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| **FR. Conceicao Rodrigues College Of Engineering**  Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50  **Department of Mechanical Engineering**    **B.E. (Mechanical) (semester VII)  (July 2022 – Dec. 2022)**  **Lecture Plan**  **Subject: Machinery Diagnostics (MEDLO7041)                                      Credits-03** |

1. **Syllabus.**

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| **Module** | **Contents** | **Hours** |
| **1** | * 1. **Basics of Vibration**   Periodic and random motion, Spectral Amplitude Scaling: RMS, Peak and Peak-to-Peak Conversion and Selection, Time and frequency domain analysis, Phase analysis, Orbit analysis, Understanding signal pattern, Importance of speed in accurate diagnosis, Importance of side bands in frequency spectrums.   * 1. **Introduction to Vibration based Condition Monitoring**   Maintenance Principles, Vibration based fault Prognosis, Goal of Vibration Monitoring, Steps in Vibration Monitoring, Benefits of Vibration based condition monitoring. | **07** |
| **2** | **Vibration Measurement**  Vibration measuring instruments: displacement, velocity, acceleration; Force measurement, Laser based measurements: laser vibrometer  Sensor Selection Criteria , Sensor – Mounting Locations and Techniques | **07** |
| **3** | **Data Acquisition & Signal Processing**  Classification of signals, Signal analysis, Fast Fourier Transform (FFT), Essential Settings in Data Acquisition System (Plot Formats, Frequency Span and Frequency Resolution, Average Types and Number of Averages, Windowing, Spectrum Scaling), Signal conditioning | **07** |
| **4** | **Machinery Fault Diagnosis I**  Natural frequency and resonance tests (Practical approach), Time and Frequency domain analysis to identify unbalance, bent shaft, Misalignment, Soft foot conditions, Mechanical looseness | **06** |
| **5** | **Machinery Fault Diagnosis II**  Rolling element bearing and Journal Bearing fault diagnosis, Faults related to Gearbox, vane defects in pumps, Fault in Fans and Blowers. | **06** |
| **6** | **Applications of Condition Monitoring**  Case studies related Balancing Problems in Turbines, Condition Monitoring in Sugar mills, Health Monitoring of Journal Bearing, Condition Monitoring of Industrial Pumps. (Aspects to be covered : Selection of sensors, recommended location of sensor, direction of measurement, selection of plot type, Data validation and Identification of Faults) | **06** |

1. **CO Statements.**

Learner will be able to

MEDLO7041.1: Relate basic concepts of Machinery Diagnostic.

MEDLO7041.2: Describe the working of Vibration Measuring Instruments.

MEDLO7041.3: Identify common faults in Machinery using Vibration Spectrum

MEDLO7041.4: Interpret the Vibration Signals for Monitoring and Prognosis.

1. **CO-PO-PSO Mapping.**

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| CO# / PO# | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| PEC802.1 | 3 | 2 |  | - | - | - | - | - | - | - | - | 2 |
| PEC802.2 | 3 | 2 |  | - | - | - | - | - | - | - | - | 2 |
| PEC802.3 | 3 | 2 |  | - | - | - | - | - | - | - | - | 2 |
| PEC802.4 | 3 | - |  | - | - | - | - | - | - | - | - | 2 |

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| CO# / PSO# | PSO1 | PSO2 |
| PEC802.1 | 3 | - |
| PEC802.2 | 3 | - |
| PEC802.3 | 3 | - |
| PEC802.4 | 3 | - |

1. **CO Assessment tools with target.**

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| **Co Statement #** | **Target for Assessment Tools** | | |
| **Unit Test** | **End Semester Exam** | **Course Exit Survey** |
| PEC802.1 | 50% | 40% | 60% |
| PEC802.2 | 50% | 40% | 60% |
| PEC802.3 | 50% | 40% | 60% |
| PEC802.4 | 50% | 40% | 60% |

Final CO achievement = 80 % of Direct assessment + 20 % of Indirect assessment

Direct assessment = 60 % of UT + 40 % of End semester result

In-direct assessment = Course exit survey

1. Curriculum Gap/Content beyond syllabus (if any).

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1. Lecture Plan.

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| **Week No.** | **Topics** | **Module** | **Hours** |
| **Week 1**  (18/7/2022 to 22/7/2022) | Periodic and random motion, Spectral Amplitude Scaling: RMS, Peak and Peak-to-Peak Conversion and Selection, Time and frequency domain analysis, | **1** | **3** |
| **Week 2**  (25/7/2021 to 29/7/2021) | Phase analysis, Orbit analysis, Understanding signal pattern, Importance of speed in accurate diagnosis, Importance of side bands in frequency spectrums. | **1** | **3** |
| **Week 3**  (1/8/2021 to 5/8/2021) | Maintenance Principles, Vibration based fault Prognosis, Goal of Vibration Monitoring, Steps in Vibration Monitoring, Benefits of Vibration based condition monitoring. | **1** | **3** |
| **Week 4**  (8/8/2021 to 12/8/2021) | Elementary treatment of Hidden lines and surfaces. Cubic spines Bezier curves & B- spines, Animation and Color models. | **2** | **3** |
| **Week 5**  (15/8/2021 to 20/8/2021) | Vibration measuring instruments: displacement, velocity, acceleration; Force measurement, Laser based measurements: laser vibrometer | **2** | **3** |
| **Week 6**  (22/8/2021 to 26/8/2021) | Sensor Selection Criteria , Sensor – Mounting Locations and Techniques | **3** | **3** |
| **Week 7**  (29/8/2021 to 3/9/2021) | **Academic break** |  |  |
| **Week 8**  (5/09/2021 to 9/9/2021) | Classification of signals, Signal analysis, Fast Fourier Transform (FFT), Essential Settings in Data Acquisition System (Plot Formats, | **3** | **3** |
| **Week 9**  (12/09/2021 to 16/9/2021) | UT1 |  |  |
| **Week 10**  (19/09/2021 to 23/09/2021) | Frequency Span and Frequency Resolution, Average Types and Number of Averages, Windowing, Spectrum Scaling), Signal conditioning | **3** | **3** |
| **Week 11**  (26/9/2021 to 30/9/2021)) | Natural frequency and resonance tests (Practical approach), Time and Frequency domain analysis to identify unbalance, | **4** | **3** |
| **Week 12**  (3/10/2021 to 7/10/2021) | bent shaft, Misalignment, Soft foot conditions, Mechanical looseness | **4** | **3** |
| **Week 13**  (10/10/2021 to 14/10/2021) | Rolling element bearing and Journal Bearing fault diagnosis, Faults related to Gearbox, vane defects in pumps, Fault in Fans and Blowers. | **5** | **3** |
| **Week 14**  (1710/2021 to 21/10/2021) | UT2 |  |  |
| **Week 15**  (24/10/2021 to 29/10/2021) | Case studies related Balancing Problems in Turbines, Condition Monitoring in Sugar mills, | **6** | **3** |