# GUJARAT TECHNOLOGICAL UNIVERSITY

**Master of Engineering**
**Subject Code: 3730906**
**Semester – III**
**Subject Name:** ROTOR DYNAMICS

**Type of course:** Program Elective

**Prerequisite:** Zeal to learn the Subject

**Rationale:** Rotating elements are found in majority of mechanical equipment. Their behavior is quite different from element with motion along a linear path. It is essential to understand techniques required to analyse behavior of such elements. The course aims to impart basic understanding for analysing rotating elements.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | Practical Marks | | |
| | | | | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 0 | 0 | 3 | 70 | 30 | 0 | 0 | 100 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 1 | **Introduction to Vibration and the Laval-Jeffcott Rotor Model:** Co-ordinate systems, steady state rotor motion, elliptical motion, single degree of freedom systems, free and forced vibrations. The two degrees of freedom rotor system, geared systems, translational motion, natural frequencies and natural modes, steady state response to unbalance, the effect of flexible support. | **10** |
| 2 | **Torsional Vibrations of Rotating Machinery:** Modelling of rotating machinery shafting - Multi degree of freedom systems - Determination of natural frequencies and mode shapes - Branched systems - Holzer method, Numerical methods for fundamental frequency. | **08** |
| 3 | **Rigid Rotor Dynamics and Critical Speed:** Rigid disk equation - Rigid rotor dynamics- Rigid rotor on flexible rotor - The gyroscopic effect on rotor dynamics - Whirling of an unbalanced simple elastic rotor, Unbalance response, Orbital Analysis and Cascade Plots, simple shafts with several disks - Effect of axial stiffness - Determination of bending critical speeds - Campbell diagram. | **10** |
| 4 | **Influence of Bearings on Rotor Vibrations:** Support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients - Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- Design configurations of stable journal bearings. | **08** |
| 5 | **Balancing of Rotors:** Single plane balancing, multi-plane balancing, balancing of rigid rotors, balancing of flexible rotors, Influence coefficient and modal balancing techniques for flexible rotors. | **08** |

**Reference Books:**

1. Rotor Dynamics, J. S.Rao, New Age International Publishers, New Delhi.
2. Vibration Problems in Engineering, S.Timoshenko, D H.Young and W. Weaver, John Wiley.
3. Introduction to Dynamics of Rotor – Bearing Systems, W J Chen and J E Gunter, Trafford Publishing Ltd.
4. Linear and Nonlinear Rotordynamics: A Modern Treatment with Applications, T. Yamamoto and Y.Ishida, John Wiley.
5. Vibratory Condition Monitoring of Machines, J. S.Rao, Narosa Pubulishing House.

**Course Outcome:**

After learning the course:

| Sr. No. | Course Outcome | Percentage weightage |
|---|---|---|
| CO-1 | Students will be able to understand basics of rotor modeling. | 20% |
| CO-2 | Students will be able to analyse vibration response of rotating systems. | 30% |
| CO-3 | Students will be able to determine bearing stiffness and their effect on rotor dynamics. | 25% |
| CO-4 | Students will be able to understand basic theory and methods for rotor balancing. | 25% |

**List of Open Source Software/learning website:**

NPTEL Course