MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering

120731: Advanced Production Technology **(for batch admitted 2020-21)**

Category	Title	Code	Credit-3			Theory Paper
Department Elective- DE 2	Advanced Production Technology	120731	L	T	P	Max.Marks-60
			3	-	-	Min.Marks-19
						Duration-2 hrs.

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-IICONSTRUCTIONAL 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 Processes, 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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120732: Metrology, Measurement and Control

(for batch admitted 2020-21)

Category	Title	Code	Credit-3			Theory Paper
Departmental Elective –DE2	Metrology, Measurement and Control	120732	L	T	P	Max.Marks-60 Min.Marks-19
			3	-	-	Duration-2 hrs.

Course Objectives: To make the students to understand:
1. The types of errors, design of limit gauges and various comparative measurements.
2. The fundamentals of gears, thread measurements and measurements of surface finish.
3. Non-contact measurement techniques using optical methods and vision techniques.
4. Coordinate metrology and Form Measurement.
5. The use of control chart.

Prerequisite: Nil

Syllabus

Unit –I: General Concepts of Measurement; Definition-standards of measurement, errors in measurement, limit-gauging, various systems of limits, fits and tolerance, interchangeability, ISI and ISO system. basic principles and design of standards of measuring gauges, types of gauges and their design, accuracy and precision, calibration of instruments, principles of light interference, interferometer, measurement and calibration.

Unit –II: Linear and Angular Measurements; Slip gauges, micrometers, verniers, dial gauges, surface plates, comparators- mechanical, electrical, pneumatic and optical comparator, angular measuring instruments- sine bar, angle gauges, spirit level, autocollimators, clinometers; measurement of straightness, flatness and squareness.

Unit –III: Measurement of Surface Finish and Measuring Machines; Surface finish- definitions, types of surface texture, surface roughness measurement methods, comparison, profile-meters, pneumatic and replica, measurement of run out and concentricity, length bar measuring machine, optical projection, comparator, tool makers microscope.

Unit –IV: Metrology of Screw Threads and Gears; Internal/external screw thread, terminology, measurement of various elements of threads, thread micrometer method, two wire and three wire methods; gear terminology, measurement of various elements, constant chord method, base tangent method, plug method; gear tester, gear tooth measurement; rolling gear tester.

Unit –V: Computer Aided and Laser Metrology; Co-ordinate measuring machine; applications; laser micrometer, laser interferometer, laser scanning gauge, non-contact and in- process inspection, vision system.

Course Outcomes: After successful completion of this course students will be able to:
1. **State** the basic of standards of measurement, limits, fits & tolerances.
2. **Compare** quality in engineering products.
3. **Apply** the principle of measurement in QC & QA aspects and calibration of measuring instruments.
4. **Analysis** the accuracy in the measurement.
5. **Evaluate** the product quality in manner of dimensional accuracy.
6. **Design** limit gauges.

Text & References Books:

1. Jain R.K.; Engineering metrology; Khanna publishers.

3. Gupta. I.C. “A text book of engineering metrology”, Dhanpat rai and sons.

4. Galye G.N et al; Metrology for engineers; elbs.

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120733: Total Quality Management

(for batch admitted 2020-21)

Category	Title	Code	Credit-3			Theory Paper
Departmental Elective –DE2	Total Quality Management	120733	L	T	P	Max.Marks-60 Min.Marks-19
			3	-	-	Duration-2 hrs.

Course objectives: To make the student to understand:

1. The philosophy and core values of Total Quality Management (TQM).
2. How to evaluate best practices for the attainment of total quality.
3. The concept of ISO 9000 and quality manual.
4. The various methods of design and development to improve quality of product.
5. Impact of quality on economic performance and long-term business success of an organization.

Prerequisite: Nil

Syllabus

Unit - I Introduction: Introduction, Need for quality, Evolution of quality, Definitions of quality, Dimensions of product and service quality, Basic concepts of TQM, TQM Framework, Contributions of Deming, Juran and Crosby, Barriers to TQM, Quality statements, Customer focus, Customer orientation, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

Unit - II Principles: Leadership, Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal, Continuous process improvement, PDCA cycle, 5S, Kaizen, Kanban, Supplier partnership, Partnering, Supplier selection, Supplier Rating.

Unit - III Tools and Techniques: The seven traditional tools of quality, new management tools, six sigma: Concepts, Methodology, applications to manufacturing, lean manufacturing, Agile manufacturing, Service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA, Stages, Types.

Unit- IV Tools and Techniques: Control Charts, Process Capability, Concepts of Six Sigma, Quality Function Development (QFD), Taguchi quality loss function, TPM Concepts, improvement needs, Performance measures.

UNIT- V Quality Systems: Need for ISO 9000, ISO 9001-2008 Quality System, Elements, Documentation, Quality Auditing, QS 9000 – ISO 14000 – Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

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

1. **Discuss** about quality measures, Quality control techniques.
2. **Describe** various theories of Total quality management.
3. **Determine** the cost of poor quality and process effectiveness and efficiency to track performance quality.
4. **Apply** appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQM methodologies.
5. **Evaluate** the performance excellence of an organization, and determine the set of performance indicators
6. **Enhance** management processes, such as benchmarking and business process reengineering

Text & References Books:

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1. TQM by Dr, K.C.Arora, S.K.Kataria and sons Publication, Delhi.
2. Jack Hiradsky TQM Hand book McGraw Hill New York
3. JH Taylor TQM Field Manual Me. Grew Hill Newyork
4. Chrisk Hakes: TQM-The key to business, Chapman and Holland.
5. Kim Todd, "World-class Performance", McGraw Hill, London
6. W J Sivanesan Production/Operations Management. Rich

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120761: Foundation of Computational Fluid Dynamics

Category	**Title**	**Code**	**Credit - 3**			**Theory Paper**
Departmental Elective-DE 3	Foundation of Computational Fluid Dynamics	120761	L	T	P	As per SWAYAM/NPTEL norms
			3	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me75/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
24/07/2023	15 sep 2023	24 Sep 2023	8 Weeks

COURSE LAYOUT

Week1
Module1: Introduction
Module 2: Review of basic fluid mechanics
Module 3: Review of equations and importance of terms
Module 4: Review of equations (contd.) and non-dimensionalization
Module 5: Vorticity-Stream function equation, classification of equation and the solution nature
Module 6: Classification of equations (contd.), types of boundary conditions and description about standard test cases.

Week2
Module 1: Steps involved in CFD, Information about Computational domain and grid with illustration
Module 2: Information about grid (contd.); Taylor's series expansion
Module 3: Taylor's series expansion, CD / FD / BD for first & second derivative;
Module 4: FD formula for non-uniform mesh; mixed derivative
Module 5: Derivation for higher derivative; FD formula by Polynomial procedure

Week3
Module 1: Different Approximation Methods
Module 2: Properties associated with discretization
Module 3: Errors due to approximation and their analysis – consistency, convergence
Module 4: Stability analysis
Module 5: FD formulation for model equations and explanation

Week 4
Module 1: FV formulation for diffusion equation – 1D
Module 2: Example and extension to 2D and 3D
Module 3: FV formulation for convection and diffusion equation
Module 4 & 5: Treatment of convective terms - different interpolations

Week 5
Module 1 & 2: Illustration on the performance by different approximation for convection terms
Module 3: Time integration methods
Module 4: Arrangement of variables; Introduction to Pressure velocity coupling, MAC
Module 5: SIMPLE

Module 6: Variants of SIMPLE, Projection Method

Week 6
Module 1: Introduction to Turbulent flows
Module 2: Deriving governing equations
Module 3: Reynolds stresses, modeling strategy
Module 4 & 5: Introduction to Standard models and explanation

Week 7
Module 1: Matrix inversion – Direct, Iterative procedure
Module 2: Direct solver / Iterative solver
Module 3 - 5: Iterative solver

Week 8
Module 1 - 5: Demonstration of a test case with a display of working CFD code and details

Books and references

Anderson, D.C., J.C, Tannehil, and R.H.Fletcher, Computational Fluid Mechanics, Hemisphere Publishing Corporation, NewYork.
Ferziger, J.H. and M.Peric, Computational Methods for Fluid Dynamics, Springer, 3rd Edition, 2002
Versteeg, H.K. and W.Malalasekera, An Introduction to Computational Fluid Dynamics – The Finite Volume method, Second Edition, 2007.
Chung, T.J., Computational Fluid Dynamics, Cambridge University Press, 2002.

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120762: Introduction to Composites

Category	**Title**	**Code**	**Credit - 3**			**Theory Paper**
Departmental Elective-DE 3	Introduction to Composites	**120762**	L	T	P	As per SWAYAM/NPTEL norms
			3	-	-	

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc23_me89/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
24 July 2023	13 Oct 2023	29 Oct 2023	12 Weeks

Course layout

Week 1: Intro and terminology
Week 2: Concept Review
Week 3: Fibers
Week 4: Matrix materials
Week 5: Short fiber composites
Week 6: Short fiber composites
Week 7: Orthotropic lamina
Week 8: Orthotropic lamina
Week 9: Orthotropic lamina
Week 10: Composite laminates
Week 11: Composite laminates
Week 12: Composite laminates

Books and references

Analysis & Performance of Fiber Composites: Bhagwan D. Agarwal & Lawrence J. Broutman

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120763: Advanced Machining Processes

Category	**Title**	**Code**	**Credit - 3**			**Theory Paper**
Departmental Elective-DE3	**Advanced Machining Processes**	**120763**	L	T	P	As per SWAYAM/NPTEL norms
			3	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me99/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
21 Aug 2023	13 Oct 2023	28 Oct 2023	8 Weeks

COURSE LAYOUT

Week 1: Introduction to advanced machining processes and their classification
Week 1: Ultrasonic machining and its modelling and analysis
Week 2: Abrasive jet machining (AJM)
Week 2: Water jet cutting (WJC) and Abrasive water jet machining (AWJM)
Week 2: Magnetic abrasive finishing (MAF) and its modelling
Week 3: Abrasive flow finishing (AFF) and its modelling
Week 3: Magnetorheological finishing (MRF)
Week 4: Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis
Week 5: Electric discharge machining (EDM): Principle, applications, process parameters, and modelling
Week 5: Electric Discharge Grinding (EDG), Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W-EDM)
Week 6: Laser beam machining (LBM)
Week 6: Plasma arc machining (PAM)
Week 6: Electron Beam Machining (EBM)
Week 7: Electro chemical machining (ECM): Principle, applications, and process parameters and modelling
Week 8: Electrochemical Grinding (ECG), Electrostream Drilling (ESD), Shaped Tube Electrolytic Machining (STEM)
Week 8: Chemical machining (ChM)

Books and references

1. V. K. Jain, Advanced Machining Processes, Allied Publishers, 2009
2. Gary F. Benedict, Nontraditional Manufacturing Processes, Taylor & Francis, 1987
3. J. A. McGeough, Advanced Methods of Machining, Springer, 1988
4. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Prof Med/Tech, 2005
5. V. K. Jain, Introduction to Micromachining, Alpha Science International Limited, 2010

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120764: Fundamentals Of Additive Manufacturing Technologies

Category	**Title**	**Code**	**Credit - 3**			**Theory Paper**
Departmental Elective-DE4	**Fundamentals Of Additive Manufacturing Technologies**	120764	L	T	P	As per SWAYAM/NPTEL norms
			3	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me112/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
24 Jul 2023	13 Oct 2023	29 Oct 2023	12 Weeks

Course Layout

Week 1: Introduction to Additive Manufacturing
Week 2: Computer Aided Process Planning for Additive Manufacturing
Week 3: Computer Aided Process Planning for Additive Manufacturing
Week 4: Liquid Additive Manufacturing
Week 5: Liquid Additive Manufacturing
Week 6: Sheet Additive Manufacturing
Week 7: Wire Additive Manufacturing
Week 8: Wire Additive Manufacturing
Week 9: Wire Additive Manufacturing
Week 10: Powder Additive Manufacturing
Week 11: Powder Additive Manufacturing
Week 12: Powder Additive Manufacturing

Books and references

Venuvinod, Patri K., and Weiyin Ma. Rapid prototyping: laser-based and other technologies. Springer Science & Business Media, 2013.
Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, NY, 2015.
Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.
Jacobs, Paul F. "Fundamentals of stereolithography." In 1992 International Solid Freeform Fabrication Symposium. 1992.

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120765: Energy Conservation And Waste Heat Recovery

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE4	**Energy Conservation And Waste Heat Recovery**	120765	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me122/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	13 Oct 2023	28 Oct 2023	12 Weeks

Course layout

Week 1: Introduction to Waste Heat, Importance of Waste Heat Recovery, Review of Thermodynamics – Introduction to First and Second Laws
Week 2: Review of Thermodynamics – Entropy, Entropy Generation, First and Second Law efficiency
Week 3: Power Plant Cycles - Energy Cascading, Rankine Cycle, modification of Rankine cycle, examples
Week 4: Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Heat Recovery Steam Generators
Week 5: Thermodynamic cycles for low temperature application, Cogenerations, Introduction to Heat Exchangers, Analysis – LMTD and ε-NTU method
Week 6: Analysis of Heat Exchanger – continued, Problem solving, Special Heat Exchangers for Waste Heat Recovery, Synthesis of Heat Exchanger Network
Week 7: Heat pipes & Vapor Chambers, Direct conversion technologies –Thermoelectric Generators.
Week 8:Direct conversion technologies – Thermoelectric Generators (contd.), Thermoionic conversion, Thermo-PV, MHD
Week 9: Heat Pump; Heat Recovery from Incinerators, Energy Storage – Introduction.
Week10: Energy Storage Techniques – Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage
Week 11: Energy Storage Techniques – Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells.
Week 12: Energy Economics

Books and references

Nil

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120766: Work system Design

Category	Title	Code	Credit - 3			Theory Paper
Departmental Elective-DE4	**Work system Design**		L	T	P	As per SWAYAM/NPTEL norms
			3	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me124/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	13 Oct 2023	29 Oct 2023	12 Weeks

Course layout

Week 1: Work System Design: Introduction, Introduction and Concept of Productivity, Measurement of Productivity, Productivity Measures, Productivity Measurement Models

Week 2: Factors Influencing Productivity, Causes of Low Productivity, Productivity Measurement Models, Productivity Improvement Techniques, Numerical Problems on productivity, Case study on productivity.

Week 3: Work Study: Basic Concept, Steps Involved in Work Study, Concept of Work Content, , Techniques of Work Study, Human Aspects of Work Study

Week 4: Method Study: Basic Concept, Steps Involved in Method Study, Recording Techniques, Operation Process Charts, Operation Process Charts: Examples.

Week 5: Flow Process Charts, Flow Process Charts: Examples, Two-Handed-Process Charts, Multiple Activity Charts, Flow Diagrams.

Week 6: String Diagrams, Principles of Motion Economy, Micro-Motion Study, Therbligs, SIMO Charts

Week 7: Memo-Motion Study, Cycle graph and Chrono-Cycle Graph, Critical Examination Techniques, Development and Selection of New Method, Installation and Maintenance of Improved Methods.

Week 8: Work Measurement: Basic Concept, Techniques of Work Measurement, Steps Involved in Time Study, Steps and Equipment of Time Study,Performance Rating.

Week 9: Performance Rating: Examples, Allowances, Computation of Standard Time-I, Computation of Standard Time-II, Case Study

Week 10: Work Sampling: Basics, Procedure of Work Sampling Study, Numerical Problems on work sampling, Introduction to Synthetic Data and PMTS, Introduction to MTM and MOST

Week 11: Ergonomics: Basic Concept, Industrial Ergonomics, Ergonomics: Anthropometry, Man-Machine System-1 , Man-Machine System-2

Week 12: Case Study: Office Chair, Case Study: Tower Crane Cabin, Case Study: Car Seat, Case Study: Computer System, Case Study: Assembly Line

Books and references

Introduction to Work Study: International Labor Office (ILO), Geneva.Motion and Time Study Design and Measurement of Work: Ralph M. Barnes, Wiley, The University of California.

Industrial Engineering and Production Management: M. Telsang, S. Chand and Company Ltd.

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910208: SOLAR ENERGY

Category	Title	Code	Credit-3			Theory Paper
			L	**T**	**P**	
Open Course-OC2	Solar Energy	910208	2	1	-	Max. Marks – 60 Min. Marks – 19 Duration – 2 hrs

Course Objective: To make the students to understand:

1. The basic concepts of solar energy and various sun-earth angles.
2. How to develop thermal models and how to carry out economic analysis of solar systems and establish energy balance in different solar energy systems.
3. The different types of collectors, PV systems and their application.

Course Prerequisites: Basic Physics

Syllabus

UNIT – I Solar radiation, basic concepts, various Sun – Earth angles and modeling

UNIT – II Solar collectors and types: flat plate, concentrating solar collectors, Selective coatings, thermal modeling of flat plate collectors, applications of solar collectors.

UNIT – III Active and passive heating and cooling of buildings, Home lighting systems.

UNIT - IV Solar energy storage options, Solar Economics and life cycle cost analysis.

UNIT –V Solar photo voltaic System: Basic concepts of solar cell and PV Panel in series and parallel combination, characteristics curves of PV cell and panels, Photovoltaic materials, Need for different cell design, Applications of photovoltaic for power generation.

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

1. **Define** the basic terms used in solar systems and various sun-earth angles.
2. **Establish** the energy balance and develop the thermal model of different solar systems.
3. **Investigate** the effectiveness of utilizing the solar energy by different solar systems.
4. **Analyze** the life cycle cost and other economic aspects of solar systems
5. **Describe** the application of solar systems and find out the areas of improvement.

Recommended Books:

1. Solar Energy by G.N. Tiwari

2. Solar Energy: Problems, Solution and Experiments by G.N. Tiwari, P. Barnwal, S.C. Solanki and M.K. Gaur

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910209: Maintenance Engineering

Category	Title	Code	Credit-3			Theory Paper
Open Course-OC2	Maintenance Engineering	910209	L	T	P	Max.Marks-60 Min.Marks-19 Duration-2 hrs.
			2	1	-	

Course Outcomes: Through this course, student should be able to

- Identify different maintenance categories
- Understand the principles, functions and practices adopted in industry for the successful management of maintenance activities
- Implement the maintenance function and different practices in industries for the successful management of maintenance activities.
- The Condition Monitoring & Non-Destructive Testing.
- The fault Identification, Computerized Maintenance Systems.
- The Maintenance strategies and overall configuration and Maintenance of Machines, structure and System.

UNIT I

Evolution of maintenance, objective of maintenance, maintenance policies and philosophies, maintenance concept, importance of maintenance, elements of good maintenance classification of maintenance programs, corrective preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance-concept, functions, benefits and limitations, training and safety aspects in maintenance.

UNIT II

Condition monitoring, objectives and benefits of condition based monitoring, what to monitor, when to monitor, principles, condition based maintenance techniques: visual/manual monitoring, temperature monitoring, thermography, lubricant monitoring, debris and spectroscopy, performance monitoring, vibration monitoring, current monitoring, and corrosion monitoring, odour monitoring, noise and sound monitoring, Time Domain Analysis, Frequency Domain Analysis, Non Stationary Signal Analysis, Practical Examples of Vibration.

UNIT III

Tribology in Maintenance, Friction wear and lubrication, friction & wear mechanisms, prevention of wear, types of lubrication mechanisms, lubrication processes, lubricants and its types, general and special purpose, additives, testing of lubricants, degradation of lubricants, seal & packings, repair methods for basic machine elements: failure analysis, failures and their development.

Unit- IV:

Accelerometers, Rotational Speed Measurements, Introduction to Faults in Rotating Machines, Unbalance Detection, Field Balancing, Misalignment, Gears, Pumps and Cavitation, IC Engines, machinery Diagnostic Chart, Basics of Instrumentation, Signal Conditioning and Filtering, Errors In Measurements, Dynamic Range And Frequency Response.

Unit- V: Non-Destructive Testing, Ultrasonics, Eddy Current and Acoustic Emission, Radiography, Dye Penetrant Tests, Tool Condition Monitoring, Experimental Modal Analysis, Introduction to Failure

Analysis, Railway Locomotive Noise and Vibration Monitoring, Paper Mill Vibration Monitoring, Overview of CBM facilities at SKF Reliability Lab, Artificial Intelligence in Maintenance Engineering, Expert Systems for fault Diagnosis. IoT in Maintenance Engineering.

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

1. **Describe** the fundamental concepts of maintenance engineering noise and vibration, measurement techniques of Condition Monitoring.
2. **Show** skills of fault diagnosis.
3. **Demonstrate** the need of instrumentation and signal processing for condition monitoring
4. **Examine** the condition of machine parts through Failure analysis of plant machineries
5. **Apply** correct usage of a method or procedure of maintenance.

Text & Reference books:

- A. R. Mohanty, Machinery Condition Monitoring: Principles and Practices, CRC Press, 2014
- Bikash Bhadury. 'Total Productive Maintenance". Allied Publisher Ltd. New Delhi.
- BC langlay. "Plant Maintenance". Prentice-Hall International. New Jersey.
- P Gopalakrishnan and AK Banerji, "Maintenance and Spare Parts Management". Prentice-Hall of India (P) Ltd. New Delhi.
- Kelly, "Maintenance Planning & Control"
- Industrial Maintenance by HP Garg. S. Chand & Company Ltd., New Delhi.
- Srivastava S.K., “Industrial Maintenance Management”, - S. Chand and Co., 1981
- Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 1995
- White E.N., “Maintenance Planning”, I Documentation, Gower Press, 1979.
- Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.
- Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill, 5th Edition, 1988.
- Armstrong, “Condition Monitoring”, BSIRSA, 1988.
- Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 1996.

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910210: Supply Chain Management

Category	Title	Code	Credit-3			Theory Paper
			L	**T**	**P**	
Open Course-OC2	Supply Chain Management	910210	2	1	-	Max. Marks – 60 Min. Marks – 19 Duration – 2hrs

Course Objective: To make the students to understand:

1. The basic concepts of Supply Chain Management.
2. Goal of a supply chain and find out the impact of supply chain on the success of the firm.
3. The network Design and Synthesize different real-life cases.

Course Prerequisites: NIL

Syllabus

Unit 1: Introduction to Supply Chain Management: Overview of Supply Chain Management, Evolution and Importance of Supply Chain Management, Decision Phases in Supply Chain, Process Views of a Supply Chain, Competitive and Supply Chain Strategies, Strategic Fit, Supply Chain Drivers and Metrics, The role IT in supply chain.

Unit 2: Supply Chain Network Design: Role of Distribution in Supply Chain, Factors influencing Distribution network design, Design options for Distribution Network, Online Sales and the Distribution Network, Distribution Network in Practice, Role of network Design in Supply Chain, Framework for network Decisions, The Impact of Globalization on Supply Chain Networks.

Unit 3: Demand Planning and Forecasting: The Role of Forecasting in a Supply Chain, Characteristics of Forecasts, Classification, Forecasting Techniques and Models: Forecasting Methods, Time-Series Forecasting Methods; Aggregate Planning in Supply Chain, Sales and Operations Planning, Supply Chain Coordination and the Bullwhip Effect.

Unit 4: Inventory Management: Introduction to Inventory Management, Types of Inventory and Inventory Costs, Economic Order Quantity (EOQ) and Reorder Point, Inventory Control Models: ABC Analysis, JIT, and Safety Stock, Vendor-Managed Inventory (VMI) and Collaborative Planning.
Sourcing and Procurement: Role of sourcing in supply chain, Outsourcing benefit, Importance of suppliers, evaluating a potential supplier, Supplier selection, Supply contracts, Competitive bidding and Negotiation, Procurement Process, E-procurement.

Unit 5: Logistics and Transportation Management: Introduction to Logistics Management, Role of transportation in supply chain, factors affecting transportations decision, Design option for transportation network, Transportation Modes: Selection and Trade-offs, Freight Management and Distribution Network Design, Warehouse Operations and Materials Handling, Reverse Logistics and Sustainable Supply Chains. Lean Supply Chain and Six Sigma, Emerging Trends in Supply Chain Management.

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

1. **Develop** the various supply chain and network design.

2. **Apply** the forecasting methods in supply chain.
3. **Investigate** the effectiveness of utilizing the supply chain.
4. **Analyse** the inventory level and other economic aspects of supply chain.
5. **Describe** the application of supply chain and find out the areas of improvement.

Recommended Books:

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education
2. Mohanty. R. P, Deshmukh. S. G., Supply chain Management, Phoenix publishing
3. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management", PHI,
4. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press
5. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition.

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering

120715- (DLC-): Reliability and Vibration Lab

Category	Title	Code	Credit - 1			Practical Paper
			L	T	P	Max.Marks-60
Departmental Lab Core- DLC	**Reliability and Vibration Lab**	**120715**	-	-	2	Min.Marks-19

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.

List of Experiments

1. Determination of Critical Speed in Whirling of Shafts.
2. Determination of Natural Frequency in Longitudinal Vibrating System.
3. Determination of Natural Frequency in Torsional Vibration System.
4. To verify the relation of compound pendulum & to determine the radius of gyration
5. To study the undamped free vibration of spring mass system.
6. To study the forced vibration of simply supported beam for different damping.
7. Undamped tensional vibrations of single and double rotor system.
8. To study the damped torsional vibration of single rotor system and to determine the damping coefficient.
9. To study the forced damped vibration of spring mass system.
10. Study the machine fault diagnostic system based on vibration analysis.

Text Books:

1. **Mechanical Vibrations**: by 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.