Course Code	Course Name	Credits
MEC503	**Dynamics of Machinery**	**03**

Objectives:

1. To acquaint with working principles and applications of Governors / Gyroscope
2. To study static and dynamic force analysis in the mechanisms
3. To familiarize with basics of mechanical vibrations
4. To study the balancing of mechanical systems

Outcomes: Learner willbe able to…

1. Demonstrate working Principles of different types of governors and Gyroscopic effects on the mechanical systems
2. Illustrate basic of static and dynamic forces
3. Determine natural frequency of element/system
4. Determine vibration response of mechanical elements / systems
5. Design vibration isolation system for a specific application
6. Demonstrate basic concepts of balancing of forces and couples

Module	Details	Hrs.
1.	**Governors and Gyroscopes:** **1.1 Governors:** Introduction to Centrifugal and Inertia governors, Study and Force analysis of Porter and Hartnell governors includingPerformance characteristics, Governors effortand power. **1.2 Gyroscope:** Introduction, Gyroscopic couple and its effect on spinning bodies, naval shipsduring steering, pitching, rolling and their stabilization.	**07**
2.	**2.1** Static and Dynamic force analysis of Slider crank mechanism (neglecting mass of connecting rod and crank), , Turning moment on crank shaft **2.2** Dynamically equivalent systems to convert rigid body into two mass with and without correction couple(Case study- Connecting rod)	**05**
3.	**3.1Basic Concepts of Vibration:** Vibration and oscillation, causes and effects of vibrations, Importance of study of vibrations, Vibration parameters - springs, mass, damper, Motion- periodic, non-periodic, degree of freedom, static equilibrium position, vibration classification, steps involved in vibration analysis **3.2 Free Undamped Single Degree of Freedom Vibration System:** Longitudinal, transverse, torsional vibration system, Methods for formulation of differential equations by Newton, Energy, Lagrangian and Rayleigh's method	**06**
4.	**4.1 Free Damped Single Degree of Freedom Vibration System:**Introduction to different methods of damping, Study and analysis of **1)** Viscous damped system (under damped, critically damped, over damped; Logarithmic decrement) **2)**Coulomb's damping (Combined Viscous and Coulomb damping excluded) **4.2 Equivalent Single Degree of Freedom Vibration System:** Conversion of multi-springs, multi masses, multi-dampers into a single spring and damper with linear or rotational co-ordinate system,	**06**
5.	**5.1 Forced Single Degree of Freedom Vibratory System:**Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation (excluding elastic damper)	**08**

	5.2 Vibration Isolation and Transmissibility: Force Transmissibility, motion transmissibility, typical isolators & mounts. **5.3 Vibration Measuring instruments:**Principle of seismic instruments, vibrometer, accelerometer - undamped and damped, Introduction to conditioning monitoring and fault diagnosis	
6.	**6.1 Rotor Dynamics:**Critical speed of single rotor, undamped and damped **6.2 Balancing:**Static and Dynamic balancing of multi rotor system(up to four rotors), balancing of reciprocating masses in In-line engines(up to four cylinders) , Introduction to V-engines (excluding other radial engines)	**07**

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests.
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved

Text/Reference Books:

1. Theory of Machines Thomas Bevan CSB Publishers & Distributors
2. Theory of Machines by Jagdishlal Metropolitan Book New Delhi, Company, Daryaganj, Delhi
3. Theory of Machines by S.S.Ratan Tata McGraw Hill , New Delhi
4. Theory of Machines by P.L.Bellaney Khanna publication, NewDelhi
5. Theory of Machines and Mechanisms by John J Uicker, Gordon R Pennock and Joseph E Shigley, Oxford University Press
7. Theory of Vibration with Applications, by W. Thomson, 2nd edition, Pearson Education
8. Mechanical Vibrations by S.S.Rao, fourth edition, Pearson Education
9. Mechanical Vibraitons by G.K.Grover
10. Fundamentals of Mechanical Vibration by S.Graham Kelly, Tata McGraw Hll
11. Principles of Vibration by Benson H Tongue, 2nd Edition, Oxford University Press
12. Vibration Analysis by P. Srineevasan, TMH
13. Mechanical Vibrations- Schaum's outline series, William W.Seto, McGraw Hill
14. Theory and Practice of Mechanical Vibrations by J S Rao and K Gupta, New Age International
15. Elements of Vibration Analysis by Leonard Meirovitch, McGrav- Hill, New York

Links for online NPTEL/SWAYAM courses:

https://nptel.ac.in/courses/112/101/112101096/ - Dynamics of Machines, IIT Bombay
https://nptel.ac.in/courses/112/107/112107212/ - Introduction to Mechanical Vibration, IIT Roorkee