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

Academic session 2020-21 admitted

120615: Mechanical Vibrations

Category	Title	Code	Credit - 4			Theory Paper
Departmental Core - DC	Mechanical Vibrations	120615	L	T	P	Max.Marks-50 Duration-2 hrs.
			2	1	2	

Prerequisite: Engineering Mathematics, Engineering Mechanics

Course Objectives:

1. To impart basic knowledge and importance on Mechanical Vibration in Engineering Fields among the students.
2. To create the awareness on Mechanical Vibration in Research and Application area

Syllabus

Unit-I:

Introduction: Importance and scope of vibrations, Definitions, Types of vibrations, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier transform and problems.

Undamped (Single Degree of Freedom) Free Vibrations: Derivations for spring mass systems, Methods of analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.

Unit-II:

Damped free vibrations (1DOF): Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

Whirling of shafts: Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.

Unit-III Forced Vibrations (1DOF)

Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.

Unit-IV

Systems with two degrees of Freedom:

Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping), Torsional system, Semidefinite system

Multi Degree Freedom System: Free Vibration equation of motion. Stiffness influence coefficients, , flexibility influence coefficient, inertia influence coefficient

Unit V

Numerical Methods: Dunkerley's Methods, Rayleigh`s Method, Holzer`s Method, Methods of Matrix iterations, Jacobi's method

Vibration Control: Transducers and vibration pickup, Vibrometer, accelerometer, velometer, frequency measuring instrument, FFT analyser, vibration exciters.

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

Text Books:

1. Grover, G.K., " Mechanical Vibrations", 7th Ed., Nem Chand & Bros.
2. Rao, S.S., " Mechanical Vibrations", 5th Ed., Addison-Wesley Longman, Incorporated.

References Books:

1. Theory of Vibrations with Applications: W T Thomson CBS Publishers Delhi
2. Fundamentals of Vibration: Leonard Meirovitch , McGraw Hill International Edison.
3. Principles of Vibration Control: Asok Kumar Mallik, Affiliated East-West Press.
4. Mechanical Vibrations A H Church ,John Wiley & Sons Inc
5. Mechanical Vibrations J P Den Hartog ,McGraw Hill.
6. Mechanical Vibration Analysis: Srinivasan ,McGraw Hill.

List of Experiments

1. To verify the relation of simple pendulum.
2. To determine the radius of gyration of given compound pendulum.
3. To study undamped free vibration of equivalent spring mass system.
4. To study the torsional vibration of single rotor system
5. To study damped free vibration of equivalent spring mass system.
6. To study the damped torsional oscillation.
7. To study the forced vibration of spring mass system
8. To study the free vibration of Two rotor system.
9. To determine the whirling of shaft.
10. To verify the Dunkerley's rule.

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120616/190616: Refrigeration and Air-conditioning

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core -DC	Refrigeration and Air-conditioning	120616/190616	2	1	2	Max.Marks-50 Duration-2 hrs

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:

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.

List of Experiments (Expandable):

1. Demonstration of fundamental study of Absorption Refrigeration System.
2. To study Performance of Ice-Candy unit.
3. Demonstration of C.O.P. and Performance of Air-Conditioner.
4. Demonstration of fundamental study of Vapour Compression cycle (Ice candy Unit)
5. Determination of C.O.P. in Vapour compression Refrigeration system.
6. Demonstration of Electrolux Refrigerator.
7. Equipment and controls of Refrigeration Systems.
8. Equipment and controls of Air Conditioning Systems
9. To study duct and induct type AC
10. To study refrigeration and fault simulator
11. Demonstration of C.O.P. and other performance parameters for Mech. Heat Pump.
12. Demonstration of C.O.P. and other performance parameters for Mech. Heat Pump.

Text Books:

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

References Books :

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

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120661: Fundamental of Welding Science and Technology

Category	**Title**	**Code**	**Credit - 3**			**Theory Paper**
Departmental Elective-DE 2	Fundamental of Welding Science and Technology	120661	L	T	P	As per SWAYAM/NPTEL norms
			3	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me20/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
23 Jan 2023	17 Mar 2023	26 Mar 2023	8 Weeks

Course layout

Week 1 : Introduction and classification of welding
Week 2 : Nomenclature and symbol of welding joints
Week 3 : Power source of welding
Week 4 : Physics and principle of arc welding
Week 5 : Different type of welding methods and their details
Week 6 : Different type of welding methods their details
Week 7 : Different type of welding methods their details
Week 8 : Welding defects and inspection

Books and references

1. V. M. Radhakrishnan, Welding Technology and Design, New age. 2002.
2. Dr. O. P. Khanna, Welding Technology, Reprint: 2002.
3. J. A. Goldak, Computational Welding Mechanics, Springer 2005.
4. O. Grong, Metallurgical Modelling of Welding,2nd Ed. IOM publication , 1997.
5. L-E Lindgren, Computational Welding Mechanics, Woodhead Publishing Limited,2007.
6. J. F. Lancaster (Ed), The Physics of welding, Pergamon, 1986.
7. R.W. Messler, Principles of Welding, John Wiley and Sons,1999.

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190662/120662: Viscous Fluid Flow

Category	**Title**	**Code**	**Credit - 3**			**Theory Paper**
Departmental Elective-DE 2	Viscous Fluid Flow	190661/120662	L	T	P	As per SWAYAM/NPTEL norms
			3	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me57/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
23 Jan 2023	14 Apr 2023	30 Apr 2023	12 Weeks

Course layout

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

Books and references

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

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120663: Properties of Materials (Nature and Properties of Material: III)

Category	**Title**	**Code**	**Credit - 3**			**Theory Paper**
Departmental Elective-DE 2	Properties of Materials (Nature and Properties of Material: III)	120663	L	T	P	As per SWAYAM/NPTEL norms
			3	-	-	

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_mm08/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Duration**
20 Feb 2023	14 Apr 2023	29 Apr 2023	8 Weeks

Course layout

Week 1 : Introduction and Basic Elasticity
Week 2 : Mechanical testing and plastic deformation
Week 3 : Plastic deformation mechanisms
Week 4 : Strengthening mechanisms
Week 5 : Electrical properties of metals
Week 6 : Quantum mechanics and band theory
Week 7 : Semiconductor properties
Week 8 : Thermal properties

Books and references

1. V. Raghavan, Materials Science and Engineering
2. W.D. Callister, Materials Science and Engineering
3. H.W. Hayden, W.G. Moffatt and J.W. Wulff, Mechanical Behaviour (Volume III: Structure and Properties of Materials)
4. L.F. Pease, R.M. Rose and J. Wulff, Electronic Properties (Volume IV: Structure and Properties of Materials)
5. A. Guinier and R. Julien, The Solid State

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910108 (OC-1): Product Design

Category	Title	Code	Credit - 3			Theory Paper
Open Course-OC	Product Design	910108	L	T	P	Max.Marks-50 Duration-2 hrs.
			2	1	-	

Course Objectives: To make the students to understand:
1. The multidisciplinary aspects of product development and innovation.
2. The basic methodology and tools that can be used in product development projects.

SYLLABUS

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

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

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

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

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

Course Outcome: - After the completion of the course the student will be able to
CO1. Analyze the demands and needs of customers to conceptualize product.

CO2. Describe the different steps involved in the product design.

CO3. Analyze the shortcoming in the product development.

CO4. Identify the opportunities to develop the product.

CO5. Utilize the recourses available in efficient manner for maximum productivity.

CO6. Forecast the impact of product on the surrounding environment.

Text books and References:

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

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910109 (OC-1): Robotics

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Open Course-OC	Robotics	910109	2	1	-	Max.Marks-50 Duration-2 hrs.

Course Objectives: To make the students to understand:

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

Syllabus

UNIT -I Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system, Chain type: Serial manipulator and Parallel Manipulator. Components of Industrial robotics-recession of movement-resolution, accuracy and repeatability
Kinematic and Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors, Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, Force or Torque sensors.

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

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

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

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

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

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

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

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

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

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

Text & References Books:

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