvt.

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900102 (OC-1): Product Design

Category	Title	Code	Credit - 3			Theory Paper
Open Course-OC	Product Design	900102	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	-	

Course Objective:
The goal of the course is to give an introduction to multidisciplinary aspects of product development and innovation. Students will familiarize themselves with basic methodology and tools that can be used in product development projects. Practical problems will be considered in cooperation with companies in order to simulate real product development situations.

SYLLABUS

Unit 1:
Basic: Significance of product design, product characteristics, product design and development process, the challenges of product development, design morphology, sequential engineering design method**.**
Product Planning: Identifying opportunities evaluate and prioritize projects, allocation of resources.

Unit 2:
Identifying Customer Needs: Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs, Translating customer needs
Product Specifications: Establish target specifications, setting final specifications, product costing.

Unit 3:
Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output.
Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, design for manufacturing, design for assembly, and design for maintenance, design for environment.

Unit 4:
Concept Selection: Overview, concept screening and concept scoring, methods of selection, Creativity techniques.
Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, general theory of innovation and TRIZ, Value engineering applications in product development and design, Model-based technology for generating innovative ideas.

Unit 5:
Concept Testing: Elements of testing: qualitative and quantitative methods including survey, measurement of customer's response.
Intellectual Property: Elements and outline, patenting procedures, claim procedure.

Course Outcome: - After the completion of the course the student will be able to

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CO1. **Analyze** the demands and needs of customers to conceptualize product.
CO2. **Describe** the different steps involved in the product design.
CO3. **Analyze** the shortcoming in the product development.
CO4. **Identify** the opportunities to develop the product.
CO5. **Utilize** the recourses available in efficient manner for maximum productivity.
CO6. **Forecast** the impact of product on the surrounding environment.

Text books and References:

1. Ulrich K. T, and Eppinger S.D, Product Design and Development, Tata McGraw Hill.
2. Otto K, and Wood K, Product Design, Pearson.
3. George Dieter, Engineering Design, MGH New York.
4. Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.
5. Inventive thinking through TRIZ: a practical guide, By Michael A. Orloff, Springer.
6. Systematic innovation: an introduction to TRIZ ; (theory of inventive Problem Solving), By John Terninko, AllaZusman, CRC Press.