

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)

Department of Mechanical Engineering

For batch admitted in Academic Session 2019-20

120711: Refrigeration and Air-conditioning

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Elective –DE3	Refrigeration and Air-conditioning	120711	4	-	-	Max.Marks-70
						Min.Marks-22 Duration-3hrs

Course Objectives: To make the students to understand

1. The fundamental principles and different methods of refrigeration and air conditioning.
2. Different refrigerants with respect to properties, applications and environmental issues.
3. The various equipment, operating principles, operating and safety controls employed in refrigeration air conditioning systems.

Pre-requisite: Engineering Thermodynamics

Syllabus

Unit I: Introduction to Refrigeration: –Basic Definition, ASHRAE Nomenclature, Air Refrigeration: Air Refrigeration Cycles-reversed Carnot cycle, Bell-Coleman cycle analysis, Air Refrigeration systems-merits and demerits, analysis.

Unit II: Vapour Compression Refrigeration System (VCRS): Carnot Vapour compression refrigeration cycle, Working and analysis, Limitations, Standard Vapour Compression Refrigeration system, Working and analysis, Effects of sub cooling and super heating, Multi-Pressure or Compound Vapour Compression Refrigeration Systems, Flash Gas removal, Flash inter cooling and water inter cooling.
Refrigerants: Classification, Selection of Refrigerants and Nomenclature of refrigerants, Desirable Properties of an ideal refrigerant, A discussion on Ozone layer Depletion and Global Warming.

Unit III: Vapour Absorption Systems: Absorbent – Refrigerant combinations, Water-Ammonia Systems, Water Lithium Bromide System, Contrast between the two systems, Modified Version of Aqua-Ammonia Brief Discussion on (i) Steam-Jet refrigeration system and (ii) Thermoelectric refrigeration system
Refrigeration System Equipment – Compressors, Condensers, Expansion Devices and Evaporators, System with Rectifier and Analyser Assembly

Unit IV: Psychrometry: Introduction to Air-Conditioning, Basic Definition, Classification, ASHRAE Nomenclature pertaining to Air-Conditioning, Applications of Air-Conditioning, Psychrometry –Air-water vapour mixtures, Psychrometric Properties, Psychrometric or Air-Conditioning processes, Psychrometric Chart.

Unit V: Air-Conditioning: Mathematical Analysis of Air-Conditioning Loads, Related Aspects, Numerical Problems, Different Air-Conditioning Systems-Central – Station Air-Conditioning System, Unitary Air-Conditioning System, Window Air-Conditioner and Packaged Air-Conditioner, Components related to Air-Conditioning Systems

Course outcomes: After the successful completion of this course, the student will be able to:

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1. **Understand** vapour compression refrigeration system.
2. **Describe** the working principles of air, vapour absorption, thermoelectric and steam-jet refrigeration systems.
3. **Obtain** cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems.
4. **Analyze** the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. **Develop** thermal comfort conditions with respect to temperature and humidity
6. **Estimate** cooling and heating loads in an air-conditioning system.

Text Books:

1. Arora C.P., Refrigeration and Air-conditioning, Tata McGraw –Hill Latest Edition, New Delhi

References Books :

1. Roy J. Dossat, Principles of Refrigeration, Wiley Limited
2. Stoecker W.F., and Jones J.W., Refrigeration and Air-conditioning, McGraw - Hill, New Delhi

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120713: Metrology, Measurement and Control

Category	Title	Code	Credit-4			Theory Paper
Departmental Elective –DE3	Metrology, Measurement and Control	120713	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

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.

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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.
5. Rajput R.K; Engineering metrology and instrumentation; Kataria &sons publishers.

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120714: Total Quality Management

Category	Title	Code	Credit-4			Theory Paper
Departmental Elective –DE3	Total Quality Management	120714	L	T	P	Max.Marks-70
			4	-	-	Min.Marks-22 Duration-3hrs.

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.

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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:

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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120751: Foundation of Computational Fluid Dynamics

Category	Title	Code	Credit - 2			Theory Paper
Departmental Elective-DE 4	Foundation of Computational Fluid Dynamics	120751	L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc22_me85/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
25/07/2022	16 sep 2022	25 Sep 2022	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

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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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120752: Introduction to Composites

Category	Title	Code	Credit - 2			Theory Paper
Departmental Elective-DE 4	Introduction to Composites	120752	L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc22_me87/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
25 July 2022	14 Oct 2022	30 Oct 2022	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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120753: Advanced Machining Processes

Category	Title	Code	Credit - 2			Theory Paper
Departmental Elective-DE 4	Advanced Machining Processes	120753	L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc22_me119/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
22 Aug 2022	14 Oct 2022	29 Oct 2022	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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900203: INDUSTRIAL AUTOMATION

Category	Title	Code	Credit-3			Theory Paper
Open Course-OC2	Industrial Automation	900203	L	T	P	Max.Marks-70
			2	1	-	Min.Marks-22 Duration-3hrs.

Course Objective: To make the students to understand:

1. The basic principles and elements of automation.
2. The material handling and Identification Technologies.
3. The function of Industrial Robots and their applications for transformational and handling activities.

Pre-requisite: Nil

Syllabus

Unit I Introduction to Automation: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines.

Unit II Material handling and Identification Technologies: Overview of Material Handling Systems, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.

Unit III Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Quality Control Systems: Traditional and Modern Quality Control Methods, Inspection Principles and Practices, Inspection Technologies.

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.

Unit V Overview of Industrial automation using robots: Selection and use of robots in manufacture and assembly, welding robot, machining inspection and painting.

Course Outcome: After the successful completion of this course, the student will be able to:

1. **Identify** potential areas for automation and justify need for automation
2. **Select** suitable major control components required to automate a process or an activity
3. **Translate** and simulate a real time activity using modern tools and discuss the benefits of automation.
4. **Decide** suitable automation hardware for the given application.
5. **Design** appropriate modeling and simulation tool for the given manufacturing application.

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

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3. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.
4. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.
5. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.

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900204: SOLAR ENERGY

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC2	Solar Energy	900204	2	1	-	Max. Marks – 70 Min. Marks – 22 Duration – 3 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
3. Solar Energy by John A. Duffie, William A. Beckman
4. Solar Energy by S.P. Sukhatme and J.K. Nayak

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900214: ENGINEERING MATERIALS FOR INDUSTRIAL APPLICATIONS

Category	Title	Code	Credit-3			Theory Paper
Open Course-OC3	Engineering Materials for Industrial Applications	900214	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	-	

Course Objectives: To make the students to understand:

1. The basic fundamentals of materials science and engineering.
2. The different classes of materials, their properties, structures and imperfections present in them.
3. The functional properties of materials and the roles of microstructure, heat treatment defects and environment play in typical engineering applications.

Course Prerequisites: Basic Chemistry

Syllabus

Unit- I Properties of Engineering Materials: Materials for space applications, Materials for Solar applications, Shape Memory Alloys, Materials for High Temperature Applications, Materials of Electronic and Electrical Applications: Semiconductors, Organic Semiconductors, Liquid Crystals, Electroluminescent Materials, Magnetic Materials. Materials for Development of Energy Efficient Building, Materials of Chemical Applications: Plastics, Rubber, Ceramics, Magneto-Rheological Materials

Unit-II Production of Engineering Materials: Production of Electronic Materials- Semiconductors, Magnetic Materials. Production of Civil Materials- Cements, Concrete, Steel and its types. Synthesis of Chemical Engineering Materials- Polymerisation, production of ceramics.

Unit- III Fabrication Techniques of Engineering Materials: Fabrication of ICs, optical fibres, steel, glass, ceramics, plastics.

Unit- IV Composite Materials: Introduction to composites, Particle- Reinforced Composites, Fibre-Reinforced Composites, Influence of Fibre Length and Orientation on properties, Different types of Fibre-Reinforced Composites, Structural Composites, fabrication process of Composites.

Unit - V Nano-materials and Super Alloys: Introduction to Nano technologies, nano-materials and their importance, Various methods of synthesis- Various kind of Nano-structures- Carbon fullerenes and CNT, Metal and metal oxide nano-wires, Self assembly of nano-structures, Core-shell nano-structures, Nano-composites. Physical and Chemical properties.

Super Alloys: Introduction to superalloys, Nickel- Iron Base Alloys, Cobalt- Base Alloys, Nickel- Base Alloys, Strengthening Mechanisms, Compositional Effects.

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

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1. **State** the properties of engineering materials.
2. **Understand** the material composition and their effects.
3. **Classify** different engineering material.
4. **Discuss** the production and fabrication techniques of Engineering Materials.
5. **Select** different types of materials as per requirement.

Text & Reference books:

1. Material Science and Engineering **by** Raghvan, V; Prentice Hall of India.
2. Material Science and Engineering by Callister's; Wiley Pub.
3. Elements of Material Science and Engineering **by** Lawrence, H. Vanvlack dison; Wesley.
4. Introduction to Engineering Materials **by** Agrawal, B.K; Tata Mc Graw Hill, N. Delhi.

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900215: Maintenance Engineering

Category	Title	Code	Credit-3			Theory Paper
Open Course-OC3	Maintenance Engineering	900215	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	-	

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.

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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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120701- (DLC-): Reliability and Vibration Lab

Category	Title	Code	Credit - 2			Practical Paper
			L	T	P	
Departmental Lab Core	Reliability and Vibration Lab	120701				Max.Marks-50
			-	-	4	Min.Marks-16

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 torsional 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.