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(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering
For batch admitted in Academic Session 2018-19

120711: Refrigeration and Air-conditioning

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

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

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

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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120712: Basic of Finite Element Analysis

Category	Title	Code	Credit - 4			Theory Paper
Departmental Elective-DE3	Basic of Finite Element Analysis	120712	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course Objectives: To make the students to understand
1. The concepts of Mathematical Modelling of Engineering Problems.
2. The use of FEM to a range of Engineering Problems.

Prerequisite:
Engineering Mathematics, Mechanics of Materials, Machine Design

SYLLABUS

Unit-I Introduction: Historical Background, Mathematical Modelling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods, Variational Formulation of Boundary Value Problems – Ritz Technique , Basic concepts of the Finite Element Method.

Unit- II One-Dimensional Problems: One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements, Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer, Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.

Unit- III Two Dimensional Scalar Variable Problems : Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements, Shape functions and element matrices and vectors, Application to Field Problems – Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

Unit- IV Two Dimensional Vector Variable Problems : Equations of elasticity – Plane stress, plane strain and axisymmetric problems, Body forces and temperature effects , Stress calculations , Plate and shell elements.

Unit- V Isoparametric Formulation : Natural co-ordinate systems, Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements, Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems –,Introduction to Analysis Software

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

1. **Understand** the basics of finite element formulation.
2. **Define** discrete and continuous models
3. **Use** variational Formulation of Boundary Value Problems

4. **Apply** finite element formulations to solve one dimensional Problem.
5. **Analyse** finite element formulations to solve 2D scalar Problems and vector problems
6. **Design** finite element method to solve problems on Isoparametric element and dynamic Problem

Text Books:

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

References Books

1. C. S. Krishnamoorty, Finite Element Analysis, Tata McGraw-Hill
2. David V. Hutton, Fundamentals of Finite Element Analysis, McGraw Hill
3. Erik G. Thompson, Introduction to the Finite Element Method: Theory, Programming and Applications, John Wiley
4. H. C. Martin and G. F. Carey, Introduction to Finite Element Analysis - Theory and Application, NewYork, McGraw-Hill
5. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India, New Delhi, India
6. M. Mukhopadhyay, Matrix, Finite Element, Computer and Structural Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India
7. O. C. Zienkiewicz and Y. K. Cheung, The Finite Element Method in Structural and Soild Mechanics, McGraw Hill, London
8. R. D. Cook, Concepts and Applications of Finite Element Analysis, Wiley
9. S. S. Rao, Finite Element Analysis, Elsevier Butterworth-Heinemann

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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.

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 Min.Marks-22 Duration-3hrs.
			4	-	-	

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:

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
			L	T	P	
Departmental Elective-DE4	Foundation of Computational Fluid Dynamics	120751	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: -https://onlinecourses.nptel.ac.in/noc21_me77/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
July 26, 2021	September 17, 2021	September 26, 2021	8 Weeks

COURSE LAYOUT (Syllabus):

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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120752: Introduction to Composites

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

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_me110/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Enrollment Ends	Duration
July 26, 2021	October 15, 2021	October 24, 2021	August 02, 2021	12 Weeks

COURSE LAYOUT (Syllabus):

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

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120753: Advanced Machining Processes

Category	Title	Code	Credit – 2			Theory Paper
Departmental Elective-DE4	Advanced Machining Processes	120753	L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_me89/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
August 23, 2021	October 15, 2021	October 24, 2021	8 Weeks

COURSE LAYOUT (Syllabus):

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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120754: Industrial Safety Engineering

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Departmental Elective-DE 4	Industrial Safety Engineering	120754	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_mg59/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
July 26, 2021	October 15, 2021	October 23, 2021	12 Weeks

COURSE LAYOUT

Week 1 : Introduction, key concepts, terminologies, and safety quantification, safety by design
Week 2 : Hazard identification techniques (e.g., HAZOP, FMEA, etc.)
Week 3 : Fault tree and event tree analysis (qualitative & quantitative)
Week 4 : Bow-tie and quantitative risk assessment (QRA)
Week 5 : Safety function deployment
Week 6 : Safety vs reliability – quantification of basic events (repair to failure, repair-failure-repair, and combined processes)
Week 7 : Safety vs reliability – quantification of basic events (contd.)
Week 8 : Systems safety quantification (e.g., truth tables, structure functions, minimal cut sets)
Week 9 : Human error analysis and safety
Week 10 : Accident investigation and analysis
Week 11 : Application of virtual reality
Week 12 : OSHAS 18001 and OSHMS

BOOKS AND REFERENCES

Probabilistic Risk Assessment for Engineering and Scientists, Komamoto and Henley, IEEE Press, 1995. Industrial Accident Prevention, Heinrich et al., McGraw Hill, 1980. Techniques for safety management - A systems approach, Petersen D, ASSE 1998.

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900203: INDUSTRIAL AUTOMATION

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC2	Industrial Automation	**900203**	2	1	-	Max.Marks-70 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
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. The thermal model of solar collector.
3. The utilization of solar energy in heating and cooling of a particular space.
4. The economic analysis of solar systems and to analyze solar energy storage medium.
5. The basic principle of solar 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 solar collector system.
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 photovoltaic.

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
			L	T	P	
Open Course-OC3	Engineering Materials for Industrial Applications	**900214**	3	-	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

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.

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

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.

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 2018-19

900215: Maintenance Engineering

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

Course Objective: To make the students to understand:

1. The fault Identification, Computerized Maintenance Systems.
2. The Maintenance strategies and overall configuration and Maintenance of Machines , structure and System.
3. The Condition Monitoring & Non Destructive Testing.

Course Prerequisites: Basic Mathematics

Syllabus

Unit- I: Introduction, Maintenance Principles, FMECA, Fault Diagnostics and Prognostics, Machine Learning in CBM, Basics of Vibration, Free and Forced Response, Vibration and Shock Isolation, Practical Examples of Vibration.

Unit- II: Time Domain Analysis, Frequency Domain Analysis, Non Stationary Signal Analysis, Modulation and Beats, Orbit and Order Analysis, Computer aided data acquisition, Orbit and Order Analysis, Data Recording, Cepstrum Analysis, Hilbert Transform in Condition Monitoring.

Unit- III: Introduction to MATLAB, Signal Processing using MATLAB, Numericals in Signal Processing and Data Acquisition, Signal Hetrodyning, Practical Signals, Basics Of Instrumentation, Signal Conditioning and Filtering, Errors In Measurements, Dynamic Range And Frequency Response, Overview of Transducers For CBM.

Unit- IV: Accelerometers, Vibration Monitoring, Rotational Speed Measurements, Basics of Noise, Noise Monitoring, Introduction to Faults in Rotating Machines, Unbalance Detection, Field Balancing, Misalignment, Crack and Looseness, Journal and Anti-Friction Bearings, Gears, Pumps and Cavitation, IC Engines, machinery Diagnostic Chart, Principles of Motor Current Signature Analysis, Faults in Electrical Machines, Thermography, Wear Debris Analysis, Oil Analysis,

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, Future of Condition based Monitoring, 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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Department of Mechanical Engineering

120701- (DLC-): Reliability and Vibration Lab

Category	Title	Code	Credit - 2			Practical Paper
			L	T	P	Max.Marks-50
Departmental Lab Core	**Reliability and Vibration Lab**	**120701**	-	-	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 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.
11. Measurement of Noise

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.